TECHNICAL SENSORIUMS: A Speculative Investigation into the Entanglement and Convergence of Surveillance and Technology

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Intellectual Property and Publication Statements

The candidate affirms that the work submitted is his own and the appropriate credit has been given where reference has been made to the work of others.

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Abstract

Surveillance and technology are among the most prevalent phenomena in the developed world, the proliferation of which is abetted by an ever increasing profusion of products and services extending the competencies of these capabilities into new opportunities and markets worldwide. More significantly, this momentum is leading to a convergence of these disparate competencies towards a common techno-surveillant milieu. Yet much of what is written and theoretically understood about these topics (singularly and collectively) fails to provide for a unified accounting that anticipates either the trajectory or the heterogeneous forms of this converging phenomenon.

This projects sets out to excavate why our understanding of techno-surveillance is so myopic. Following the evidence, I assert that this short-sightedness is not simply the result of methodological shortcomings. Rather, most researchers of surveillance and technology are blinded by philosophical presumptions (primarily grounded in epistemology) that exclude the kinds of questions (largely ontological) they must ask to go deeper in their investigations.

This study examines the archaeological detritus of an early techno-surveillant system, the characteristics of which are typical of the kinds of systems that have come to challenge researchers about the implications of their analyses. Based on this analysis, this study proposes an ontological model, which I call *ontigeny* that is consistent with the evidence and helps to explain the heterogeneity of techno-surveillance, as well as its potential trajectories.

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Chapter One: *Roadmap*

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I. Introduction

Phenomenon of Surveillance and Technology

Over the past thirty years, surveillance has become more pervasive and ubiquitous, intruding increasingly into nearly every secreted crevice of our public and private lives. The evidence for this enveloping phenomenon is well established in the attested behavior of government bodies such as the U.S. National Security Agency (NSA) or Britain's General Communication Headquarters (GCHQ) as well as private data behemoths *facebook*, or *google.com*, and to a lesser extent, credit bureaus such as Experian or Trans-Union, and data marketing firms, Axciom and Epsilon. What is less well observed are the ways in which the enabling of this insidious development is accomplished almost entirely through the development and application of technology employed to survey, record, discriminate, sort, connect, and classify subjects of surveillance. Surprisingly, very little theoretical research is available on the specific technologies and applications employed in surveillance projects, and as a result we are often in the dark about how new surveillance initiatives arise. Nevertheless, it is a core presumption of this research project that there is indeed something very important in the relationship between surveillance and technology; that this relationship is evolving and adapting to new opportunities and conditions independent of human design; and that emergent forms, representing a more significant convergence between surveillance and technology, are already underway. The basic questions this project pursues are: what is the relationship between surveillance and technology? How is it instantiated? Where is it going? And most importantly, how are any of these conditions possible and why have they been ignored in the literature? These, as it turns out, are primarily ontological questions.

The Failure to Explain

The hypothesis of this thesis is that there is a fundamental inadequacy in the literature on surveillance which fails to account for the role technology plays in surveillance, and, moreover, this inadequacy, is the result, not of bad research, but of poor theoretical foundations. The paucity of research connecting surveillance to technological initiatives underscores how little is understood about the convergence of surveillance and technology. While it is tempting to point to weaknesses in the research agendas or the methodologies that are incorporated into these research programs, the hypothesis of this thesis is that there is a more systemic epistemic blindness arising from philosophical prejudices of which many analysts are not even aware, let alone, critically evaluated. This project focuses on analyzing these philosophical concerns, while using the sensitivity about surveillance as a foil to tease out just how the underlying philosophical myopia limits the kinds of questions we ask about surveillance and technology. As a result, though surveillance and technology are featured prominently in this study, this is not primarily a study about surveillance *per se*, but rather, about how something so obvious as surveillance and technology is so opaque to more penetrating analysis. I attribute three sources to this failure: anthropocentrism, the prioritization of epistemology, and an aversion to theorizing contingent events.

The Failure to Explain: Anthropocentrism

The first blindness to which I refer arises from two highly related prejudices. The first is anthropocentrism, which is a predisposition to evaluate human interests, capabilities, and values as of precedent or higher importance than that of other things -- living, natural, or artificial. The second bias is derived from this anthropocentrism and arises from a failure to take *things* seriously, including computers, software, satellites, and cameras, and associated processes and practices, with less than the ontological status given to human beings. As a result, anthropocentric chauvinism subordinates nearly any interpretation of technology to the motives and intentions of the human beings who use it or create it, including interests of power, desire, eroticism, etc. Similarly, following an assertion first articulated by Aristotle that natural things are different from made things, wherein the former have the capacity to regenerate or reproduce themselves, while the reproduction of made things is a cause external to the thing itself and that things which are made (*technē*) only complete what nature has left unfinished or are imitations of nature itself. (*Physics* 192b8, 199a15). In other words, things that are made have a lesser ontological status than natural things. Nor is this a small difference as natural things are prioritized by whether they are living or not, and the living by whether they are rational or not. Thus, investigations of surveillance and technology usually turn on political and moral issues -- problems that arise uniquely for human beings, rather than for rocks or computers. This keeps the discourse on surveillance and technology bounded by human issues of intentionality, control, and values.

The Failure to Explain: The Priority of Epistemic Knowledge

This limitation is compounded by a corresponding anthropocentric bias in which human perception and reason are deemed problematic. Originating with novel assertions in the seventeenth century, this critique states that human knowledge is limited by what the senses can perceive and, even then, assertions of knowledge can be justified only when it can be grounded by mind-independent, empirical verification. On this formulation, ontological knowledge, if it is acknowledged at all, is derived from epistemological principles -- not the other way around. As a result, *what* I know is subordinated to *how* I know. I refer to this as the epistemological bias or epistemic fault, which significantly contributes to the circular justification of anthropocentrism. This thesis seeks to undermine this epistemic fault and construct an ontologic alternative.

The Failure to Explain: Universal Laws

Finally, there is an underlying assumption by researchers that the most meaningful work should reveal universal laws. This bias, inherited from Parmenides and incorporated in both Platonic and Aristotelian interpretations of the nature of the world, downplays that which is contingent, unstable, and inconsistent as not being characteristic of that which is universal, and presumably much more valuable. As a result, surveillance and technology, both of which inherently exhibit the properties of instability, are considered less interesting than the universals of moral good or democracy. This gives rise to a contentious difference over what is important, because to take, more generally, *things* seriously, and surveillance and technology more specifically, requires jettisoning a large part of the Western philosophic tradition. This thesis doesn't definitively establish what that alternative is, but it does suggest what concerns it must prioritize.

Failure to Explain: Consequences and Response

The principal fallout of this anthropocentrism is the failure to take inanimate *things* (computers, drones, cameras) as seriously as the humans that are attributed to being their creators and users. Other kinds of less material *things*, of which these inanimate things are often a part, such as information networks, processes, and software, are given even less attention. It is my contention that only by raising these entities to at least the same ontological status as human beings, can we ever understand the dynamics driving surveillance and the trajectory of its future.

As a result, this thesis investigates parallel tracks that strongly complement and confirm each other: the first is philosophical and the second is empirical. I refer to this form of analysis as empirically-based speculative philosophy.

The philosophical analysis works through three consecutive sets of issues:

- Define the epistemological bias in its theoretical and historical forms and the ways this bias affects the kinds of social theories usually brought to bear on surveillance and technology. (Chapter Three).
- In rejecting this bias, the project then investigates whether classical ontology (which is experiencing a renewal of interest among some social theorists) would better explain surveillance and technology. Given several limitations in the classical model, the project investigates whether a more contemporary

elaboration of ontology, referred to as speculative realism offers more explanatory power. (Chapter Four).

- Despite some significant and innovative developments in this latter approach, it turns out that it largely ignores several dimensions of what is real that are crucial to explaining surveillance and technology, particularly time, noise, processes, events, and *things*. I refer to this event-driven paradigm as "ontigeny", which seeks an accounting of the metaphysics of the origins of *things*. This approach explicitly sets aside (as opposed to rejecting) the objective of understanding Being (*ontos*) as a problem of universal application (*logos*) in favor of the study of beings (*onti*) that change or individuate over time (*genesis*). (Chapter Five).

Overall, this progression represents a transition from empirical and epistemologically based research to one founded on metaphysics -- not for the sake of pursuing a purely speculative construct, but with the goal of finding a philosophy and methodology that takes *things* seriously. For it is in *things* that we locate the preponderance of encounters one finds in contemporary practices like techno-surveillance -- things like the U.S. *NROL-39* spy satellite with its extremely fine-grained radar imagery technology.

The parallel track of my research, bookends this theoretical discussion with two empirical chapters. In chapter two, I catalog a remarkable surveillance program from the 1950's that has never been examined by social theorists. Though several historians have documented the so-called SAGE system, their analyses have been limited to specific aspects of SAGE -- to the computer that was built for it, the institutions that were formed to sustain it, or the leaders that envisioned the project. To date, no sociologist or philosopher of technology has published a study of the largest military project ever undertaken in modern times and a program that literally made IBM a computer industry giant, formed the first computer network, inspired the creation of professional software programming, sparked the creation of the first mass storage devices, along with hundreds of other innovations that still reverberate in both surveillance and technology. SAGE, then, represents an ideal model to study the intersection of surveillance technology. I will reference, throughout the chapters of philosophic discussion, the technics of the SAGE project as examples why many of these approaches are inadequate.

In the concluding chapter, I apply the *ontigenetic* event-driven paradigm to data on the SAGE system to determine whether such a model offers a more coherent and comprehensive explanation of what drives a techno-surveillant system. I then use this analysis to speculate on the convergent trends between surveillance and technology.

In the balance of this introduction, I will expand on just what constitutes surveillance and technology, elaborate on the philosophical issues that drive our persistent misinterpretation of surveillance and technology, and chart the balance of this research project.

II. Surveillance

In this section I address the questions of what constitutes surveillance, how it operates, its origins, the character and structure of surveillance, its motives, its technics, and why surveillance is more than just a social practice.

A Spectrum of Watching -- The Government

What is surveillance? It is relatively easy, thanks to Edward Snowden, to define some kinds of surveillance as the practice(s) of government agencies watching over us. These include the well-known satellite listening stations of the NSA and GCHQ at RAF Station Menwith Hill/Yorkshire, GCHQ Bude/Morenstow in the U.K., Joint Defense Facility/Pine Gap in Australia, and US Air Force Base/Misawa in northern Japan, as well as more than twenty-five other much less well known stations such as US Naval Support Facility/Diego Garcia in the Indian Ocean, NSA/Khon Khaen in Thailand, GCHQ Station/Agios Nikalaus in eastern Cyprus, and US Naval Support Facility/Camp Lemmonier in Djibouti.

A recent report quoted a National Security Agency official to the effect that the volume of data collected every six hours on non-U.S. citizens by the U.S. National Security Agency is "an amount of information equivalent to the store of knowledge housed at the Library of Congress." (Calvert 2011; Priest and Arkin 2011). By way of reference, the Library of Congress has more than 800 miles of bookshelves.

A Spectrum of Watching -- The Private Sector

Nor is the breadth of this surveillance exclusive to national spooks. Local government and the private sector use of closed circuit television (CCTV) systems account for nearly 250 million units deployed worldwide, according to a recent market survey. (Ingram 2015). Even with the lowest resolution (352x240 pixels) recording at 30 frames per second, motion-activated at an average of twelve recorded hours per day, and employing an MPEG4 compression ratio, the sum of all of those cameras would require data storage of 64 yottabytes (1000^8) of digital storage every day. Add to this volume, the number of smart phones being used for video recording and public and private interests are documenting much of our daily activities and behavior. But these are hardly the only kinds of surveillant practices.

A Spectrum of Watching -- Data Flows

The Internet has become a primary communications vehicle. Cisco, the largest network products provider, estimates that by the end of 2016, the total volume of Internet-based communication (web, email, IP video, file transfers) will exceed one zettabytes per year. Much of that traffic is stored, if only temporarily on routing devices and end-user servers. Over the past 25 years (1986-2011), the world has aggregated more than 295 billion gigabytes (exabytes) of digital data representing more than 40 gigabytes of data for every man, woman, and child in the world. (Hilbert and Lopez 2011) And while the world's population is increasing at between 1.1% today (with a declining rate of increase), the expected increase in data storage is growing at better than 23%.

A Spectrum of Watching -- Consumption

In the United States during 2010, seventy-four billion credit card transactions were processed by the major clearing houses. (Herbst-Murphy 2013: 1). Every one of these transactions was recorded, sorted, analyzed, and correlated with other consumer data to develop profiles of consumers. Acxiom Corporation, of Little Rock, AK, is one of the largest hoarders of consumer data in the world -- updating more than thirty-two billion records every month. (Acxiom 2012). This information is collected, cleaned for errant and duplicate data, classified, sorted, segmented, and analyzed to create highly defined market segments to which producers and retailers can direct focused sales campaigns. Nor are the boundaries between public interest and private records sacrosanct. In April 2001, the Wall Street Journal uncovered a contract between an Acxiom competitor, Choicepoint, itself a spinoff of another data broker, Equifax, wherein Choicepoint routinely provided personal data to Federal investigative agencies including the FBI. (Simpson 2001). In 2008, Choicepoint was sold to yet another data broker, Reed Elsevier.

A Spectrum of Watching -- Espionage

Some nations have asserted that so-called foreign intelligence operations are really nothing but economic and technological espionage in disguise. (Troianovski and Torry 2015). Speaking of the reputed Chinese theft of millions of US government personnel records, including classified data, the US Director of National Intelligence James Clapper observed that the intrusion was not an attack *per se* but rather it's "a passive intelligence collection activity -- just as we do". (Cited in Nextgov 2015)

A Spectrum of Watching -- Voyeurism

Then, there are private citizens, in furtherance of their social interests (promoting status, fulfilling curiosity, or seeking revenge), who engage in a kind of surveillance we refer to as voyeurism. (Calvert 2004). For some, this indulgence is a form of mass entertainment in the form of "reality television", or what Mark Andrejevic (2003) calls "the work of being watched". Exhibitionism as a means of provoking attention is nothing new, but exhibitionism to incite surveillance is entirely inventive --

and is now even recognized as an art form. (Levin 2014). Researchers are suggesting that what is behind some of this behavior is a kind of narcissism, a seeing of the self. (Davenport, et. al 2014; Kandias, et. al. 2013) In some cases, as with *facebook* users, the distinction between voyeurism, exhibitionism, and narcissism is a similitude. As a result, there is a spectrum of surveillance-like activities ranging from espionage to surveillance to voyeurism to narcissism. More significantly, a single act of watching may simultaneously embrace moments of surveillance and voyeurism.

A Spectrum of Watching

As a result, when the term "surveillance" is used in this project, unless reference is made to a specific kind of activity, I am referring to any one of the following activities.

A Spectrum of Surveillance				
Espionage	Surveillance	Voyeurism	Exhibitionism	Narcissism

It has become, literally, a potpourri of forms of watching. But was it always this way?

Origins of a Concept

Surveillance as a concept and as a practice is not new. The English word "surveillance" is borrowed from the French word "surveiller", which, in turn, is derived, in part, from the Latin "vigilare", meaning to keep a vigilant watch. Sallust, the earliest of the Roman historians, describes Catiline's exhortation to his fellow conspirators "to be armed at all times", "to be always alert and vigilant, day and night", and "ready for action" (Sallust *Bellum Catilinae*, §. 27). Cicero, in his first oration against Catiline accuses the putative traitor in nearly the same way: "You have trained your whole life for this, laying on the ground to fulfill some nefarious deed, but to commit these crimes, your ever spying (*vigilāre*) and plotting against the sleep of husbands…" (Cicero, *In Catalinam I*, §. 10). Night time, in particular, was for vigilance, for *vigilāre* was also to remain awake, attentive, and alert.

Surveillance is an Ancient Practice

Surveillance is, in fact, attested as an ancient practice (Dvornik 1974) found in the literature of the Shang dynasty ancient China (Sawyer 2011) as well as the early Bronze Age of Assyria (Oded 1970). And there is the well-studied tenth chapter of Sun Tzu's *Art of War* which focuses on the importance of spies and spying. In the short-lived Qin dynasty of China (3rd century BCE), a sophisticated form of surveillance was instilled by a central administration but effected at the local level. Here, we find a combination of household registration with a morality of collective responsibility maintained by mutual surveillance. The Qin state effectively "atomized" the populace by "holding individuals collectively responsible for crimes committed by relatives and neighbors and by encouraging them to report on one another with handsome rewards. By destroying the fabrics of family and society, the Qin state could dominate the society with little recourse to the actual use of force." (Hui 2005: 48). Some seven hundred years later, the administrators of the Sui dynasty utilized the same divide-and-conquer strategy for political surveillance, tax enforcement and control of the rural population. (Wright 1979).

Modernist Origins of Contemporary Surveillance

It is in the late sixteen and seventeenth centuries of France, where we find the first use of term "surveiller" referring to keeping a careful watch over general affairs. In the first edition of the *Dictionnaire de l'Académie Française*, "surveiller" refers to having "a plain sight, a general inspection on something, on any person. It's not enough that such and such take care of this matter, it is necessary that someone is watching over them. General of an army must monitor all things, cavalry, infantry, artillery, food, the baggage & c." (Institut de France 1694, n.p.). It is not a specific activity, but a broad instruction for what it means to keep a "general inspection".

Revolution

It is in the chaotic uncertainties of the French Revolution that we see the term "surveillance" referring to a specific activity of watching over others. The National Convention on the 17th of September, 1793 adopted its "Law of Suspects" empowering “committees of surveillance” to watch over foreigners and suspected counter-revolutionaries. (Dyer and McPhee 2002: 103-104) Established in every region of the country, these committees "soon became local vigilantes who watched over and interrogated any suspect person in the neighborhood". (Neeley 2008: 179). Less than ten years later, Napoleon establishes "the modern 'security state' based on administrative surveillance, coercive policing, and the legitimacy that came with restoring and maintaining order." (Brown 2006, p. 16). This form of social control is described by a contemporary observer, "The workmen are not locked up within the walls of the manufactory, as was the case during the monarchy, but they are kept under the constant 'surveillance' of the police." (Lemaistre 1803, np).

Surveillance is an Active Practice

Surveillance is an active process. This includes many, but not all kinds of voyeurism, including "peeping Toms" and those who watch pornography to get some kind of erotic or emotional satisfaction from their activities, tourists who are vicariously visiting slums as a vacation, (Weiner 2008) viewers (as opposed to producers) of photography and video recordings such as stealth shots of lovers, images from Dachau, or tabloid pictures of homicide victims,(Phillips 2010**)** and digital-*flâneurs* who stroll social media seeking interesting encounters and returning with their own provocations. And without any facetiousness, there is another set of voyeurs, social theorists, who use the facade of academic license to seek access to worlds to which they would not otherwise have purview. After all, the etymological origins of the word "theory" is the Greek term for spectator. How much of voyeurism constitutes a type of surveillance depends on the functionality of the active participant -- i.e., the more indifference, the less likely surveillance is an act of voyeurism and the more intentional the objectives of watching, the more it is similar to surveillance.

Why Watch Over?

What are surveillant objectives? Accompanying the gaze of surveillance is what analytic philosophers call a "propositional attitude", that is, a belief or feeling. Surveillance theorist, David Lyon (2001), suggests that these attitudes can be conceptualized as two distinct empirical types: "categorical suspicion" -- a term he borrowed from Gary Marx's (1988) work on undercover police operations -- reflecting the attitude of state authority towards a supervised population; and "categorical seduction". In Lyon's model, this latter category corresponds to the attitude promoted by agents of commercial markets, such as advertisers and retailers, who operate with an intention of seducing consumerism. The only difference between the suspicious and seductive forms of surveillance is that the former seeks to find anomalies and the latter seeks to exclude them.

What is common to both of these categories is the "watching over" with at least one of the following six objectives:

- to see what is publicly accessible without being seen undertaking such observations;

  this is probably the most common form of surveillance, whether by government or commercial interests; or

- to see what can be seen, but without being perceived as watching a specific subject;

  related to the first objective, except that the observer is in plain view, say a policeman, who conveys that, in general, she is watching, but without indicating that a specific subject is being watched; or,

- to see what can't be seen;

  the objective is to observe what behavior is exhibited when subjects "believe" they cannot be seen or heard with the use of hidden microphones in undercover police work or so-called "nanny-cams" at home; or

- to monitor behavioral responses to stimulants;

  this might be surveillance for commercial marketing research or it might entail police using a bait to gauge the propensities of a subject; or,

- watching to see if one is being watched;

  this is an inversion of surveillance subject-object relations in which the subject is watching the observer to see if they are watching -- consider the exhibitionist tendencies of users on *facebook*; or,

- the use of surveillance as a disruptive agent;

  the intention is not to watch, but to disrupt through sabotage or to instill a psychological state such as paranoia or fear -- consider Stuxnet or *agent provocateurs* or increasing acts of *sous-veillance* of "watching the watchers" of documenting police actions.

Though there are many other variant examples, the principal observation is that surveillance is complicated by multiple interests, objectives, and venues. This becomes even more complex when one considers all the different ways surveillance can be carried out.

Surveillance is Multi-sensory

"Seeing" and "watching" imply some kind of exclusively ocular-centric kind of perception, and although there is no doubt that such scopic variation is often present, perception can include any of the unaided human senses, including aural, olfactory, and proprioception.[1] At the same time, there is a distinction between perception which is active, engaged, and intentional, on the one hand, and passively gazing with disinterest, on the other. The latter is a kind of staring, in which the observer is either indiscriminate as to what is being watched or unconsciously absorbing perceptions without imposing any sustained focus or distinction over what is being watched. For example, indifferently gazing at people in a park, might entail voyeurism, or it might simply be a form of daydreaming in which no object becomes the center of focus.

Surveillance is Not Just a Social Act

Though most people are likely to associate surveillance with some kind of social relationship -- police with suspects, intelligence agencies with foreign states, etc. -- the concept of surveillance applies to all sorts of forms of "watching over". Almost all technical systems include a surveillance component to monitor system health, intrusions, capacity utilization, etc. Health officials use surveillance protocols to watch for pandemic conditions. Ecologists use many forms of technics to watch over wildlife habitats and eco-systems.

In the world I am setting out to explore, surveillance is comprised of a wide set of behaviors with many different kinds of actors -- both institutional and individual -- who have a common objective in mind -- to survey behavior, identify its patterns, and use this knowledge for one's own goals. The considerable difference in contemporary surveillance comes not from the actors or their motives, but through the means they

[1] I will often use the word "see" to refer to surveillance, but wherever this word is used be aware that one may substitute any sensory access.

have to implement their surveillant practices, and that difference preponderantly arises from technology.[2]

III. What is Technology?

In this section, I address a set of issues about technology, similar to those found in surveillance: how technology is interpreted, the organization of technical practices, and the techniques of technology.

Interpreting Technology

What is meant by technology or technics is decidedly imprecise and ambiguous. Though it is common to speak of technology as one of the oldest of human practices, its contemporary meaning as a category of activity is quite recent – apparently no earlier than the beginning of the last century. As Leo Marx observes, "the fact is that during all but the very last few seconds, as it were, of the ten millennia of recorded human history…the concept of technology—in our sense of its meaning—did not exist." (Marx 1997: 966). It was only in 1921, that the American economist, Thorsten Veblen, introduced the word "technology" into the American vocabulary as referring to an activity associated with a trained class of "engineers". (Veblen 1921).

The imprecision of what technology refers to also has consequences for how we study it. Mark Shields (1997) posits (borrowing from Langdon Winner) that the study of technology has suffered from "technological somnambulism" and argues that, by

[2] The other form of leverage can come from legal authority -- either to prohibit or authorize certain kinds of acts and behavior. But, at least for now, the wild west of technological differentiation is usually well ahead of jurisprudence and its agents.

default, most studies have been biased towards an instrumentalist interpretation of technology, meaning that technology *per se* can only be evaluated as an instrument for serving a means to an end. Consequently, technology is often judged as value-neutral and independent of the value of whatever end it assists in achieving. The same technology could, presumably, be used to achieve any other end with no greater or lesser value assigned to the technology itself.

Technological Organization

Whereas, the kinds of surveillance are portrayed as a horizontal distribution of types, technology is considered in vertical relations which are reflected in successively more complex relations.

- Components -- are basic technical devices that do little or nothing on their own, but when used in an assembly can perform a basic function. For example, a single gear by itself will do nothing, but when put in a gearbox, enables, when force is applied, the ability to shift among torque ratios.
- Assemblies -- are aggregations of components to accomplish a specific task.
- Tools -- are basic "extensions" of intentional human capabilities, e.g., binoculars that extend the distance of an observer's vision. As the reader will see below, the use of the term "extension" should be interpreted cautiously as there are other synonymous terms with entirely different implications that could be used here.
- Process -- are any set of repeatable tasks which entail training or discipline. In this way, human beings and machines are reduced to the same ontological plane when they engage in performing tasks in predictable repetition.

- Machines -- are assemblages of tools empowered by leveraged force. An automobile is an assemblage of other tools (fuel pumps, carburetors, pistons, flywheel, etc.) which employs fuel to create a force of energy that turns gears in a transmission, drive train, wheels, and tires at a rate far greater than could be similarly produced by human beings.
- Automata -- are machines that operate independent of any human intervention (at least for some period of time or set of tasks).
- Networks -- constitute the connection of machines and agents for the purposes of distributing information and managing command and control.
- Systems -- incorporates networks or large collections of integrated machines including material components, as well as processes and practices. With respect to surveillance, this represents, for example, the integration of sensors, image analysis and isolation, facial recognition algorithms, pattern matching against image databases, and mapping of network affiliations of subject with others.
- Organism -- this is a relatively new category of technology, but physical systems are increasingly being folded into an organism, both in reality and metaphorically. Again from a surveillance perspective, an organistic technology is one that mimics or, even anticipates, the behavior of living beings through technology, particularly learning-based software.

Techniques

As a technology's organization becomes more complex, the more autonomous it becomes from those who made or use it. With greater complexity, it exposes more of its internal logic or techniques. By understanding these techniques, we gain a better understanding of the trajectory of that logic and its organization. Jacques Ellul, one of the earliest and strongest critics of technology, defines seven "characteristics of modern technique" (Ellul 1964: 79-133).

- Technique always optimizes to a technical choice and does so as part of its internal and automated logic.

> What is learned in a surveillance operation is always limited to the "frame" of the sensors employed. Anything outside that frame which may give additional context for what is observed is often lost. Thus, what is inside the frame represents an "optimal" set of information.

- Technique always moves in the direction of self-augmentation - improvement in efficiency and efficacy. Modern technique achieves self-augmentation often without any human intervention. This self-augmentation is always irreversible and progresses geometrically, not arithmetically.

> In 1975, the cost of the equivalent of a megabyte (MB) of memory was $421,888. One year later the cost had dropped to $23,040. In 1980 the cost had dropped to $6480. In 1990, the cost plummeted to $106. By 2000, the cost of memory per MB was down to $1.56 and by 2010, the cost almost disappeared at $0.019. The average cost to store a one MB image between 1990 and 2010 dropped more than 99%. (McCallum 2015).

- Technique operates upon itself in a closed world.

> Technology works according to its own internal principles. We can adjust the parameters of a system, for example, alter the software code that is processed by a computer, but the state of the system will ultimately determine how it operates (or fails to operate).

- The synergy of technical system encloses the parts, while the parts contribute in indeterminate ways to the whole.

> A digital video camera is comprised of a sensor (charged coupled device); a color filter that is sensitive to particular light frequencies; an analog-to-digital converted that translates every analog value to a digital value; a light reading system including a lens, aperture setting, and exposure speed; and some sort of archiving technology (flash cards, CD/ROM, or attached hard drive). We can take a camera apart and see all the parts, but it doesn't work until we put it all back together again into its casing. How all of those parts specifically work together to produce a specific image is indeterminate.

- The rules of self-augmentation and monism assure the presence of the assemblage such that disparate techniques are integrated into the whole. This assemblage creates both the opportunity for, and the necessity of, an organization of technique.

> Even basic technology like a water pump has to be designed such that all of the components are designed to synchronously work with each other.

Usually schematic designs mitigate construction and implementation conflicts.

- The extension of technique also mandates the universalization of technique, the creation and imposition of standards in time, law, accounting, transportation, communication, etc. As a result, technique imparts an agency through a universal language "which compensates for all the deficiencies and separations [technique] has itself produced. This is the major reason for the great impetus of technique toward the universal." (132-133).

  Using the video camera as an example again, all of the parts share pathways (busses) and interfaces that have to match exactly from component to component. These interfaces reduce the complexity of a product, significantly decrease the cost of quality control and repair and improve the overall mean-time-between-failure of the system. Standard interfaces for components also make it easier to add third party suppliers to reduce costs without having to sacrifice the entire technological design.

- Technique has a status of autonomy, such that "external necessities no longer determine technique. Technique's own internal necessities are determinative. Technique has become a reality in itself, self-sufficient, with its special laws and its own determinations." (133-134).

  Once a standard is established, usually by market acceptance, it is quite difficult to break through with an alternative unless it provides equivalent

> functionality at a substantial discount in price or improvement efficacy. Even then, if it is not a new market opportunity, existing technology will dictate the structure and functionality of new technology.

Thinking Technics

The important aspects of technology are not just its internal relations, what most theorists of technology refer to as its instrumental qualities, but what technology maintains as a set of externalities -- relations, forces, flows, and directions -- that shape the ways in which technology affects and is affected by that which surrounds it.

Technology not only has its internal organization and logic, but exhibits a set of external relations, which have been interpreted in a number of different ways. The manifestation of these external forms is how theorists have interpreted the kind of *thing* technology is and the kinds of relationships it has with nature and human beings. If, based on empirical evidence, surveillance is coming to be a technological phenomenon, then these explanations are particularly relevant to understanding the relationship of surveillance to the world in which it exists.

Reach Out and Touch Someone[3]

In 1877, Ernst Kapp published the first text dedicated to a philosophy of technology entitled *Grundlinien einer Philosophie der Technik* (*Outline for a Philosophy of Technology*). His thesis, "demonstrates by indisputable facts, that man, unconsciously transfers in proportion to the structure of his body, the form, function and relationship of the work of his hands to a relationship analogous to himself. The focus of this

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[3] Tagline to a series of advertisements in the 1980's run by American Telephone and Telegraph.

research is to understand...how such an organism is achieved by mechanical devices through the projection of the organ itself." (Kapp 1877). For Kapp, technology is the morphological and functional projection of human bodies into space. The application of this theory to surveillance corresponds most closely to the tangible fear many people have about surveillance -- its capacity to materially disrupt their lives.

The Medium is the Message

In 1964, Marshall McLuhan published a seminal text which proposes that technology is always an extension of man -- that what a technology does is inseparable from how it does it. Thus, a radio and a television both provide information and entertainment, but the difference in the technical medium alters the message itself. McLuhan's thesis has been widely adopted among media theorists to explain how technical media has become so diffuse and influential in our daily lives. Though similar to Kapp's position, McLuhan isn't arguing that technology (and by extension, media) are morphological projections of man, but rather amplify a corporeal capability, in the way that a pair of binoculars are not projections of our eyes, but instead magnify our existing capabilities. (McLuhan 1964).

As We May Think (Bush 1945)[4]

Between 1936 and 1949, a remarkable series of papers were published reconceptualizing the foundations of what constituted technology by shifting the focus of attention from problems of nature to questions of information. These studies have

[4] In his prescient article, Vannevar Bush (1945) proposed a computing/archival model that anticipates in many ways the hypertext information technics used on the World Wide Web.

had a profound impact on how we think about the intersection between surveillance and technology, and the degree to which both are reducible to problems of information.

- Allan Turing (1936) developed the idea of a universal computing machine – a theoretical device capable of not only performing symbolic operations, but of defining the logic of those operations before they are performed. A black box processes a tape that contains symbolic instructions, including the rules of how to evaluate those symbols and then proceeds to build itself. The Turing machine reduces the nature of machinic functions to symbolic operations, thus abstracting the machine to information.
- In 1943, Warren McCulloch and Walter Pitts developed a logical calculus of neural networks, proposing that excitability and inhibition were opposite binary states, and that such a scheme of successive states accounts for the complexity of logical processing in the brain. McCulloch and Pitts concluded "that every (neural) net, if furnished with a tape, scanners connected with afferent, and suitable efferents to perform the necessary motor-operations, can compute only such numbers as can a Turing machine…If any number can be computed by an organism, it is computable by these definitions, and conversely." (McCulloch and Pitts 1965a: 35). By proposing that the physical brain was reducible to its networks, synapses, electrical signals, and its logic, it is really nothing more than what Gilbert Ryle calls the "ghost in the machine" -- a metaphorical model that has driven much of computing architecture for the past thirty years.

- With the reduction of computability to symbolic operations and the transmission of neural information to that of binary signals, it is not surprising to find information itself reduced to an algorithm. In this case, the proposal was made by Claude Shannon (1948), who posited that information was a mathematical problem of signal reliability (noise/message) and the probability that a message received was the same as the message transmitted. The solution, Shannon, suggested was not to examine the meaning of the content of a message, but to evaluate messages in relationship to their entropy. I will discuss this topic in more detail later, but suffice it to say, this strategy corresponds to why intelligence agencies are satisfied with looking at metadata of communications rather than the content itself.
- McCulloch and Pitt's research supports the notion that living beings with sensory and some form of analytic capability are ontologically members of the same set. Norbert Weiner (1948) extends this conclusion by proposing that living beings, including aggregates of living beings like social and eco-systems, are ontologically inclusive. In addition to supporting Shannon's entropy model of information, Weiner outlines how that information circulates through an organism to create a cybernetic regulatory system. Today, both anomaly detection and imaging surveillance systems employ neural networks and cybernetic feedback loops in Bayesian inferential engines to learn how to better discriminate among and identify subjects of interest.

- Turing (1950) extended his earlier consideration of a universal computing machine by asking whether “machines can think?" His response was that the definition of the word "think" was problematic, but if the question was rephrased as to whether computers could "imitate a human", then, a more pragmatic evaluation could be conducted. He proposes placing one person in a room with a computer and in another room, an interrogator. The two rooms would be connected by a teletype machine. The interrogator proceeds to ask questions of the party in the other room and by reading the responses, tries to determine if he is "talking" with a human being or a computer. If the computer can deceive the interrogator, then we know that the computer is as good an imitator of a human being as another human being might be. This is now known as the Turing Test. Today, some of the most sophisticated software used in surveillance tries to emulate human decision-making and social relationships to profile and detect suspicious behavior and anticipate a subject's next move.[5]

The cumulative effect of the conceptual transformations inspired by these initiatives has been profound. Quite beyond envisioning machines that could think, converting a noisy analog world to a silent digital network, and the automation of nearly every process from production to consumption, the real alteration of the material landscape is its increasing dematerialization. From media to currency, entertainment to war, knowledge

[5] Though most intelligence agencies develop applications internally, one commercial product suite offered by Palantir Technologies was developed almost from the ground up with the assistance of the Central Intelligence Agency and the National Security Agency and is widely deployed in nearly all Western intelligence agencies.

to kinetics, much of what was deemed significant in the material world before 1980 has been replaced with an intangible medium.[6]

Technology as Autonomous Agent

A technology that emulates a human being is a difficult, but not impossible task, as the mounting successes of IBM's Watson Project demonstrates. But there is whole different quality to this emulation if it is enacted autonomously. Such an image was the basis for one of the memorable scenes in Stanley Kubrick's film *2001: A Space Odyssey* wherein, HAL, a 9000-series computer, not only sustains human-like interactions, but autonomously comes to the conclusion that his human compatriots are threatening the mission and decides to eliminate them. Perhaps even more striking is the television series *Battlestar Galactica* (2004-2009) in which robotic anthropods initiate a revolution against their human creators -- striking because today, it seems so plausible

Freud wrote, "If we go back far enough, we find that the first acts of civilization were the use of tools, the gaining control over fire and the construction of buildings…With every tool man is perfecting his own organs, whether motor or sensory, or is removing the limits to their functioning." (Freud 1989: 42-43). He continues,

> Long ago (mankind) formed an ideal conception of omnipotence and omniscience which he embodied in his gods. To these gods he attributed everything that seemed unattainable to his wishes, or that was forbidden to him...Man has, as it were, become a kind of prosthetic God. When he puts on all his auxiliary organs he is truly magnificent; but those organs have not grown on to him and they still give him much trouble at times. (*ibid* 44).

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[6] In 1975, for example, the value of intangible assets -- brand value, intellectual property, goodwill, customer base of a S&P 500 listed company was 17% of the total market value of the company. Today 84% of the value of public companies is mostly digital or the reputation of a business. For a company like Walt Disney, that percentage is closer to 95%. Source: Ocean Tomo Merchant Bank (2015). Downloaded from: http://www.oceantomo.com/2015/03/04/2015-intangible-asset-market-value-study/

The trouble that Freud refers to is the way in which machines periodically decide to do something other than what we expect them to do. Sometimes, these are what we might call inadvertent product features -- such as an airliner designed to transport passengers instead being used as a terrorist weapon. In other cases, such features were considered out of bounds, in what Paul Virilio refers to as "original accidents" like the probability of a train derailment. (Virilio 2007). At other times, our confidence in the bounds are so great that we design this flexibility into our technology. Lewis Mumford, in his 1934 study on the relationship between technology and history, observes that "As the machine tended towards the pole of regularity and complete automatism, it became severed, finally, from the umbilical cord that bound it to the bodies of men and women: it became an absolute." (Mumford 1963: 301).

Today the relationship between human being and technology is being inverted at a rapidly accelerating rate. For example, in 2012, IBM joined in partnership with New York City's premier cancer research center, Memorial Sloan-Kettering, to use the Watson computer in oncology diagnostics. For two years, Watson was trained in oncology protocols, diagnostics, case histories, and evaluated against active cases. Now, Watson takes patient input and within seconds returns with a treatment plan. IBM reports that "90% of nurses in the field who use Watson now follow its guidance". (Upbin 2013). This would suggest that technology, at least in the form of things like Watson, are not extensions of human beings, but replacing them. The question is, how?

Autonomy and the Origins of Systems

The German media theorist, Friedrich Kittler shares McLuhan's view that media is related to inherent human capacity. (Kittler 1999: xxxix). But, unlike McLuhan, Kittler believes the role technology fulfills is one of compensation for the sensory disabilities of humans. (Kittler 2010: 148). As a result, technology is a prosthesis or supplement, which unlike McLuhan's interpretation, does not amplify, but replicates the corresponding, but deficient, functionality of a human sense organ. This results in parallel organs, one which is biologic, and another technologic -- the latter being a prosthesis which corresponds to, but is not inter-dependent with the human organ. This gives each set of organs the possibility of autonomy. For example, with respect to the invention of the phonograph, "ever since that epochal change", he writes, "we have been in possession of storage technologies that can record and reproduce the very time flows of acoustic and optical data. Ears and eyes have become autonomous." (Kittler 1999: 3). This independence, however, is not innocent. The essence of a human being escapes into apparatuses. Kittler challenges the anthropocentric legacy of most other theorists with a wholly different ontology – one in which technology and mankind are co-existent entities, not one determined by the other. Kittler follows from Nietzsche in considering the consequences of such an ontology in asking, "are these humans, or perhaps only thinking, writing, and speaking machines?" (Kittler 2010: 17).

Kittler's conclusion to this question is explicit. "What remains of people is what media can store and communicate. What counts are not the messages or the content with which they equip so-called souls for the duration of the technological era, but rather (and in strict accordance with McLuhan) their circuits, the very schematism of perceptibility." (Kittler 1999: xl-xli). This transferability of the body into a digital dissolution is accomplished not in a single technological leap, but in what are sometimes minute, incremental innovations. This translation is masked by the circuitry which concurrently and simultaneously adapts itself to accommodate the co-evolving relationship between prosthesis and organ.

Autonomy as Evolutionary Momentum

"The genesis of the technical object is part of its being", writes Gilbert Simondon (1958: 20). Simondon, whose work has greatly influenced Gilles Deleuze and Bernard Stiegler, among others, argues that how a technical object comes to be is as much a part of what it will be some time in the future. The genesis, individuation, and evolution of technical objects are an ontological product which is always in the process of becoming something different, new, or more. Simondon was the first philosopher of technology to appreciate that technical objects are something more than what has been made -- they have their own phenomenological narrative. It is for this reason that Simondon distinguishes between technical things that are abstract and those that have become fully realized, a state that he identifies as concrete. This is not a binary condition, but a state in transition.

Technical things, more specifically technical elements and to a lesser extent, technical objects, that function independently within a technical system and are less integrated constitute a status of technical abstraction – technical elements with unrealized potentialities. By contrast, the greater a technical element's integration and the greater the application of technicity, the greater is a technical element's concreteness. But are technical things "made" or do they "come to be"? The answer, from the time of the ancient Greeks, as well as our contemporary common sense, both tell us that technical things are made by human beings. On the other hand, if technical objects acquire a degree of autonomy, how are technical things both of us and separate from us?

Simondon rejects the notion that technology evolves from exogenous influences – the evolution of technicity is wholly internal. However, the manifestation of these internal drivers is frequently external. In fact, the more technical the object, the greater is its avoidance of external demands (e.g., custom features), in its preservation of efficiency, dependability, and effectiveness. In this way, technical objects of extreme concreteness such as space flight eschew any forms of extraneous, non-integrated functionality. The evolution occurs, in large part, from the ways in which the technical object reveals itself in use. "Reforms in structure that allow the technical object to reveal its own specific character constitute what is essential to the becoming of this object." (Simondon 1958:27). As each element reaches its limits of saturated use and these limits impinge on the relations with other elements within the object, the potentialities of technical evolution are revealed. This point he refers to as a moment of technical convergence.

It is here that Simondon faces a contradiction in the logic of technical evolution. How is it that technical elements, in response to endogenous constraints, can continue to differentiate in their functionality and proliferate different technical features, while, at the same time, converge in concretization as each element performs multiple functions. His response is that differentiation facilitates the continuing integration of the elements “into the functioning of the ensemble”, thus persisting the coherence of the elements in its own concretization. (*ibid* 31-32). It is precisely the potentiality of these functional synergies that makes technical evolution possible. What Kittler identifies as a property of technical augmentation, namely increasing autonomy, is, in Simondon's interpretation, simply a process of differentiation. Increasing technical autonomy is not something peculiar or unique, but is a bi-product of technical evolution, or what Simondon refers to as individuation.

Technology as Co-evolution

To our common sense way of thinking, the idea that autonomy is a manifestation of the internal logic of technical evolution seems a rather odd assessment of why technics are the way they are. After all, whether rightly or wrongly, we were all taught that what sets human beings distinct apart from the animal kingdom is that we are tool-bearers and tool-forgers. We are the source of the tool's existence and formation. The archaeological evidence shows that as hominids began to appear so does the evidence of tools. The resulting assumption is that no one else made the tools so human beings must have made them.

However, that conclusion seems a bit odd given an alternate possibility that the accessibility of tools -- and here I am considering stones -- made it possible for hominids to become more than what were before the availability of tools. The notion, in retrospect, that one (hominids) came before the other (tools) is anthropocentrically presumptuous. What if tools and hominids evolved in such a way that contemporary *Homo sapiens sapiens* are not just tool forgers, but forged of tools as well? In other words, what if human beings and technology have co-evolved?

If Simondon is right that technology has its own internal logic and that that logic is responsively adaptive, then it suggests that we need to think of technology, or at least advanced technology, as more life-like than utterly inanimate. Co-evolution is a mechanism of collective optimization, yet one that is not deterministic of the options or the responses. Optimization, in this case, means achieving the best alternative among the options available -- options which are mutually accessible, though not necessarily mutually relevant. Co-evolution means that there is a relationship -- in some cases, symbiotic or mutualistic, and for yet others, parasitic, while adaptation, in some cases, may be so radical that entirely new forms emerge. There is one consideration that interrupts this argument. It requires human beings and technology to be organisms in a larger system -- not as conscious life forms, but as living entities each capable of adaptation.

This requires us to consider technology and human beings as existing on the same ontological plane. That is quite a stretch for many to take. Simondon's teacher, Georges Canguilhem, observes that the relationship between technology and organic life (including, but not exclusively, human beings) has been studied and modeled with a single bias, the organism has been explained by reference to the machine. (Canguihelm 1992). Technology, until recently, has been a science of precision, geometry, and Newtonian physics. The efficacy, presumably of this model, was not only the limits of imagination, but seemingly of nature itself, in which the source of energy for all force and movement was an exertion from outside of the object. The problem, as Canguilhem notes, is that such a move does not solve the problem of genesis -- machines do not create other machines. But this problem disappears when machines are evaluated as organs of human beings: "A tool or a machine is an organ, and organs are tools or machines." (*ibid* 55). This is not a functional substitution, but an ontological correspondence.

The Mechanics of Co-evolution Among Humans and Technology

How does this co-evolution work? Though we have yet to trace how precisely this might transpire for surveillance, Kittler suggests -- whether he means it literally or metaphorically isn't clear -- that four stepwise inventions account for the transformation of the neo-classical man of the early nineteenth century into the digital simulacrum of the latter half of the twentieth. His chronology sets a standard for what we should be looking for, as well, with respect to surveillance.

- First, the gramophone, which obliterates the linear temporality of human sound with the ability to record, replay, interpolate the present of the human voice with the past and project it into the future. This has several consequences:
    - Sound is demonstrated to be a product of speed (time), not of extension (space).

        As we will see in chapter six, this proves to be of critical importance in assessing the ontological character of techno-surveillance.

- The recording disk had a "remarkable ability: memory". (Kittler 1999: 31).

    Surveillance is usually about discriminating differences which means that the memory of events become crucial in the performance of surveillance.

- If the phonograph could "hear" what its recorder mimicked, and if the phonograph could remember its past (what its recordings simulated), then "from this point of view it would be neither very imprecise nor very disconcerting to define the brain as an infinitely perfected phonograph -- a conscious phonograph". (*ibid* 33).

* The second of these innovations is that of film, which also transgresses time, but it does so as an illusion, a deception of perceptions. Where the gramophone captured and replayed the physical motion of sound waves, which were etched into the grooves of a vinyl recording, film is at least two degrees away from what is real. What starts in the art of Muybridge's time splices of motion becomes a prosthetic device, not of our eyes, but of our imagination.
    - Surveillance is almost always a simulacrum. We are never direct observers, but always removed by multiple degrees: the camera, the network, the monitor, the recording, and the replay. Only our imagination allows us to redactively stitch these phases together into our own narrative.
* Third, Kittler points us to the development of the typewriter. Here the innovation is not one of electric extensions, but of a return to the mechanical

device as a production process. The output, however, is anything but simply mechanical. It is extended storage of memory and thought. Quoting Heidegger, Kittler notes, "It is not accidental that modern man writes 'with' the typewriter and 'dictates' (the same word as 'poetize' [*dichten*]) 'into' a machine." (*ibid* 198). The haptic provision of writing is technologically enabled as an extensor that is absorbed into the machine, as if the nerves of the imagination are propelled into motion in the keystrokes. Kittler sees the auto-enscribing machine a harbinger of the digital computer. These are "technologies that not only subvert writing, but engulf it and carry it off along with so-called Man, render their own description impossible. Increasingly data flows once confined to books and later to records and films are disappearing into black holes and boxes that, as artificial intelligences, are bidding us farewell…" (*ibid* xxxix).

The Technologicalization of Perception

Today, nearly everyone in the developed, as well as the developing world, walks around with smart phones, with which they not only take photographs and movies, but also edit and transmit around the world. Universal surveillance is available, its inexpensive, its accessible, and it doesn't discriminate among observer or observed. But the technologicalization of perception is not something that just happened to occur at the turn of the twenty-first century. The fascination with and the attendant innovation of mechanization of the scopic began its acceleration in the early nineteenth century. As Jonathan Crary notes, "by 1840 the process of perception itself had become, in various ways, a primary object of vision." (Crary 1990: 138). Following the work of Gustav

Fechner, Crary points out that the paintings of J.M.W. Turner dissolved space into successions of light,

> Thus human perception became a sequence of magnitudes of varying intensity. As Fechner's experiments with afterimages also had shown [Turner], perception was necessarily temporal; an observer's sensations always depended on the previous sequence of stimuli. (*ibid* 146)

Crary goes on to note the connection between the velocity of new technologies and the rate of increase in the circulation of capital that results in the displacement of space in vision by speed. Speaking of Edward Muybridge's Horse in Motion series, Crary writes elsewhere,

> The segmentation of Muybridge's work should be understood not simply as the breakup of a perceptual field but also as the claiming of an instantaneity of vision from which space is deleted. It announces a vision compatible with the smooth surface of a global marketplace... (Crary 1999: 142).

Most information systems before the twenty-first century are a bit like Leibniz' monads - blind to the world. They are closed systems with a limited input capacity dictated to by users and an even more restricted output facility. But in the post-World War II period, it became increasingly clear that the information systems needed sensory capacity and with the emergence of high definition cameras, satellite communications, highly sensitive microphone and hydrophone surveillance systems, that need became substantial. The groundwork for the technical enablement of multi-sensory information systems began in the 1950's. Proof of concepts for optical character recognition were produced in 1952, optical scanners were first demonstrated in 1957, and in 1959, Bela Julesz, of Bell Laboratories, demonstrated how three dimensional vision should be statistically manipulated and represented. Orit Halpern, in her documentation of the process of convergence between vision and reason writes of this period,

> Perception became an informatic entity assumed to operate according to some sort of algorithmic and communicative principles that could be cordoned off and isolated. Cybernetics would become a mode of operations interested not in representing the world but in understanding what templates, approximations, agglomerations of information facilitated generalized productions of universal concepts that allowed the eye, now an independent set of processes not attached to conscious reason, personal history, or specific situations, perceive and act on the world. (Halpern 2014: 65).

This autonomization of the scopic and its insertion into the circularity of algorithms is just the first step of the technologization of perception. The next step requires its integration into the entire stream of information, computation, distribution, and archival capabilities of modern information technology. In 1982, David Marr published what turned out to be a landmark text, for digital imaging theory. As he enthusiastically writes at the beginning of his monograph,

> Vision is therefore, first and foremost, an information-processing task...our brains must somehow be capable of *representing* this information -- in all its profusion of color and form, beauty, motion, and detail. The study of vision must therefore include not only the study of how to extract from images the various aspects of the world that are useful to us, but also an inquiry into the nature of the internal representations by which we capture this information and thus make it available as a basis for decisions about out thoughts and actions. This duality -- the representation and the processing of information -- lies at the heart of most information-processing task and will profoundly shape our investigation of the particular problems posed by vision. (Marr 1982: 3)

Today, 28% of the current investment portfolio of In-Q-Tel (the private capital investment arm of the Central Intelligence Agency) is for video and other sensor development.[7] The genealogy of most of these projects can be linked directly back to Marr's theoretical work.

Kant famously asserted in his *Critique of Pure Reason* that "thoughts without content are empty; intuitions without concepts are blind." (A51/B75). For surveillance and technology, we can draw an analogy: the former consists of a persistent informatic gaze, but has nowhere to go; while the latter consists of flowing of information, but is blind to the world. These are parallel domains that have no "necessity" for each other, but do have shared "interests". The key to generating this tsunami of data is the sensors (the perceptual systems) attached to the nervous system (the network) that feed the cognitive system (the software and storage). Which gives rise to the question -- from where does the incentive arise to converge these interests and turn use into necessity?

IV. Techno-Surveillance

Modern forms of surveillance (and the cognates I suggested above) have another common characteristic which also makes them markedly distinct from any earlier prototypical forms we may find -- they are all enabled, facilitated, and extended by technology. From older techniques like recording (such as tape recorders and cameras), reproduction (xerox), and transmission (telephone and radio), to more contemporary ones based on digitalization and technical standards including encoding (ASCII), distribution (tcp/ip), and software (SQL). While these examples suggest that surveillance has much in common with information technologies, it is clear from the last two

[7] Cf. In-Q-Tel at https://www.iqt.org/

decades that surveillance is equally embedded in and with biotechnology, robotics, nano-technology, and kinetic forces. As a result, there are a sufficient number of intersections to ask whether the relationship between surveillance and technology is simply coincidental or whether there is a deeper convergence occurring.

The Technics of Surveillance

The evaluation of how surveillance is implemented includes examining how it is employed in the field. The sum of this engagement is the technics of surveillance.

- To be successful, surveillance abides by **protocols** and customs of the environment in which it operates and may entail multiple sets of protocols (.e., abiding by legal procedures while working within organized crime).
- Surveillance always entails multiple phases and is often iterative. As a result, a surveillance project is always a **process**, not an event.
- Technologies (or **technics**) are employed in surveillance to maximize the field or period of observation, extend the focus of perception, discriminate among stochastic events or agential flows, and to automate and routinize surveillant processes.
- Because surveillance is a process, it must follow protocols. As such, surveillance is also a **practice** (repetitious, goal-oriented, processes that are bound to procedural rules and domains.)
- The integration of protocols, processes, technics, and practices forms a **technicity**.

These technicities can be aggregated into four broad categories which assume that at the end of a cycle, the process loops back to the beginning. In military parlance this is referred to as an OODA loop, which has gained wider applicability than just military operations.[8] (Coram 2002). Within each of these categories there can be discrete techniques or tasks with greater or lesser emphasis applied depending on the type of surveillance being conducted or mission objectives. Not all of these techniques are applicable to every type of surveillance. Finally, this is a highly stylized set of technics so the more informal the surveillance, the less distinct any of these technical tasks are likely to be.

Pre-Engagement

- Definition of objectives -- why, what
- Target definition -- who
- Rules of Engagement (protocols) -- when, where, how

Observe

- Observe -- direct/remote, known/hidden, alias/unknown
- Collection -- HUMINT, SIGINT, ELINT, MASINT, OSINT, IMINT[9]
- Record -- text, analog, digital

Orient

- Categorize patterns of behavior -- discriminate categories of interest

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[8] U.S. Air Force theorist, Col. John Boyd, coined the concept of the OODA loop: Observe, Orient, Decide, Act. He developed the OODA loop as a combat process for fighter pilots. It is was widely adopted until machines were designed to perform the same functions much more quickly.

[9] Human intelligence, signals intelligence (telephony, microwave, etc.), electronic intelligence (radio frequency emissions such as radar), measurement and signature intelligence (non-radio frequency emissions), open source intelligence including social media, image intelligence.

- Label behavior -- identify behavior for future reference
- Distinguish anomalies -- establish baseline and identify anomalies with type/source
- Identify individuals -- correlate target representations with identifying data

Decide

- Sort and prioritize -- based on objectives, sort targets and behavior, prioritize follow-up
- Link network connections -- construct deep network profile of prioritized targets, re-sort based on this deep profile
- Track behavior over time --follow top targets over a period of time; re-sort based on tracking profile
- Isolate and classify -- prioritize targets based on access, currency, interest

Act

- Engage, loop back to beginning and modify objectives/target, or disengage.

These tasks are more structured for well-defined and formal objectives (such as operations subject to legal review) and highly unstructured for users of *facebook*, although the sequence of processes is similar (consider a job search on *linkedin.com* or looking for a date on *match.com*).

The Organism of Techno-surveillance: What Remains of the Human?

Technology, in the form of the machine and its successor, the organ, contingently arrive at an *a priori* valorization, an ontological status that is determinative of the whole system, including its human actors who are embedded within its processes, values, and outcomes. Ellul contests that "this progressive elimination of man from the circuit must inexorably continue…man must have nothing decisive to perform in the course of technical operations, after all, he is the source of error." (Ellul 1967: 136) The autonomy of technics assures its own essentiality, its own determinative path, accommodations, and adaptations.

Katherine Hayles (1999) picks up on Simondon's thesis and argues that interpreting evolutionary change of technology must shift from seeing technics as static entities to seeing "them as temporary coalescences in fields of conflicting and cooperating forces…[a] perspective [that] starts from a consideration of the nature of technical objects rather than from the nature of human experience." (*ibid* 86). It is an entanglement of iterative development, incrementally adaptive, in which human being and technology are engaged in what Hayles calls a "technogenetic spiral". These iterations are expressions of a latent and embedded temporality that embrace a temporary stability, while always being altered by the necessity of innovation. Hayles sites Bruno Latour's reference to the enfolding of time where technical individuals (e.g., cars) call other technical individuals (e.g., freeways) into existence, while cars themselves were called into existence by manufacturing systems. In this paradigm the past of technical objects are embedded in the present, while the future is prefigured in the same present instance. These technics seem much more than an amplification, extension, or prosthesis. Rather, there is a way in which these technics are ontologically parallel with us, but interpenetrated into our experience of the world—enfolding media time into our own.

Where Do We Go From Here

In this and the previous section I briefly outlined the current interpretations of surveillance and technology. It is fairly obvious how these two domains parallel each other, and not difficult to conjure, the ways they intersect, but apart from the last two discussions of technology as a state of co-evolution and technology as enframing, it is not clear how to conceptually frame these common interests. The absence of these potential (actual) connections is hard to read because of the ways we distinctively divide the domains.

V. Elaboration of the Philosophic Issues

This section outlines the set of philosophical issues that need to be developed in order to understand why the momentum behind surveillance and technology and the emergent convergence of the two domains has been ignored and what kind philosophic approach is theoretically required to alter our perception of surveillance and technology.

Research is Blind

To recall, the primary thesis of this project is that research on surveillance (primarily) and technology (secondarily) is blind to the fundamental forces behind this convergence. It is a two-fold blindness. First, positivist methodologies, as found in most social sciences, rely on a set of assumptions from modern epistemology -- be it rationalist or empiricist -- that almost always begin with a set of *a priori* assumptions that emphasize the priority of "how we know something" over a subordinated set of questions around "what we know". In other words, epistemological questions are prioritized over ontological ones. Second, in those cases where positivists have considered ontological problematics, they have walked away confused and cynical because the classical ontology they reference is riddled with conflicts and inconsistencies. This project asserts that a wholly new approach based on an emergent, adaptive, and organic model which is much better suited to not only explaining what is the basis for the interaction between surveillance and technology, but where it is going. Only the application of philosophical analysis can untangle what is going on.

Epistemic Blindness

In the epistemological problem, we are faced with a conundrum that states *we can only know that which appears to our senses, and what appears to our senses must be what is real, but what is real is all we can know*. Therefore, to break this circularity, and to know what is real, we must know *how* we can know what it is that we sense. This requires the establishment of "external" standards such as methodologies of verification and falsifiability that presumably measure the trustworthiness of our sensibility independent of our own subjectivity, but standards attuned to the limits of this same subjectivity. This conundrum has come to be known as "correlationism", the consequence of which, is to turn our analysis from the object (the thing-in-itself) to a grounding of our judgmental reason, in other words, a form of reason, Slavoj Zizek refers to as "subjectively objective" -- a reality that can only be known and grounded in the capabilities and limitations of the subject.[10] Throughout this project, I will refer to this as the problem of "*how* we know" something.

Classical Ontology

By contrast, ontology concerns itself with the problem of "*what* we can know" -- that is, what are the kinds of objects that exist in the world, how are they related to each other, what are their properties, how do they change and what it means for something to change. Classical ontology, which originated with Aristotle, assumes that the things of the world -- entities, objects, and substances -- are what are most real because their tangibility is stable and persistent over time (the tree I see today is the same tree I saw yesterday). As a result, we can derive the kinds of properties (contingencies) and laws (universals) these things exhibit. Borrowing from Parmenides, classical ontology posits a principle of non-contradiction which asserts that "what is" can never be "what is not". Thus, something that "is" must always have been and will always be (a trascendental condition), and any changes that occur to it, are contingent properties. This is not to say my dog, Yoda, will not someday die, but that what Yoda is -- namely, a dog -- never changes. This kind of philosophical assumption assumes that what something "really is" is a combination of the form (*Canis lupus familiaris*), its matter (sharp teeth, big tail, eyes, etc.), its contingent properties (hair colored black and tan), and its essence (loving, loyal, protective) which make it a particular species

[10] The reference to Slavoj Zizek is from *The Plague of Fantasies* (1997 London: Verso) on page 121.

(*Deutscher Schäferhund*) of the primary instance called Yoda. This approach puts an emphasis on spatial dimensions, taxonomic division, and universal essence. In a world of surveillance, where things appear and disappear, and in technology, where things are becoming obsolete as they are being designed, classical ontology is inconsistent with empirical evidence.

Event-driven Ontology

Alternatively, there is a less well known approach which inverts the primacy of space with time and as a result puts an emphasis on the significance of events, flows, processes, things as in-process, relations, and networks in the accounting of what constitutes the world. Here everything is always in transition -- though time scales may vary enormously -- we consider the world to be in states and phases, rather than in hylomorphic form/matter distinctions. The problem with a temporal approach is there is no specific tradition within Western philosophy from which we can specifically draw. Rather, there are parts and parcels of investigations from Leibniz, Spinoza, Nietzsche, Bergson, Whitehead, Heidegger, and Deleuze that suggest how we can think about temporal things and flows. As there is no one philosophical perspective that specifically aligns with this project, I will, at the risk of appearing inconsistent, draw from many of these sources to construct my approach to this problem.

How Will Ontology (of any kind) Help Us to Understand Surveillance and Technology?

Until recently, the technology of surveillance has largely been treated as a means to an end -- as instruments of human interests in discipline, control, domination, and power. From the experiences of Nazi Germany, the Soviet Union, and Imperial Japan, this might be understandable. But we are now many, many decades past this era, and we are still no closer to foregrounding the things and processes of techno-surveillance as primary objects of investigation. We do not consider them seriously as things in themselves, nor do we appreciate that they might be capable of having their own way of being in the world. Are these things and processes capable of expressing their own requirements, perhaps in ways we do not recognize?

To undertake such an analytic necessitates our adoption of a new framework for interpreting these kinds of *things*. The primary distinction has already been noted between *how* we know something and *what* something is. This is the distinction in philosophy between epistemology and ontology. There is a further difference, however, within ontology between the study of Being (ontos) and the *things* that manifest this Being (the ontic). Furthermore, there is a substantial analytic difference between a *thing* that is persistent the same over time (wherein we seek to discern its structure, relations, hierarchy, etc.) and things that are in a constant state of flux and change (through individuation, mutation, recombination). The latter approach is concerned with the genesis and temporality of things -- what I refer to as ontigeny. This study focuses specifically on examining why ontology is less useful than an ontigenetic approach to understanding things like techno-surveillance.

Following the ground-breaking studies of French researchers like Georges Canguihelm, Gilbert Simondon, Gilles Deleuze, and Bernard Stiegler with their focus on understanding the ontological basis of technics, there is increasing momentum towards engaging technics (and surveillance as its perceptual organ) as an assemblage that is projecting its own trajectory, making its own demands, and setting its own agenda. Gilles Deleuze, working with the material of some of these theorists, has constructed an ontological toolbox of concepts, perspectives, analytic frameworks, and terminology that helps us reconstitute the primacy of technological studies. Canguihelm contributed empirical evidence of the way difference works in our language and epistemic conceptualizations. Simondon takes technics seriously as entities that can be studied phenomenologically and things that possess intentionality. Stiegler reminds us that the dimension of time is inseparable from the assessment of how technics evolve. Ontology brings us back to the question of what things are, how they are constituted, and, when considering temporality, the trajectories of their mergence, evolution, and decay or convergence. What we expect to locate in this kind of analysis are the constituent processes, inter-connections, and networks that comprise the life of a thing, and how these factors might account for the ways in which the interests of surveillance and technology not only have parallels with each other, but synergistic exchanges that enable and further their inter-dependence.

VI. Key Research Questions

There are three broad questions in this research project.

1. What is it that really underlies the emergence and spread of techno-surveillance?

   Social theorists propose it is something like power. Others speak of the essence of surveillance or of technology. The objective here is to develop a coherent paradigm that is consistent with both the things of techno-surveillance, as well as its practices. This is a speculative philosophic project rooted in empirical or practical evidence.

2. What are the key indicators that can be used to trace the future of techno-surveillance?

   If there is coherent model, are there patterns, forces, behaviors, or vectors that indicate just where techno-surveillance is headed?

3. What are the likely directions of this future?

   If there are such indicators, given the complexity and instability of such a large investigatory surface, can we identify the directions and forms this techno-surveillance is likely to take in the future, given certain *a priori* assumptions?

VII. Methodology

Given that surveillance, by its very nature, is largely carried out in stealth and deception, and the philological root of technology is the Greek word *μηχανάομαι* (*mechanaomai*) or "artful deception" (Garrison 1998: 49), it is perhaps not surprising that the peripatetic lineage of this project reveals the methodological challenges of uncovering the subterranean lives of things that are not to be seen as they are. Long before this specific project was conceptualized, my interpretations of the entanglement of surveillance and technology centered on cultural and historical transformations, and was particularly influenced by Michel Foucault. But, the deeper one excavates, the more faint and illusive these trails seem to get. There is something far more important than social relations at stake in this investigation.

Empirically-based Speculation

The methodology that I seek to apply in this project is experimental, something I have already referred to as "empirically-based speculative philosophy". The primary thrust of this initiative focuses on taking things seriously -- both phenomenally and materially. Most pointedly, it is a rejection of both the Humean and Kantian traditions in which, in one case, the fundamental materiality of things is irrelevant, or in the other case, that such things cannot be known in and of themselves. At the same time, I am rejecting the positivist alternative that states that metaphysics cannot be used to verify the empirical world. At the heart of this project is a program of metaphysical speculation about *things*. As such, I am primarily concerned with the ontic affairs of the world, and in particular, how they emerge, develop, reproduce, and wither away. Thus, the speculative part of this project is denominated as ontigeny.

At the same time, and in keeping with the ontical perspective, I employ empirical evidence of techno-surveillance to illustrate, verify, and support the larger ontigenetic program. Such a parallel endeavor permits, what Ian Bogost calls, a "speculating about the unknowable inner lives" of things (Bogost 2012: 61) and to the relationships those things have with us. To paraphrase W. J. T. Mitchell (writing about pictures), we need to set forth an investigation of "what [things] want from us, what we have failed to give them, is an idea of [thingness] adequate to their ontology." (Mitchell 2005: 47). He continues, "vision is as important as language in mediating social relations, and it is not reducible to language, to the 'sign' or to discourse. [Things] want equal rights with language, not to be turned into language."

The methodology I am adopting in this project is undoubtedly alien to both philosopher and technologist, but is becoming increasingly applied by anthropologists working in alien environments. Eduardo Kohn (2013) and Eduardo Viveiros de Castro (2014) observe in their separate investigations of tribal life in the deep Amazon, the notion of a conscious and intentional world outside of cognitive beings, human beings and otherwise, is an alien concept. The eco-system they investigate is not comprised of individual things, but a rhizomic budding of billions upon billions of things that exchange, inter-pose, and converge with each other. This is not an outsider's interpretation of a kind of world, it is about becoming in-the-world. It is an ontogenetic investigation in which everything beholds an equal sense of wonder, which is sustained no matter how much closer one gets, because the closer one gets, the more the things under observation become different. One doesn't get lost in the details, because, like a Mandelbrot set, the details become objects in themselves.

The Empirical Data Set

Finding an appropriate data set that would permit this project to fully explore the multiple dimensions and implications of an ontogenetical investigation required identifying a discrete techno-surveillance system that had a.) Sufficient complexity exemplifying the permutations of adaptations such a system is likely to undergo; b.) Provided access to sufficient documentation (if not the original participants) in order to trace the development of the principal components of the system; c.) Undergone a technical maturity such that the system encountered an open environment (not just limited to closed, experimental conditions); and d.) Reflected a high degree of integration between the technical and surveillance components of the system.

The initial choice was to document the increasing use of unmanned air vehicles being used by the U.S. Air Force with the intention of observing either real-time or simulated flight operations out of Creech Air Force Base about thirty miles north of Las Vegas NV. Although a certain amount of valuable documentation is publicly available, it became clear that any access to non-classified data or personnel that was not otherwise available for general access was going to require vetting by the Air Force. For this project, that was not a tenable option.

The second choice was a relatively unknown covert project from the Vietnam War called Operation Igloo White. Jointly run by the Central Intelligence Agency and the US Air Force, Igloo White was an elaborate surveillance project entailing the deployment of sophisticated (for its time) sensors along the Ho Chi Minh Trail in Laos and Cambodia to detect the movement of North Vietnamese troops and supplies towards South Vietnam and to interdict these transfers with massive bombing campaigns. The project was coordinated by a Top Secret Surveillance Center in northeastern Thailand. Although public knowledge about this operation had begun to spread as early as the late 1970's, the entire project and all documentation related to it was classified Secret until August 2006. Even then, the primary source, a report produced by the US Air Force was only forty-five pages long. No other government documentation is known to be available. A participant in Operation Igloo White, Anthony Tambini, published his account, as well as drawing on other documents and sources, though not classified, would be difficult to access. (Tambini 2007). As a result, given the paucity of data and lack of access to individuals involved in this operation, it was decided to forgo this investigation.

The third, and final, techno-surveillant system was, in many ways, more ideal than either the UAV or Igloo White projects. This project is yet another US Air Force endeavor known as SAGE (Semi-Automatic Ground Environment). It was a project on a colossal scale -- so it was not as obscure as the other projects I investigated. It was older -- it began in the early 1950's and was phased out in the late 1960's -- and thus had had more time to go through the declassification process. It entailed the development of very complex systems (radar, computers, software, telephony, and real-time automation) that pushed the limits of nearly every component of the system. And because much of the work on the project was conducted by outside contractors (academic and manufacturing), substantial, detailed documentation was available at resources public (University of Minnesota, Massachusetts Institute of Technology), private (RAND Corporation, MITRE, and IBM Corporation), and government (the Air University Library at Maxwell Air Force Base, Montgomery AL and the Defense Technical Information Center at Ft. Belvoir VA).

As it turns out, the choice of SAGE proved to be prescient. SAGE served as a model for much of Operation Igloo White (particularly the Integrated Surveillance Center (ISC) at Nakhon Phanom, Thailand). Operation Igloo White, in turn, serves as a model today for the deployment of acoustic sensors around sensitive facilities and national borders. The SAGE experience and the ISC serve as models for the Fusion

Centers jointly operating both within the United States (Homeland Security and FBI) and overseas (Department of Defense, CIA, NSA). In addition, the collective experience of coordination in SAGE operations and Igloo White surveillance programs are being expanded and amplified upon by UAV-based surveillance operations (whether in combat missions or homeland security).

VIII. Chapter Outline

The balance of this project is organized into five chapters, each defining a distinct set of successive issues that are summarized at the start of each chapter. The outline of this project is as follows:

- In Chapter Two [Ontography], I introduce the material formations that I will reference throughout the balance of the project, particularly in Chapter Six. The format of this text is unusual in that it is a laundry list, or what Ian Bogost calls, in reference to Bruno Latour, a Latourian Litany. This Litany is specifically a listing of some features, technical anecdotes, major scientific theories, extraordinary technical leaps, minor inventions, engineering processes, institutions, and particularly technology devices that comprised the largest, most expensive surveillance project ever undertaken.
- In Chapter Three (Epistemic Faults), I present the fundamental problem of current social theory in its reliance on epistemological propositions. I begin with an outline of how this challenge has affected surveillance studies and how the consequences can be traced to epistemological assumptions. I then proceed to

trace the origins of this epistemological bias. I show that this bias has had a particularly blinding affect on social theory, a bias I refer to as social epistemics, particularly manifested in theories built around social constructionism. I then illustrate how this bias has developed in Michel Foucault's work on surveillance.

- In Chapter Four [The Ontology of Things], I introduce two alternatives to the epistemological bias discussed in Chapter Three. The first of these is "classical ontology", originally developed by Aristotle. This approach is currently undergoing a revival among some philosophers today. However, given a number of inadequacies in the classical approach, I proceed to investigate a revisionist interpretation entitled speculative realism that has been introduced over the past fifteen years. I refer to this approach as "neo-classical ontology". This investigation will demonstrate that speculative realists have made a number of significant improvements to classical ontology. However, I demonstrate that speculative realism falls flat for one very significant reason that undermines its validity, which I introduce in the following chapter.
- In Chapter Five [Events, Flows, and Processes], I claim that the missing dimension of all forms of substance-based ontology is temporality. When time is introduced as the primary dimension of existence and reality, a whole chain of other consequences cascade forth: the importance of difference, emergence, flows, processes, the presence of things, and networks. In order to justify this altered ontological priority, I devote some space to outlining what the issues with time as a dimension are and what resolution might address these issues.

- In Chapter Six [Convergence], I compare how ontology and ontigeny treat a set of core methodological issues and what the differences between the two approaches reveal about surveillance when applied to the data of SAGE. I conclude by exploring some of the implications of my analysis for how we may interpret the ongoing convergence between surveillance and technology, now and into the future.

Chapter Two: Ontography -- not a question of *how*, but of *what*.

Setting aside theoretical interest, this chapter enumerates many of the dimensions of things, background noise, objects, entities, events, flows, processes, and practices, institutions that comprise the most expensive surveillance system ever constructed. The items in this chapter are treated as recovered archaeological artifacts, which can be interpreted individually and as part of integrated wholes.

Our World

Our own existence and that which surrounds us is comprised of things -- immobile objects, animate beings, intangible substances, emerging and degenerating, sometimes acting autonomous of each other, or at other times being co-dependent on or parasitic of other things. Indeed, the world seems to be nothing but things, all bumping against each other, perturbing and altering their proximate neighbors or generating butterfly-like events with distant things through a process of cascading perturbations. The constancy of motion among things seem, at times, to be comprised less of things, than of events, flows of events, and processes that repetitively constrain these flows. In Section II of this project, I set out to locate a framework, a set of related perspectives, will help us to understand what it is that comprises our world.

This is not an idle exercise, but an effort at understanding, in the case of surveillance and technology, just what constitutes the relationships among things, and what kind of things come into and pass out of existence, change qualities and functions, and evolve into other things. Indeed, as we shall see, things also seem to be constituted of events, flows, processes, and practices. If we take account of the things on my desk -- a broken light bulb, a coffee mug of pens, a photograph of my daughter, an empty bowl that once held cashews, computer printouts of documents, a cup of coffee, some CD's, a computer mouse, a telephone -- we arrive at a discombobulated accumulation of items that have piled up in a particular space. To an outside observer, they may simply be the archaeological layers of past activities. To me, they represent an assemblage of recent encounters. To my German Shepherd, it is an opportunity to find morsels hidden among the clutter. And then there are the things that are so common that I barely recognize their distinctiveness -- the maple wood of the desk itself, the ceramic lamp on the corner of the desk, and barely protruding out from beneath the tectonic layers of papers, books, and old paper Starbucks cupis my "long lost" stapler. There are many things on my desk constituting a multiplicity of relationships provoking an even greater multiplicity of interpretations, and most, if not all of them, are "accidental". Yet all of them, as a whole, constitute an encounter with a system. These things are set aside, undisturbed, even revered -- nothing is important and nothing is unimportant.

In his post-apocalyptic novel, *Canticle for Leibowitz* (1959), William Miller recounts, among other things, how the monks of a future world discover a 20th century fallout shelter in the Utah desert that was once the temporary home of the founder of their order, Isaac Leibowitz. In this tomb, they find the notes and scribbles including a shopping list for bagels, cream cheese, and pastrami. The list's references have no meaning for the monks, but given their origins, the scribbles are revered as hieroglyphs, sacred markings that hold some potential meaning, yet to be determined.

In this project, I will build another kind of canticle, of most profane origins, but one that may hold some wonder about the nature of things and the ways they pass through existence. I begin by itemizing lists of things, or what Ian Bogost, inspired by Bruno Latour, refers to as "Latour Litanies" (Bogost 2012: 38). These are lists of things that constitute what Bogost also calls an "ontography" -- a register of the being or existence of things. He writes, "litanies are not indulgences; they do indeed perform real philosophical work." (39) He goes on to observe, "in its most raw form, the Latour Litany offers an account of a segment of being. It's an *account* in the literal sense of the word, like a ledger keeps the financial books. The practice of ontography -- and it is a practice, not merely a theory -- describes the many processes of *accounting for* the various units that strew themselves throughout the universe." (50). It is a basic technique by which we can engage with the world of things without being distracted by thinking about causality or teleology. The lists are simply itemizations of things of all kinds and forms by which we can be begin the work of analyzing the multiplicities of being.

Surveillance as Ontography

In this chapter, I employ a Latourian Litany as a method for itemizing some of the different kinds of things one would expect to find in a system integrating surveillance and technology. In this case, I will inspect the largest surveillance system ever built -- the United States Air Force's Semi-Automated Ground Environment (SAGE) system which was operational from 1958 to 1984. [11] A project that covered the entire North

[11] There is no single comprehensive study of SAGE. However there are a number of studies focusing on particular aspects of the SAGE system and those individuals and organizations that contributed to its design and construction. On the overall design of the SAGE ADS and its

American continent, SAGE is also the most expensive military project ever built -- far greater than the Manhattan Project that developed the atomic bomb or Ronald Reagan's Strategic Defense Initiative (known as "Star Wars").

The experimental predecessors of SAGE began in 1949 and, once the system was deployed in 1958, were maintained in an operational state until 1984. SAGE, and its associated projects, was an extraordinary endeavor entailing the employment of nearly a hundred thousand individuals, the invention of literally hundreds of new technologies, and envisioning how things (machines, human beings, information) could be integrated into a single system of surveillance. Though SAGE was a strategic military failure (details below), it had a profound impact on the second half of the twentieth century in the development of digital computers, computer networks, software programming, real-time man-machine environments, simulation and gaming, command and control systems, and surveillance. SAGE not only conjures every possible connotation of what might be construed as a thing, but poses a number of questions around what a thing is made of and what makes a thing. The exposition of a thing, particularly a thing as large as SAGE, requires new methods and approaches. Ian Bogost suggests that we think of this kind of exploration as "ontography" -- a term, as best as I can tell, was first used by

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historical context, see Kenneth Schaffel (1991); on the history of radar including SAGE, see Robert Buderi (1996), chapter 18 and on the specific SAGE radar implementations see David Winkler (1997); on the development of SAGE computers, see Kent Redmond and Thomas Smith (2000), Robert Everett [ed.] (1983), Bernd Ullman (2014); on the history of SAGE programming and the development of systems engineering, see Claude Baum (1981), Harold Sackman (1967) which includes a number of schematics of the SAGE software design, and Nathan Ensmenger (2010); on the cathode ray technology used in SAGE, see Robert Brown [ed.] (1958), particularly S.H. Boyd and C.W. Johnson, "The Presentation of Alphanumeric Information", pp. 142-148; on the politics and culture of SAGE, see Paul Edwards (1996, chapters two and three.

Michael Lynch in 2008. Ontography is the study of relationships among components and what those relationships imply for the ontological status of things themselves. Bogost analogizes this kind of analysis to an "exploded diagram". He writes,

> Let's adopt *ontography* as a name for a general inscriptive strategy, one that uncovers the repleteness of units and in their interobjectivity. From the perspective of metaphysics, ontography involves the revelation of object relationships, without necessarily offering clarification or description of any kind. Like a medieval bestiary, ontography can take the form of a compendium, a record of things juxtaposed to demonstrate their overlap and imply interaction through collocation." (Bogost 2012: 38)

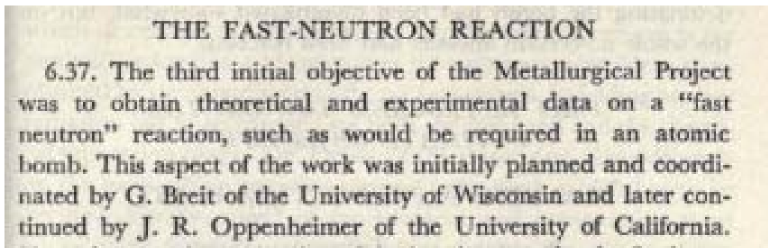
As this project seeks to excavate both the material and ontological constitution of surveillance, the work will require iteratively moving back and forth between matter and being, or as I shall argue later, between difference and becoming. As we recursively descend further and further into these relationships, this project seeks to uncover the precise relationships, or the dynamics of these relationships between surveillance and technology. As it is also *our* story (i.e., that of human beings), it means that we will find ourselves constantly triangulating between human being, machine, and processes.

I: Noise

Every system has its moment of emergence -- some are "big bangs", while others are whimpers of unrecognizable origin. SAGE was "birthed" somewhere in between a series of "big bangs” and a quiet, but anxious fortitude. In the beginning was noise.

Trinity

The background and context of air defense in the period of 1950 to 1965 is set by the events, shock, and balance of interests that are upset on 16 July 1945 when a project, code-named Manhattan, results in the test explosion of an atomic bomb at a secret test site east of Alamogordo, New Mexico. The test, code-named Trinity, is the first real evidence of the devastating power of atomic weapons and generated the equivalent force of twenty kilotons of TNT. (Rhodes 1986).


THE FAST-NEUTRON REACTION

6.37. The third initial objective of the Metallurgical Project was to obtain theoretical and experimental data on a "fast neutron" reaction, such as would be required in an atomic bomb. This aspect of the work was initially planned and coordinated by G. Breit of the University of Wisconsin and later continued by J. R. Oppenheimer of the University of California.

(Source: H.D. Smyth 1945:. 103)[12]

Little Boy

On August 6, 1945, flying over the city of Hiroshima, the United States Army Air Corps dropped a single ten foot long object, named "Little Boy," from the bomb bay of a B-29 bomber. At an altitude 6,600, a barometer switch turned on the power to radar-based altimeters. As the device approached 2,000 feet above the city, a series of cordite detonators exploded hurtling a tube of uranium along a shaft in the bomb, at the other end of which was a one-hundred-forty pound payload of uranium- 235. The ensuing collision initiated a nuclear chain reaction unleashing an explosion equivalent of 13,000 tons of TNT. In an instant, the city center of Hiroshima was obliterated.

[12] *This volume, written by Princeton physicist Harold Smyth, was known as the Smyth Report. It was ostensibly written as a history of the Manhattan Project. Underwritten with the support of the U.S. government, it was designed to appear to be forthcoming about the technical details of the atomic bomb without revealing any significant details from which the Soviet's could build a bomb. It was, in fact, largely a political document to show the Soviet Union that the U.S. was not withholding information about the bomb and therefore, to give the Soviet's an assurance that they need not worry about the need to build their own. Of course, Stalin already had much of this information, and what the report helped confirm was what development paths NOT to take. Given Soviet knowledge, what was not in the report were specific details as to what was important to the actual completion of an atomic bomb. (See Gordin 2009: 93-104)*

> LIFE HISTORY OF ONE GENERATION OF NEUTRONS*
>
> 8.8. All the chain-reacting piles designed by the Metallurgical Laboratory or with its cooperation consist of four categories of material—the uranium metal, the moderator, the coolant, and the auxiliary materials such as water tubes, casings of uranium, control strips or rods, impurities, etc. All the piles depend on stray neutrons from spontaneous fission or cosmic rays to initiate the reaction.

(Source: H.D. Smyth 1945: 132)

Fat Man

Three days later another atomic bomb was dropped over the city of Nagasaki with a force equivalent to twenty-one thousand tons of TNT. The bomb, called "Fat Man", was of an entirely different architecture from the gun-design of Little Boy. The Fat Man design had been held in abeyance because scientists had discovered the enrichment process for plutonium-239 generated impurities with unstable plutonium-240. Though it was theoretically presumed that a plutonium-based weapon would be much more destructive than Little Boy, this instability meant that the metallurgical, explosive, and physical design was much more complicated than the design of Little Boy.

To work around this problem, John von Neumann suggested using a simultaneous spherical, convex implosion that would trigger a massive increase in the density of plutonium. In the center of the plutonium was a small core of polonium and beryllium which, when compressed, initiated a massive release of neutrons, further accelerating a chain reaction. Six days after the bombing of Nagasaki, the Japanese surrendered. (Gordin 2007).

> 13.2. A weapon has been developed that is potentially destructive beyond the wildest nightmares of the imagination; a weapon so ideally suited to sudden unannounced attack that a country's major cities might be destroyed overnight by an ostensibly friendly power. This weapon has been created not by the devilish inspiration of some warped genius but by the arduous labor of thousands of normal men and women working for the safety of their country. Many of the principles that have been used were

(Source: H.D. Smyth 1945:. 223)

Illusions

For the following four years, the United States held a monopoly on atomic weapons offering unilateral assurance of national security. In the meantime, Americans exulted in a new foundnewfound economic resurgence, an insular isolation from the devastation of Europe and East Asia, a rekindled confidence in technological progress, resulting in a sense that America alone was safely ensconced at the pinnacle of world power and prosperity. As a U.S. Army history of strategic air defense puts it, "Seeing the war to have destroyed the existing power balance in Europe and Asia, America thought it would take years before nations—particularly the Soviet Union—would recover from the damage and losses suffered during World War II." (U.S. Army 2009: 7).

II. Reaction

The perturbations of "big bangs" ricocheted all over the world, but nowhere more than in the Kremlin. The reaction to these events initiated a series of simultaneous processes including accelerated research, creation of new institutions, formations of organizational discipline, and espionage.

Laboratory No. 2

In the 1930's, Soviet scientists had conducted groundbreaking research into atomic energy. But Hitler's invasion of Russia in the summer of 1941 substantially interrupted funding and resources to continue research and development. In response, in 1943, in response to a letter from Georgy Flyorov detailing the importance of revamping Soviet nuclear research, Stalin ordered the creation of special institute to be led by Igor Kurchatov called Laboratory No. 2.[13] (Holloway 1994). By the end of the war, this institute was to be overseen by the director of the People's Commissariat of Internal Affairs (NKVD), Laventiy Beria.

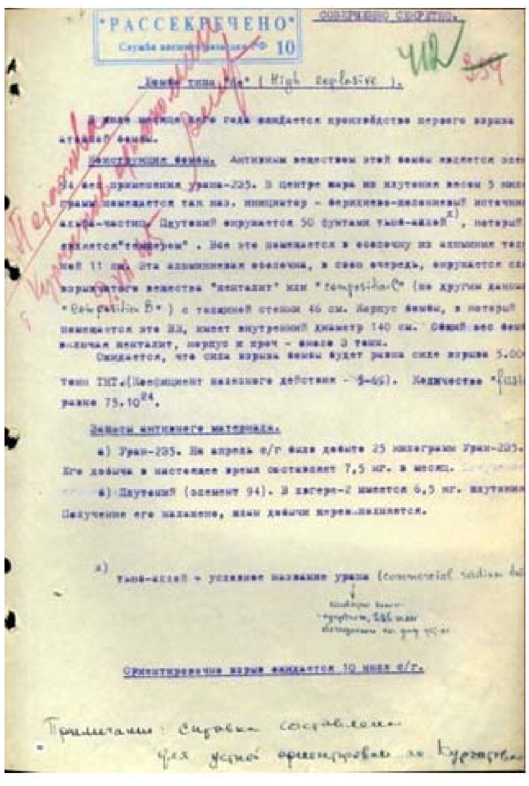
Following the American "demonstration" of its new destructive weapons, Stalin called his top nuclear weapons experts to the Kremlin on August 17th or 18th, 1945, where he declared, "A single demand of you comrades...Provide us with atomic weapons in the shortest possible time! You know that Hiroshima has shaken the whole world. The balance [of power] has been destroyed." (Andrew and Gordievsky 1990: 376). While Kurchatov focused on the technical aspects of building an atomic bomb in his new secret laboratory, Beria was able to bring two things to bear on the project: access to uranium supplies (in Russia and overseas) and access to American secrets.

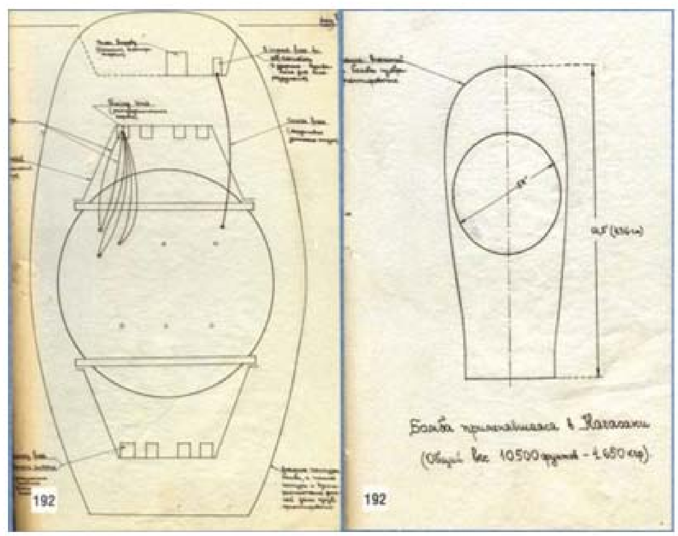
ENORMOZ

There can be little doubt that American counter-intelligence agents were overwhelmed by the number of Soviet spies working in the United States, but perhaps even more importantly, they were extraordinarily naive about the detection and

[13] Now known as Kurchatov Institute located in the Shchukino District of northwest Moscow.

entrapment of these spies and their allies, often going after innocent suspects and ignoring the possibilities of more serious intrusions. For the Soviet's, the initiative was so important it was assigned the ironic code name of ENORMOZ. (Weinstein and Vassiliev 1998). As can be seen in the images below, a letter to Beria in February 1945 updates him on the current status of the Trinity test which was expected to be tested in July. The letter simply transliterates American words such as the American code name "Tube Alloy" for uranium. In the second image is a Soviet sketch of the Fat Man bomb.


"РАССЕКРЕЧЕНО"
10



(Source: Atomnii projekt SSSR: katalog vystavki Moscow: Rosatom, 2009).[14]

[14] Downloaded from: http://blog.nuclearsecrecy.com/2012/07/27/rare-photos-of-the-soviet-bomb-project/ on February 7, 2015

First Lightning

In August 1947, the Soviet Politburo mandated the creation of a site for testing an atomic bomb. Project director "Kurchatov selected an isolated spot 160 kilometers west of the city of Semipalatinsk in Kazakhstan." (Cochran, Norris, Bukharin 1995: chapter one, np). The project, code named *Pervaya Molniya* (First Lightning), resulted in a bomb (RDS-1) based on the Fat Man design. On August 29, 1949 at 7:00 AM local time, the Soviet Union secretly detonated a plutonium bomb with the explosive power equivalent to the bomb dropped on Nagasaki.

RDS-1

From a Soviet report:

> In outer appearance the atomic bomb [RDS-1} is a pear-shaped missile with maximum diameter of 127 cm and length of 325 cm including the stabilizer (fins). Total weight is 4500 kg. The bomb consists of the following component parts:
>
> a) Initiator
> b) Active material
> c) Tamper
> d) Aluminum layer
> e) Explosive
> f) 32 Explosive lenses
> g) Detonating device
> h) Duralumin shell
> i) Armor-steel shell
> j) Stabilizer (fins)
>
> All the above-specified parts of the bomb with the exception of the stabilizer, the detonating device and the outer steel shell are spherical shells inserted one into the other. Thus, for instance, the active material is prepared in the shape of a spherical shell into whose center the initiator is inserted. The ball of active material itself is inserted into the interior of the tamper (moderator), which is itself a spherical shell. The tamper ball is inserted into the interior of another spherical shell made of aluminum, which is surrounded with a spherical layer of explosive. After the layer of explosive, into which the lenses are inserted, there is a

> duralumin shell to which the detonating device is attached and on top of which is the bomb's outer casing made from armor steel. (Vasilevskii October 1945).[15]

III. Loss of Innocence

Like a T-cell's response to a viral threat -- action -- reaction -- counter-action -- consequences of an invasion cascade throughout a system's corpus.

Dissonance

Days after the Soviet test, U.S. Air Force surveillance aircraft in the Pacific Ocean discovered evidence of unusually high levels of radioactivity in atmospheric currents coming from Soviet territory. (Jacobson and Ziegler 1995). Indicative of the uncertainty among Americans of how to react to this Soviet "surprise", President Truman did not announce his knowledge of the Soviet bomb test for nearly three weeks after the initial discovery. (Condit 1996: chapter 15 *passim*). When Truman did announce the Soviet bomb test, he averred that the U.S. administration had expected the Soviets to develop an atomic bomb, but failed to mention that intelligence reports had estimated this event to be at least several years into the future. (Schaffel 1991: 111).

Indecision

For the next few months after the Russian "surprise", the U.S. government appeared confused by its altered fortune and strategic options. (Gordin 2009). On October 28, 1949, a frustrated Director of Central Intelligence urged the Joint Chiefs to

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[15] Letter from Col. Vasilevskii to Laventiy Beria, Director NKVD, October 1945. Downloaded from http://nuclearweaponarchive.org/News/Voprosy2.html on 24 May 2015. Translated from V. P. Visgin [ed.] (1992) *On the Origins of the Soviet Atomic Project: Role of the Intelligence Service 1941 - 1946 Voprosy Istorii Estestvoznaniia i Tekhniki* (*Problems in the History of Science and Technology*, (3), pgs. 97-134.

immediately undertake a program of "technical surveillance" of Soviet atomic initiatives and capabilities. (Condit 1996). In January 1950, President Truman ordered a complete review of national strategic defense objectives which was returned to the President on April 14. Among the recommendations in the report was an immediate escalation of "military readiness which can be maintained...as a deterrent". (Executive Secretary 1950: 62). Acknowledging that the Soviet Union represented the single biggest threat to the American homeland, Air Force General Carl Spaatz wrote, the "development of the Arctic front is our primary operational objective." (Cited by Schaffel 1991: 58). The key to this readiness was air defense.

Thin Margins

In mid-April 1952, a succession of incidents revealed the degree to which American air defense was not much more than a Potemkin village. It began with intelligence reports from a clandestine source reporting Soviet bombers were being relocated. Ten hours later, an air defense center in California was notified that four unidentified vapor trails had been reported over the Bering Strait nearly an hour and a half earlier. While trying to confirm the sighting, the only phone line to the originating source in Alaska went dead. For the next couple of hours, agitated air defense commanders remained flustered over what to do next -- disregard the data and maintain standby status or put Air Force fighter squadrons on full alert. Meanwhile, a second report was received on the east coast indicating the presence of unidentified vapor trails just off the coast of Maine. The anxiety that was seemingly under control at Air Defense Command headquarters quickly became sheer alarm. Within the hour (and nearly six hours after the first sighting in Alaska), more than two-hundred fighters were put on standby hot-mode.

Then, less than two hours after the last warning, the alert was cancelled and all forces were ordered to stand-down. As it turned out, the tell-tale source of the last alert came from the contrails of three different commercial airliners, each of which had changed course. Though the commercial pilots had followed regulations and filed amended flight plans, the Air Force was never notified by civilian aviation authorities. As the commanding officer in charge of air defense subsequently wrote to the Air Force Chief of Staff, Hoyt Vandenberg, the cascading events made "more of our top Air Force people...aware of the very thin margin of evidence on which we too frequently must base our decisions". (The whole scenario is recounted by Schaffel 1991: 169-171)

UFOs

In July of the same year, as if "real" bogies were not enough for the Air Force, Air Defense Command and commercial air traffic control radars scrambled interceptor fighter planes in response to an unusual pattern of objects over Andrews Air Force Base on the outskirts of Washington D.C. Pilots reported seeing bright lights moving quickly at a very low elevation. Dubbed as "UFO"'s the source of the sightings never identified. (Washington Post: July 26, 1952: 1). This report was one among dozens generated in 1952 in a nation spooked by both real and perceived threats.

IV. Threats

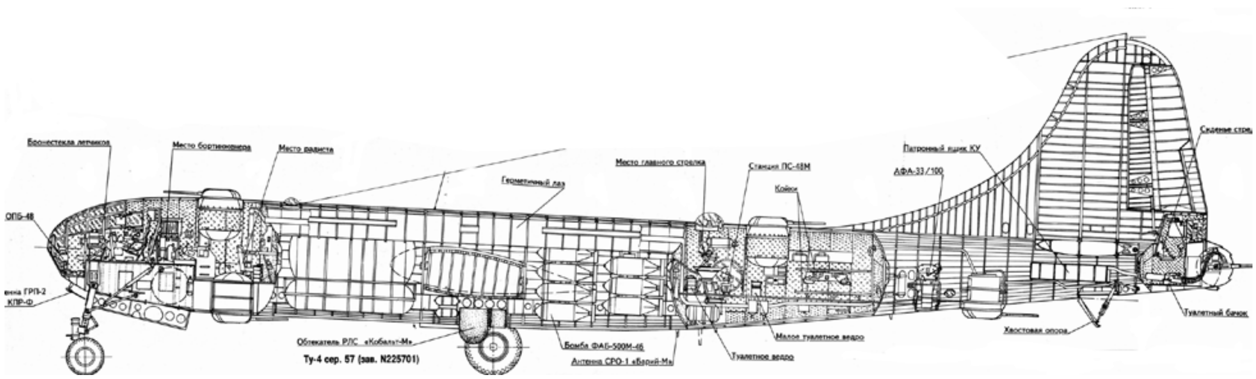
Along with action-reaction, come acts of over-reaction. The development and employment of technology -- particularly in military affairs where the fiscal cost of being wrong is inestimable -- is often a case of mis-estimation.

Capacity

What was largely missing from the ever increasing fear of a Soviet threat was a serious discussion about what capabilities the Soviet Air Force had to actually attack the U.S. with atomic weapons. In fact, "the Soviet Air Force lacked a strategic-bomber force during the war" and "the problems confronting the Soviet strategic-bomber force were both doctrinal and technological. Stalin had shown an aversion to strategic bombing and resources were concentrated on tactical aviation instead." (Zaloga 2002: 17). But after the bombings in Japan, Stalin recognized that when the Soviet built an atomic bomb, a threat was only as good as the Soviet ability to deliver a bomb to the United States, Stalin ordered his aircraft industry to build a bomber capable of reaching North America.

TU-4

Introduced in 1949, the Tupolev Tu-4 was a nearly identical copy of the U.S. B-29, the same bomber that was used to drop Little Boy and Fat Man on Japan. This feat had been made possible because four U.S. B-29's operating on bombing missions over Japan in 1944, had made emergency landings in Soviet territory. The Soviets returned the crew, but kept the planes. Soviet engineers quickly utilized these planes to reverse-engineer and design the Tu-4. This plane had a flying range, without refueling, of 3,400 miles, nowhere near sufficient to get to the United States with more than 13,000 pounds of bombs and return. But U.S. military planners were again surprised that the Soviet Air Force had so quickly developed a medium-range bomber. It was this surprise, rather than the actual capacity of the plane, that so un-nerved American strategists. Over the next three years, more than 800 Tu-4's were manufactured, before it was retired in 1952. (Zaloga 2002).



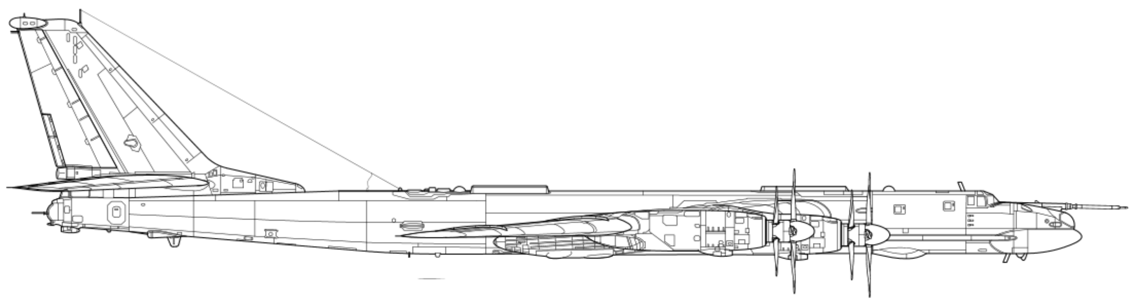
Tupolev Tu-4 Medium-range Bomber Schematic
(Source: http://www.airwar.ru/image/idop/bomber/tu4/tu4-2.gif)

Il-28

The second bomber was the Ilyushin Il-28, the first operational Soviet turbo-jet attack aircraft. This bomber had a substantially shorter range than the Tu-4 (1100 miles) and a substantially smaller destructive delivery of 6,600 pounds of bombs. Despite its shorter range, the Soviets manufactured nearly 6.700 aircraft of which three dozen are still in service in North Korea. (Zaloga 2002).

Tu-95

In 1956, the Soviet Union produced its first long-range, strategic bomber, the Tupolev T-95. Employing an unusual propulsion design, the Tu-95 is propelled by four turbo-prop engines, each of which drive two counter-rotating propellers giving it a speed of more than 500 mph and an altitude ceiling of more than 40,000 feet. The bomber can fly 9,100 miles without refueling while carrying a total bomb/missile weight of 33,000 pounds. Though the Tu-95 stopped being produced in the 1990's, it is still widely deployed by the Russian Air Force. (Zaloga 2002).



Tupolev Tu-95 Long-range Bomber (Bear)
(Source: Downloaded and edited from http://upload.wikimedia.org/wikipedia/commons/8/8a/Tu-95MSZ.svg)

V: Defense

National Security Act of 1947

> SEC. 2. [50 U.S.C. 401] In enacting this legislation, it is the intent of Congress to provide a comprehensive program for the future security of the United States; to provide for the establishment of integrated policies and procedures for the departments, agencies, and functions of the Government relating to the national security; to provide a Department of Defense, including the three military Departments of the Army, the Navy (including naval aviation and the United States Marine Corps), and the Air Force under the direction, authority, and control of the Secretary of Defense.
>
> (U.S. Senate 1947).

United States Air Force

Until the 1947 consolidation, military air forces had been a part of the U.S. Army (Air Corps). As the result of the National Security Act, the Air Force was established as a separate department reporting to a centralized civilian agency, the Department of

Defense. Strategic and tactical air forces were aligned with the Air Force, while ground based offensive and defensive capabilities remained with the Army and the Navy. This meant that ground-based air defense systems (anti-aircraft, missiles, and ground interception radar) remained under Army control, while coastal defense remained under the jurisdiction of the Navy. The new U.S. Air Force (USAF) immediately set out to redefine the boundaries of its turf.

Air Defense

A modern air defense system (ADS) is automated surveillance “on steroids” -- capable of monitoring vast amounts of geography and atmosphere; discriminating among the noise of atmospheric and electromagnetic interference, commercial aircraft, and real enemies; identifying unknown objects moving at high rates of speed long before they come within the range of human eyesight; distinguishing between friend and foe based solely on electronic signatures, vectors, and presumed point of origin; and completing all of these tasks in real-time so that the air defense system can execute a ground-controlled-interception (GCI). An effective ADS maintains constant tracking of "bogies" across multiple sensors without losing any suspects. Unlike most surveillance programs, air defense is not a retrospective, forensic exercise. It is, at its best, a simulation of future horrors. (Winkler 1997).

Men, Machines, and War

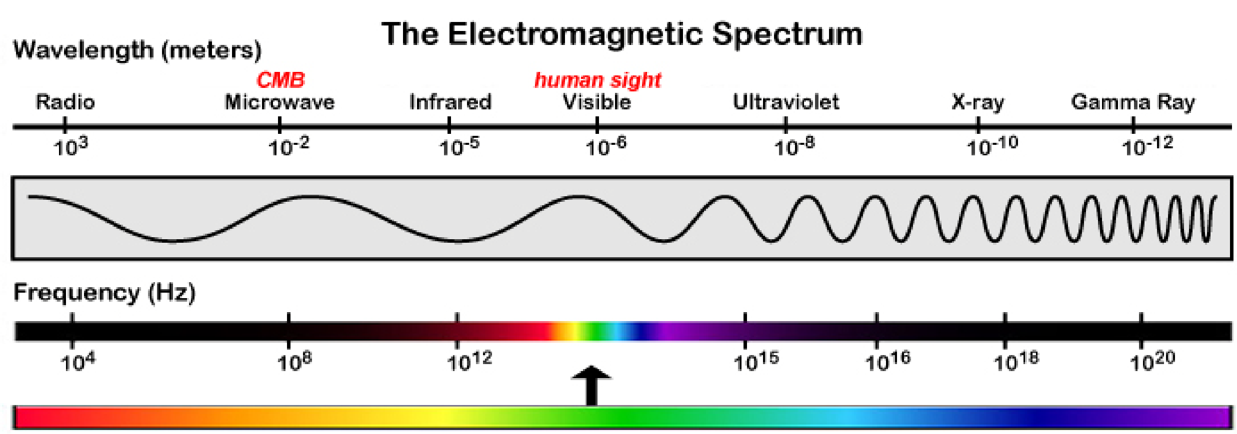
There is a fundamental difference of perspective about the relationship human beings (which has largely meant men) and technology among the different military services. Ground-based military forces, since the earliest times, have relied on human endeavor and initiative to succeed. From this perspective, the role of technology is to "equip the man" to win the battle. By contrast, the success of naval and air services in a conflict largely depend on leveraging human skill and ingenuity with technology, from which they refer to "manning the equipment".

VI. Perception

Part of this over-estimation are the limits of what is known, what can be known, and what can never be known. The limits of perception are the sources of fear and anxiety. Surveillance is designed to abet some part of that uncertainty.

Limits of Human Senses

Human beings are very limited in perceptual range. Humans cannot naturally detect infrared or ultraviolet. They can only "hear" a limited range of sonic waves, unlike porpoises or bats. Only the application of mediating technology overcomes these limits. In World War I, detection of on-coming aircraft that were beyond the line of sight was "accomplished" by the use of large megaphones amplifying the sounds of enemy aircraft engines.



(*Source: Jet Propulsion Laboratory, California Institute of Technology*)

Human Eyes

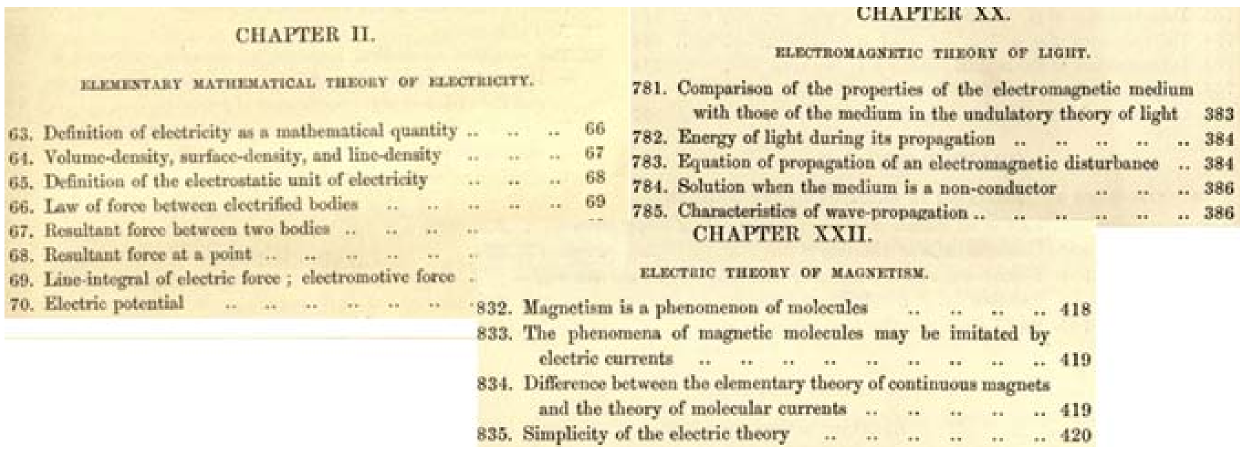
In the absence of extended-sensory capabilities, the only available "technology" to "watch" the skies are human observers. During World War II, homeland air detection and warning defense in the United States was based on the Ground Observer Corps: two-hundred and ten volunteer observers located at eight thousand posts forwarding data to twenty-six data control and filtering centers largely located around the northern, western, and eastern perimeters of the continental U.S. This resource was not demobilized until 1958. (Schaffel 1991).

VII. Energy

Social systems are interpenetrated by natural systems. Technics is the extension of nature into the social and the extension of the social by nature. The common thread is energy.

Electricity

At the foundation of nearly all modern development lies the discovery of the properties of electricity. In fact, electricity is not a single thing, but a set of phenomena, events, effects, flows, and fields that when channeled become forces, power, information, visible and invisible radiance, and, most curiously, noise. Without electricity, there would be no information age, no modern transportation, and no global economy. Indeed, the loss of electricity for most moderns would be apocalyptic. Yet, the spectacle of electricity is its many faceted characteristics. As James Maxwell (1873) demonstrated, It has the properties of a wave, which gives electricity the ability to generate light and heat; the properties of magnetism which empowers electric motors; the properties of mass which give it potential and charge; fields which enable electromagnetic radiation when particles are accelerated; and noise when electromagnetism is randomly dispersed.


CHAPTER II.

ELEMENTARY MATHEMATICAL THEORY OF ELECTRICITY.

CHAPTER XX.

ELECTROMAGNETIC THEORY OF LIGHT.

CHAPTER XXII.

ELECTRIC THEORY OF MAGNETISM.

(Source: Selected Table of Contents from James Maxwell 1873)

Vacuum Tubes

One of the key developments in exploiting electricity is the ability to control the flow of electrical current through rectification (for example, with a diode that converts alternating current to direct current), amplification (triodes), switching (triodes), logic gates (pentodes), or oscillation. In a simple vacuum tube, a cathode inside a vacuum supplies a current that "sparks" across a filament to a cathode receiver, the anode. By adding screens, gates, grids, or other interrupting devices, a vacuum tube can alter or block the transmission of electrons. Using the same properties of vacuum tubes, electrons can be transmitted against a phosphorous screen for cathode ray tubes used in oscilloscopes and similar display devices.

Edison Light Bulb
(Source: Sharp 1922: *69, fig. 2, 10-c)*[16]

VIII. Sensors

Nowhere is that interpenetrations between nature and the social more clear than in the extensions of perceptibility. In the domain of technology, perception is enabled by something called sensors.

Seeing What Can't Be Seen

In the late 19th century, Heinrich Hertz discovered that the propagation of electromagnetic waves bounce off conductive objects like metal and return to their source. To translate these properties into a useful application, three technical issues needed to be solved: generating sufficiently powerful microwaves at a high enough frequency that they wouldn't get diffracted in the atmosphere, second, the pulsing of these waves so that they if the bounced off an object they could provide a reasonable estimate of the distance, and third, a device capable of visually displaying the results. In 1935, Robert Watson-Watt wrote a memorandum "The Detection of Aircraft by Radio

[16] Clayton H. Sharp (January 1922) The Edison Effect and its Modern Applications, *Journal of the AIEE, Vol. 41, No. 1, American Institute of Electrical Engineers, New York,*

Methods" outlining just how such problems might be overcome based on some current field research into so-called "death rays". (Brown 1999: 50-51)

Radar

From the Ridenour Report on Radar Technology:

> Radar is an addition to man's sensory equipment which affords genuinely new facilities. It enables a certain class of objects to be 'seen' -- that is, detected and located -- at distances far beyond those at which they could be distinguished by the unaided eye. This 'seeing' is unimpaired by night, fog, cloud, smoke, and most other obstacles to ordinary vision. Radar further permit the measurement of the range of the object it 'sees' (this verb will hereafter be used without apologetic quotation marks) with a convenience and precision entirely unknown in the past. It can also measure the instantaneous speed of such an object toward or away from the observing station in a simple and natural way. (Ridenour 1947: 1).

Though the Germans, Russians, and Japanese were all engaged in radio detection research, it was the British, out of sheer necessity, that first deployed this technology. In 1939, a series of radio detection devices was installed around the southern and eastern coastlines of the U.K. and was referred to the "Chain Home" network. The term RADAR was coined as an acronym of RA Detection And Ranging in 1940 by researchers affiliated with the U.S. Navy. (Buderi 1996: 56).

Klystron

Early discoveries at Stanford University and innovations in the U.K. had resulted in the invention of a vacuum tube device called a Klystron. The device generated short microwaves, but had the unfortunate limitation of not being able to handle the large amounts of amplification necessary to transmit signals a long distance and could not generate ultra-high frequency microwaves, which would produce clearer images with less noise.

Cavity Magnetron

Researchers in England discovered that by emitting electrons from a cathode filament into the center of hollowed out anode, electrons would fly towards the anode. When a magnet was placed perpendicular to the anode, the electrons would travel in a circular path around the cathode as they moved towards the anode. Finally, if the anode was "sculpted" with cylindrical cavities, the accelerated electrons would become caught inside these cavities and be directed in a focused beam towards the outside, much like the sound effect of wind blowing through a flute. This device is referred to as a cavity magnetron and generated much higher frequencies of microwaves -- with waves as small as ten centimeters -- and the shorter the frequency, the clearer the reflected image. Developed during World War II, the cavity magnetron proved to be decisive in the air defense of England, in sonar detection of German U-boats, and in developing better ground images for bombardiers over Japan. (Buderi 1996).

AN/CPS-5

As the threat of Soviet military hegemony began to unfold in Eastern Europe, American planners recognized that the homeland was completely exposed to undetected enemy planes. Several attempts to raise awareness and funding for a "radar fence" with more than four hundred radars failed to gain the support of the Air Defense Command (which wanted more stations) and Congress (which thought the complete project too expensive). As a result an interim, but dramatically smaller network was assembled, which came to be known as the Lashup network. (Schaffel 1991)

Although some Lashup sites used older equipment, most stations were equipped with a Bell Laboratories-designed and Bendix/General Electric manufactured technology called the AN/CPS-5. Operating at 1300 MHz, the signal was repeated at a rate of four hundred pulses per second. This direction radar was instrumented for detection up to sixty miles and was capable of detecting aircraft as far away as 210 miles at altitudes as high as 40,000 feet. As the AN/CPS-5 could only detect the azimuth of an object. The altitude had to be found by a second radar.[17]

AN/CPS-4

The AN/CPS-5 was deployed to detect the azimuth of objects in the atmosphere. It could not detect the altitude of these objects. The AN/CPS-4, originally developed at the Massachusetts Institute of Technology's Radiation Laboratory during World War II, was designed to detect the *altitude* of an object detected on the AN/CPS-5. When the azimuth of an unidentified object was located, the AN/CPS-4 was targeted at the same azimuth and began to sweep the vertical axis to determine the object's altitude. Operating at 2700-2900 MHz, this radar was effective for a distance of ninety miles. Together the AN/CPS-4 and AN/CPS-5 required eleven personnel to operate. Both were installed in the Lashup Network in 1950.

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[17] http://www.radomes.org/museum/parsehtml.php?html=cps-5.html&type=equip_html
http://www.alternatewars.com/BBOW/Radar/CPS_Series.htm
http://www.designation-systems.net/usmilav/jetds/an-c.html#_CPS
http://www.mobileradar.org/radar_descptn_1.html

AN/FPS-19

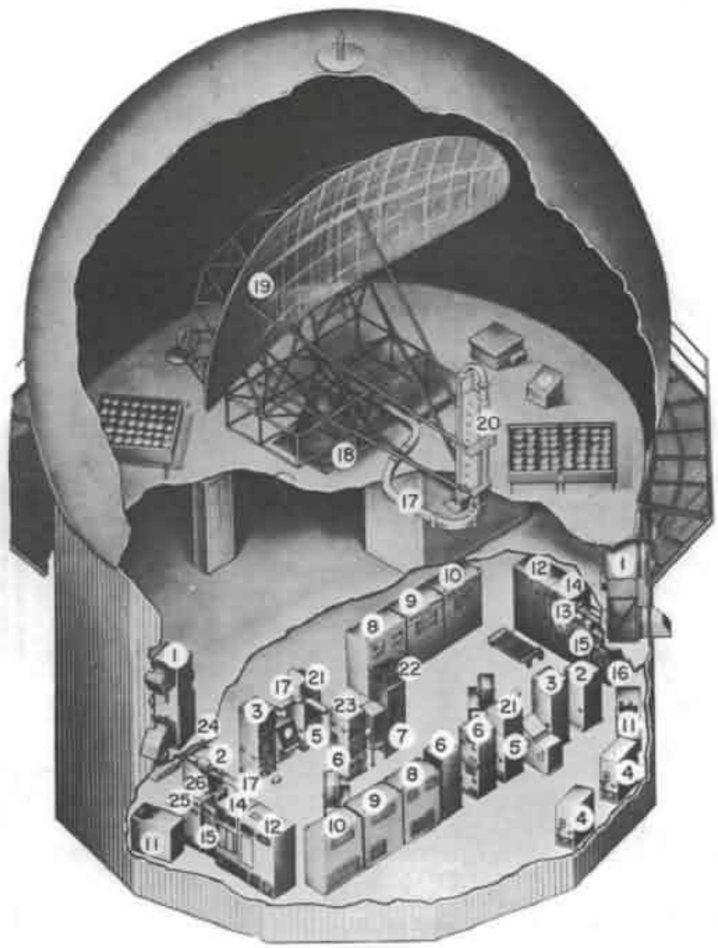
As radars began to be deployed in the far north of the American continent, the distances and ranges to be swept for signals became longer and more delayed. To meet these demands, Raytheon Corporation developed and manufactured the AN/FPS-19. It was the primary long-range radar used on the Distant Early Warning network. It was an unusual system because it used two magnetrons and two antennae that sat back to back. One antenna provided broad scope views of an area under surveillance, while the second antenna generated a narrow, focused-beam at a target, thus enhancing both the breadth and detail of its search zone. Each magnetron generated, on average 400 watts of power, with 400 pulses per second. The radar could "see" up to two hundred miles. Not only was this radar more powerful. It was much larger and weighed 4800 pounds. A photo of the unique antenna can be seen below.

(Source: www.radomes.org)

AN/FPS-20

Over time, the AN/FPS-20 radar was the most common radar technology used in North American air defense. It, or the AN/FPS-3 from which it was descended, was deployed in nearly all permanent continental U.S. sites. Manufactured by Bendix, the AN/FPS-20 could detect objects as high as 65,000 feet and as far away as two hundred miles. However, like most other radar technologies in this time period, the AN/FPS-20 could not detect low-flying objects, could not determine the height of detected objects, and was vulnerable to electronic jamming and other counter-measures.

EQUIPMENT PROFILE   RADAR SET AN/FPS-20A



1. Liquid Electron Tube Cooler HD-230/FPS-20 (coolant radiator)
2. Radar Set Control C-1934/FPS-20A (radar control cabinet [single])
3. Receiver Group OA-890/FPS-20 (receiver cabinet)
4. Power Driven Rotary Compressor HD-246/FPS-20 (air compressor)
5. Receiver Group OA-1077/FPS-20 (antichaff group)
6. Power Supply Group OA-954/GPS (receiver rectifier group)
7. Interconnecting Box J-754/FPS-20 (standby junction box)
8. Power Distribution Panel SB-492/FPS-20A (power switch cabinet [single])
9. Power Supply PP-1409/FPS-20A (HV power supply [single])
10. Radar Modulator MD-268/FPS-20A (single modulator)
11. Power Driven Rotary Pump HD-231/FPS-20 (coolant pump)
12. Radio Frequency Amplifier AM-1348/FPS-20 (power amplifier)
13. Frequency Mixer Stage CV-592/FPS-20 (high level mixer)
14. Radio Frequency Amplifier AM-1402/FPS-20 (intermediate power amplifier)
15. Amplifier-Mixer AM-1347/FPS-20 (buffer-mixer cabinet)
16. Monitor-Oscillator Group OA-955/FPS-20 (RF group)
17. Waveguide system
18. Antenna Pedestal AB-414/FPS-20 (pedestal)
19. Antenna Reflector AT-572/FPS-20 (reflector)
20. Waveguide Horn AT-567/GPS (antenna feed)
21. Electrical Equipment Cabinet CY-2180/FPS-20 (quick fix cabinet)
22. Distribution Box J-855/FPS-20 (quick fix junction box)
23. Radio Frequency Monitor ID-636/GPS (noise figure indicator)
24. Directional Coupler CU-606/GPS (noise coupler)
25. Modulator-Power Supply MD-305/GPS (noise modulator)
26. Remote Noise Indicator

Figure 1. Typical Installation of Radar Set AN/FPS-20A

5

(*Source: radomes.org*)

IX. Space

One cannot account for things in nature without considering their occupation of space, their location of place, and the ways in which relations of things are developed in space.

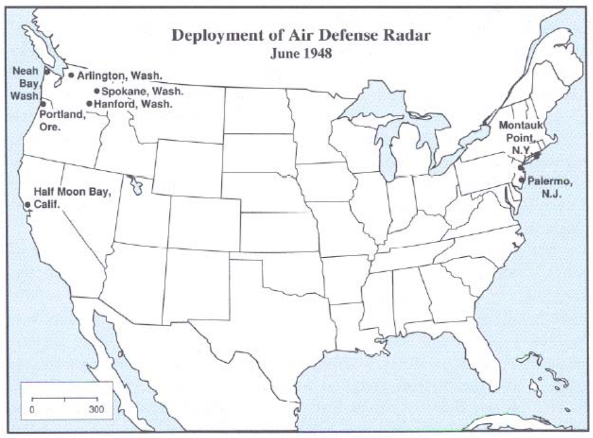
Boundaries

One of the primary differences between the detection problem in the defense of Britain in World War II and that of North America was the topographic scale and its ambiguity. The region to be protected in Britain was circumscribed by the English Channel and the North Sea -- a defensive zone approximately 800 miles in length. The North American threat zone was 4300 miles long running from the Atlantic to the Arctic to the Pacific Ocean. Defensive space shifted from national to hemispheric. More significantly, the total geography in square miles that needed to be covered in North America was more than eighty times larger than all of Great Britain.

Radar Fence

In 1948, the continental U.S. had only eight radar stations in operation and those focused on the northeastern (New York metropolitan area) and northwestern corners of the country (for Seattle's Boeing manufacturing plant and the Hanford atomic facility in the center of the state). Most of these stations operated for limited time periods and had visibility for 100-150 miles.

With the establishment of a separate Air Force, a dispute broke out among the new leadership: should strategic emphasis be put on air defense or on nuclear bombing capability. To review both of these options, the Air Force assembled two planning projects. The air defense plan (called Project Supremacy) proposed to establish four hundred and eleven radar stations and eighteen control centers, to be manned around the clock by 25,000 personnel, and to be fully operational in six years. This proposal was referred to as a "radar fence".



(Source Winkler 1997: 17)

Pine Tree

As a result of the Soviet atomic bomb test at Semipalatinsk at the end of 1949, the United States began a rapid expansion of permanent air defense capabilities across the northern perimeter of the country, including replacing the temporary Radar Fence built only a few months before, as well as filling in zones around the U.S./Canadian border on the Northeastern and Northwestern zones of the continental U.S. As some of these radars (AN/FSQ-20) were north and south of the border between the two countries and were manned by US Air Force and Royal Canadian Air Force teams, the string of radars became known as the "Pinetree Line". In two successive authorizations in 1950, another fifty-one radar stations were put unto the planning board. These radars added another fifty miles to their visibility and another ten minutes of warning, but it became increasingly clear, that none of these radars could "see" low-flying aircraft. And as these radars stations were being installed, the North Korean Army attacked and swept across South Korea, adding a new level of anxiety for strategic planners.

Distant Early Warning (DEW)

The most northern line was the Distant Early Warning (DEW) line which had 102 stations located approximately 200 miles above the Arctic Circle which were usually comprised of a long distance radar (AN/FPS-19), older radars (AN/FSQ-20), a Doppler gap-filler radar (AN/FPS-23) for coverage of low-altitude areas missed by the long-distance radar, a data transmission system to convert "bogey" locations to geophysical coordinates and transmit this data to an air defense center in the continental U.S. Construction on the DEW line began in 1953 and the system went operational in 1957. The DEW line remained operational until the mid-eighties, when it was reorganized with more advanced radar technology-- and it continues to operate today as the North Warning System jointly managed by the U.S. and Canada.

Texas Towers

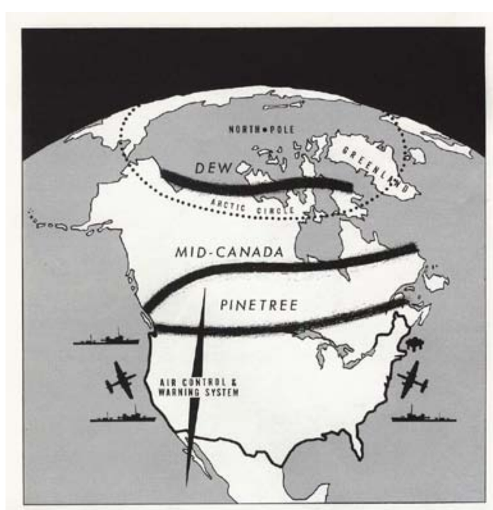
One hundred miles off the coast of Cape Cod, Massachusetts, well into the Atlantic Ocean, the Air Force built three odd looking platforms. Similar to the anti-aircraft derricks the UK used in the English Channel to give early interception capability against the German Luftwaffe, the so-called Texas Towers hosted long range radars to detect enemy aircraft probing U.S. air defense systems. The Towers were in use from 1958 until 1963, when better radar technology replaced the Towers surveillance capabilities.

Picket Ships

Recognizing that the Atlantic and Pacific coastlines remained exposed to enemy flight patterns, the Navy upgraded a small number of World War II-class destroyer escorts with more current radars to begin patrols off of both coasts. A bigger investment was made in converting sixteen World War II Liberty transport ships into a surveillance platform with multiple radars (long-range, short-range, and height finders). Data from these picket ships was transmitted in real time to a land-based receiving station where the data was forwarded to an Air Force command center.

Airborne Surveillance

From 1956 to 1965, the U.S. Navy utilized four squadrons of Lockheed Constellation four-engine turbo-props converted for radar and signals intelligence missions. Flying out of Maryland, Newfoundland, and Midway Island, Lockheed WV-2's would fly roundtrips from the Canadian coast to the Azores (in the Atlantic) and from Midway to the Aleutians (in the Pacific). Like the pickets ships, radar data was transmitted continuously to North American air defense centers.



(Source: Wikimedia)

X. Concepts

If systems are things and are documented by flowcharts and flowcharts are visual representation of concepts, what kind of a thing is a concept?

Information

In the early 1940's, scientists like Warren McCulloch, Norbert Weiner, and Claude Shannon began to discern that information had statistical properties. As McCulloch puts it, "The physicist believes entropy to be somehow in or of physical systems. It may or must increase with time. But it is neither material nor efficient, in fact it is a number, namely the logarithm of the probability of the state. It is therefore, a measure of the disorder of an ensemble -- or collection of systems." (McCulloch 1965b: 73-74). He goes on, "Now Norbert Weiner has proposed that information is orderliness and suggests that we measure it by negative entropy, the logarithm of the reciprocal of the probability of the state...Ideas then are then to be construed as information. Sensation becomes entropic coupling between us and the physical world, and our interchange of ideas, entropic coupling among ourselves." (*ibid*)

Communication

For Shannon (1948) this problem was even more abstract. Information has nothing to do with meaning. Information was the product of a communication process constituted by a message between a transmitter and a receiver over a connecting channel, which is invariably infected with an intervening source of noise. The statistical fidelity of a message is a function of this external noise, but also of entropy internal to the message itself, or what Shannon referred to as "equivocations". Here noise is a function of the conditional probability of a bit of information given the probability of an adjacent bit. To the extent that a message is "miscoded" (perhaps an unintentional program design or the misunderstanding of a receiver), equivocations have the effect of potentially realigning messages and this is an inherent quality of information and information systems.

Cybernetics

In 1940, Norbert Weiner suggested "the design of a lead or prediction apparatus in which, when one member follows the actual track of an airplane, another member anticipates where the airplane is to be after a fixed lapse of time." (Wiener quoted in Masani 1990: 182). Wiener's vision anticipated the American air defense strategy by almost ten years. In 1948, Wiener summarized the work he did during the war and expanded upon its implications with the publication of his book, *Cybernetics*. In Wiener's view, information is not simply noise that is input to a system which generates output. Rather, information is also that which is cycled back to the system as feedback, as correction, as something learned, or as something accommodated. The cybernetic loop is not simply a diagrammatic description of what happens, but is the process itself, the materialization of method.

Speed Limits

During World War II, a German Ju-88 bomber had a maximum speed of 300 mph. Under those conditions, air defense operators had time to read data off of radar receivers, report their analysis to group command which reported it, in turn, to fighter command which would track the incoming vectors of hostile traffic by manual calculations on Plexiglas plotting boards (the so-called Dowding system). Once a "bogey" was identified as suspicious and its course was forecasted, a manual telephone call was made to the closest airbase to scramble a response.

The launching of German V-2 rockets in the fall of 1944, radically altered air defense planners' assumptions about the dromological effects of air defense. With the introduction of jet engines, faster planes capable of covering much wider attack vectors necessitated a different approach. By the early 1950's, the U.S. B-47 turbo-jet had a maximum speed of slightly over 600 mph. Moreover, the increasing devastation that bombers could visit on an opponent meant that the tolerance for not intercepting the enemy was getting very low. The speed of the detection-calculate-plot-intercept loop was quickly exceeding human capabilities. Only a machine, a very large mechanical calculator or computer could process this amount of data consistently and quickly.

XI. Machines

In the same way, if machines are things and computers are machines, then is everything that goes on a computer, from hardware to software, also a thing?

Computers

During World War II, the need to break complex enemy ciphers (Colossus), to automatically calculate artillery trajectories (ENIAC), and to model a flight simulator (Whirlwind) contributed to significant advancements in the theory of computational mechanics. It quickly became clear that each of these engineering marvels had several limitations -- some were analog, none had a modular architecture that allowed innovation piecemeal, most utilized a very slow serial processing flow, none had stored memory, and all of them used mechanical devices to establish logic flow (what today we call programming).

von Neumann Architecture

Early computers (e.g., Mark I, Colossus) were special purpose computers that drove the unique hardware architecture for each machine. Given the singularity of hardware design, it is not surprising that programming was primarily through physical devices such as switches and relays. In 1945, John von Neumann submitted a report outlining his experiences with the EDVAC computer (von Neumann 1945). He proposed that hardware architecture be organized into and built around six discrete categories of capability--input, output, central arithmetic unit, central control unit, memory (internal storage), and external storage. He also argued that memory should uniformly serve the requirements of data and instructions (code). This simplified the design of hardware by permitting discrete divisions of labor on large projects. This approach was a significant influence on both the ADS and SAGE computer and overall system architectures.

Logic

The key to constructing a programmable machine is to embed logic gates in the computer. Logic, such as Boolean AND, OR, or XOR, provided the means by which conditions could be applied to data and calculations. For example, to evaluate the logical condition of AND for the values of X and Y, requires that X and Y both be TRUE. If X retains the value '4' and 'Y' retains the value of '1', then an evaluation would reject this equivalency as FALSE. To implement this mechanically requires that a calculator have a register to store the value of X and another register to store the value of Y, and an accumulator that compares the two values and returns a resultant value, '1' for TRUE or '0' for FALSE. Translating this into electronic devices such as vacuum tubes would utilize, as in the diagram below, two pentode vacuum tubes as logic gates

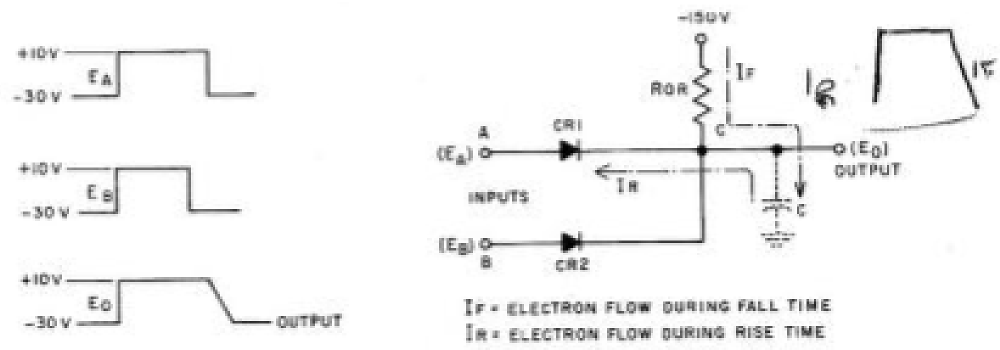


Figure 3—30. Effect of Load Capacitance in OR Circuit

(*Source: IBM (1957) Basic Circuits of the AN/FSQ-7 Combat Direction Central IBM: Kingston NY*)

CPU

The example I just provided for logic gates is what one would expect to find in a central processing unit (CPU). The CPU maintained multiple registers for storing data just before it was used in a calculation, registers for addresses, registers for program instructions, an accumulator (an adding and subtraction machine), and flags for carry and shift operations. In addition, a CPU would recognize a set of instructions such as ‘ca' (clear register A), 'aab' (add register A with register B and store the result in register A), etc. The CPU is responsible for processing all calculations, directing data to be stored in memory or on an external storage device, displayed on a terminal, etc. In addition, the early CPU's also managed many of the functions we expect operating systems to handle today such as memory management.

Fig. 3–15 **UNCLASSIFIED** T.O. 31P2-FSQ7-22 PART 3 CH 4

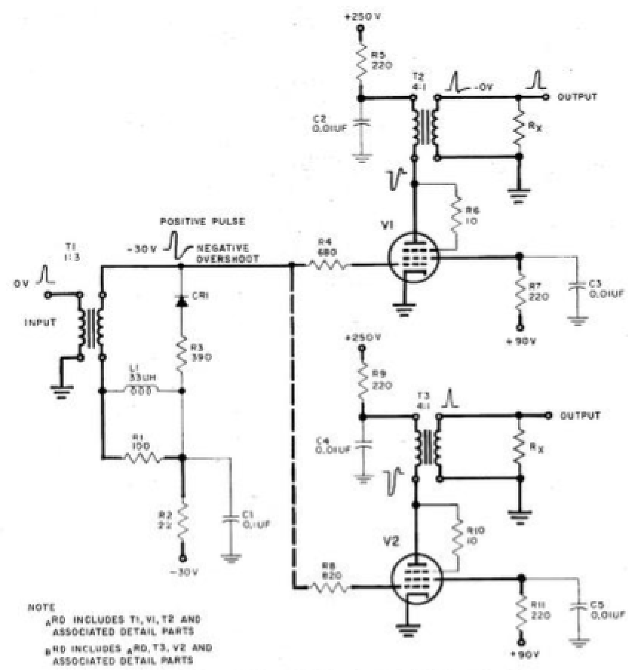


Figure 3–15. Register Driver, Models A and B, Schematic Diagram

TABLE 3–10. REGISTER DRIVERS, MODELS A AND B, FUNCTION OF DETAIL PARTS

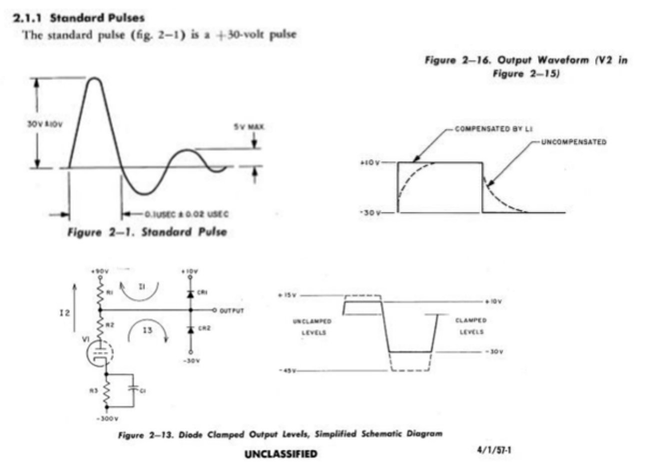
(*Source: IBM (1957) Basic Circuits of the AN/FSQ-7 Combat Direction Central IBM: Kingston NY*)

Analog to Digital

Computers are machines -- they manipulate things (electrons) based on conditions (logic gates). The earliest calculator/computer devices were completely mechanical devices employing levers, gears, crankshafts, armatures, etc. Analog computers, which found substantial application during World War II, work by leveraging electro-mechanical and hydraulic properties to create a continuous mapping of some theoretical behavior. A good example of an analog computer is the Norden bombsight developed in World War II to continuously calculate the optimal trajectory of a bomb given a bomber's altitude and other conditions such as wind strength and direction.

However, analog measurements are not discrete values and are only replicable within a small approximation.

A digital computer uses its discrete encoding of values, usually in binary form, to create representations of values. Because they represent discrete values they are only as accurate as the magnitude of the representation -- that is, sixteen binary digits (bits) is more information than eight bits. This appears when continuous analog data is "sampled" at discrete time intervals and a representation is encoded from that sample. The more samples taken within the same time period, the closer the approximation to the actual data source.



(*Source: IBM (1957) Basic Circuits of the AN/FSQ-7 Combat Direction Central IBM: Kingston NY*)

Whirlwind

In 1943, the Massachusetts Institute of Technology's Servomechanisms Laboratory signed a contract with the U.S. Navy to build a large computer for flight simulation training. The computer was called *Whirlwind* and originally called for an analog-based calculating device. It quickly became obvious that such a design would entail a computer too large, too complex, and perhaps most importantly, too inaccurate to serve the stated needs of the project. Only a digital architecture could give the engineers the performance and accuracy they required. Fortunately for the MIT engineers, one of the earliest digital computers -- the ENIAC at the University of Pennsylvania -- demonstrated that such designs were not only possible, but significantly feasible.

In the meantime, the usefulness of *Whirlwind* was discovered by the *Air Force* for its possible use in air defense. MIT and the Air Force jointly established the Lincoln Laboratory specifically to address the problem of building an air defense system. *Whirlwind* was transferred to this project and became the basis for a new real-time computing environment.

Whirlwind, though, needed to solve a problem that other calculating or computing machines had not had to address -- real-time performance. Earlier machines had run in batch mode -- single jobs that exclusively consumed computing resources without in-process inputs or alterations. A computer for a flight simulator was always running in real-time and affected by alterations in the environment.

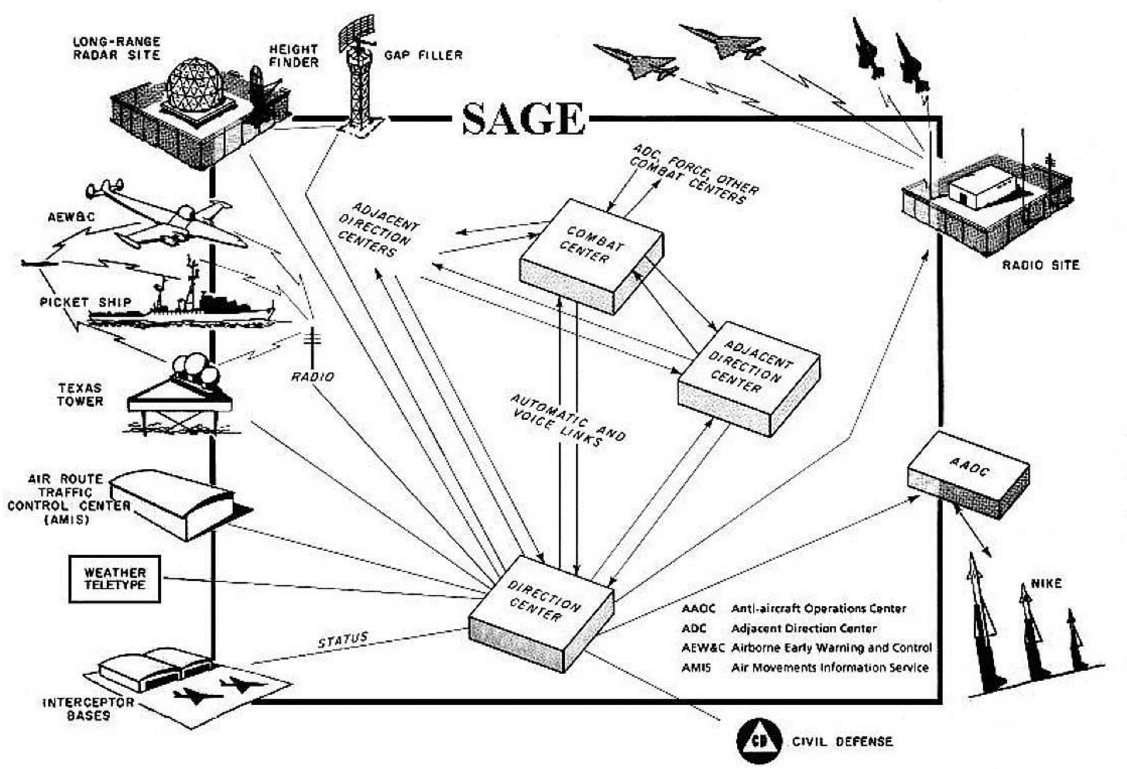
The kind of computer needed to track a thousand planes simultaneously would necessitate processing 260,000 machine instructions every 15 seconds -- a processing capacity that simply did not exist. To achieve that kind of unheard-of performance, the computer would have to process concurrent events through multiple registers and manipulate the data for end-user displays. The design of this computer was broken down into components, building blocks, and registers. The components included vacuum tubes, storage tubes, crystals, transistors, and magnetic cores, tapes, and drums. The building blocks included flip-flop circuits, amplifiers, magnetic gates, gate tubes and generators, and destructive read circuits. The registers including groups of binary numbers, were of different kinds, depending on their function -- adders, counters, decoders, selection switches, circulating registers, and memory systems. (cf. Redmond and Smith 2000: chapter 13, *passim*). Apart from vacuum tubes and amplifiers, much of this technology was to be developed or invented, and once built, integrated into the tens of thousands of other components.

XII. Systems

These things called systems come in all shapes and sizes. Some are organizations, some are flows or hierarchies of relations, and some are complex aggregations of machines that make up other machines.

SAGE

Beginning in 1953, and over the next five years, Project 416-L, more commonly referred to as the Semi-Automatic Ground Environment (SAGE), began in earnest. This entailed the design and manufacture of hardware and software, installation of communications systems, and the building of the physical infrastructure that would house what was projected to be twenty-six air defense control centers (DC). This project intended to link hundreds of ground radars strung across the polar icecap, the middle tier of Canada and along the border between Canada and the United States, as well as radars on ships, aircraft, and a series of offshore towers into a single integrated air defense system of surveillance.[18] The plan also included seven Combat Centers that would synchronize defense responses from fighter aircraft and BOMARC missiles. In the end, SAGE continues to be the most expensive military project ever undertaken.



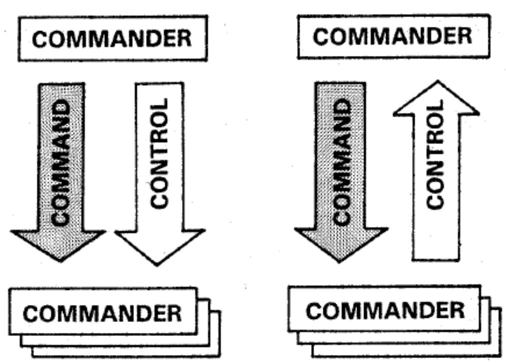
(Source: MITRE)

Command and Control

> Command and control are essential and integral parts of warfighting that require careful planning and execution to be effective. Early twentieth century air and space pioneers were quick to recognize that air warfare requires an intuitive and fast decision cycle. Commanders need to make timely decisions, based upon the best information available to them... [for] dissemination..collaboration...decision-making, synchronization of operations. Commanders also need information to be fed back to them to enable the next decision. (USAF 2007: 1).

[18] By the end of the project, only twenty-two DC's would be built

The premise of the entire SAGE system was to detect airborne traffic, determine whether it was friend or foe, and in the case of the latter, automatically initiate interception and destruction, and update status on threats. These sets of tasks required the integration of hundreds of radar sites, communication lines, computers, ground-control telemetry, and interception weapons, all of which had to assemble, process, calculate, and present data to human beings, who then authorized or blocked the onward course of automated response. All of these operations had be performed in a short burst of elapsed time, with little or no disruption or errors. The architecture of SAGE was orthogonal to existing military doctrine at the time, because it was expected that both command *and* control were the responsibility of the commander. SAGE disrupted that approach by necessitating a closed information loop that constructed detection-response-detection as an iterative loop.



A typical view of command and control—command and control seen as unidirectional.

Command and control viewed as reciprocal influence—command as initiation of action and control as feedback.

(Source: USAF Doctrine Document 6.0)

AN/FSQ-7

Following a series of tests using Whirlwind with radar data from Cape Cod MA and a series of second tests from Hanscom Air Force Base, the decision was made by the Air Force to go ahead and begin building a prototype air defense computer to operate in real-time. IBM was brought into the project (after a review of competitors) to begin designing a production level prototype anticipating the addition of memory and peripheral devices. This version became known as XD-1. As researchers began solving problems (like the addition of real-time core memory) and data communications, the system became more robust and the decision was made to move to full production. This version was assigned the military designation of AN/FSQ-7 ('AN' for Army Navy contract, 'F' for ground-based, and 'S' and 'Q' for special use). The computer worked in thirty-two bits.

When delivered, the AN/FSQ-7 comprised seven major systems: the central computer, the input system, the drum system, the display system, the output system, the power supply and marginal checking system, and the warning light system. These seven sub-systems were spread across seventy banks (or racks) and utilized 58,000 vacuum tubes and 170,000 diodes. Each SAGE site had two AN/FSQ-7's, each one weighing 250 tons, and used a combined three megawatts of power.

(*Source: IBM*)

Parallel Registers

Given that some aspects of these earlier architectures were not going to work, engineers looking more closely at ENIAC, realized crucial design problems had to be overcome. ENIAC processed information in bits serially so that sixteen "reads" would be necessary in order to construct a meaningful machine address and instruction. Sixteen "reads" multiplied by millions of computing cycles would make *Whirlwind* far too slow. As a result *Whirlwind* was built with a parallel bus architecture, sixteen bits of information flowed in parallel every machine clock cycle. At the accumulator (the component that adds and subtracts), sixteen registers were ready to take the data. Today, a parallel bus architecture is used in nearly every computer.

Core Memory

The amount of data and the requisite speed of access to the data would require a new approach to internal memory storage. The most significant drawback of the early versions of the digital *Whirlwind* computer was its reliance on vacuum tubes for core memory, which significantly reduced its reliability.

While thinking about this problem Jay Forrester, ADS project director at MIT, noticed an advertisement for a product called Deltamax -- a spooled ferrite ribbon with magnetic properties that was shaped into toroids. What Forrester suspected, but which remained to be proven, was that these toroids could be threaded with very fine conductive wire into a mesh creating an x-y grid. Treating the (x, y) intersection as an addressable bit, the toroid could be turned on or off indicating a value of 1 or 0. In addition, by adding a corrective line that wove back and forth through the toroids, reads of the same intersections could be accomplished. This "inhibition" line took advantage of the property of hysteresis in the magnetic toroid.

Hysteresis occurs where there is latency of an output depending on the current state of a system. So, for example, if the current value of a toroid is 0, a read of the toroid will keep the value of 0 and the latency will be nil. But where a toroid is 1, the read (recording a value of 1) will cause the toroid to flip to 0. The hysteresis of the toroid moving back through the inhibition line, however will revert the value to 1. (Redmond and Smith 2000). This invention by Forrester, which took a couple of years to perfect, gave computers very fast read/write access to internal memory. This technology came to be known as core storage or core memory and was used in computers until semiconductors were developed.

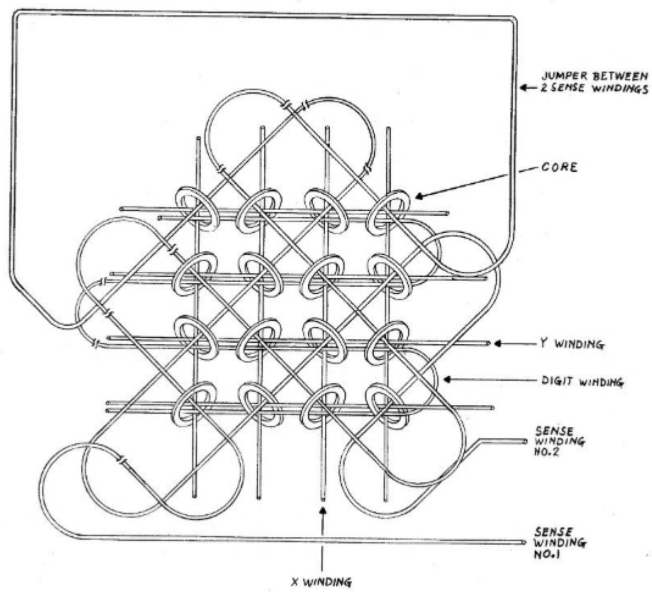


Figure 6–5. Portion of Memory Plane

(Source: IBM Theory of Operation AN/FSQ-7 (XD1, XD2) Central Computer System (Preliminary) 1955)

Vacuum Tubes Redux

One of the earliest ways in which digital values were manipulated was with vacuum tubes. Though there are a great many types of such devices, the principle remains essentially the same. A charge is emitted through a cathode, usually a tungsten filament that, as it gets hotter, emits electrons that are then received by an anode. This variant is known as a diode. In the case of the *Whirlwind* computer (and the operational version made by IBM), the vacuum tube was a 7AK7. This tube was a pentode which added a grid screen between the cathode and the anode and when electrically charged could serve as a blocking gate between the cathode and the anode, corresponding to the binary value of 0. If the grid was not charged, the flow would pass to the anode and represent the binary value of 1. Whirlwind used more than 5,000 vacuum tubes and the successor AN/FSQ-7 (which was deployed in a tandem configuration) used nearly 50,000 tubes.

Fault-tolerance

The demands of a real-time system also meant that systems could not tolerate failures. As part of its computer design considerations, IBM suggested that two computers be built into every AADC center working in tandem with one system shadowing the primary computer. If one system failed or needed to be placed in maintenance mode, the second system could switch from standby to active mode. This design was the origin of fault-tolerance, a design feature which became crucial in 1970's information architecture as computers became more integrated into real-time processes.

Reliability

One of the key objectives of the SAGE project, beyond accuracy was reliability. The engineers that designed the AN/FSQ-7, and its many peripherals, knew that no matter how well designed a product was, it would eventually fail. They key was to build sufficient parallel components (tandem computers), easy to repair (plug components), and anticipatory assessments of failure (measuring weakness of components). Fault-tolerance was the key to breaching system failure. Designing the entire AN/FSQ-7 hardware architecture to be easily repaired, required breaking the system into groups of related components (e.g., a group of vacuum tubes or a board of diodes) so that a failed component could be removed in a pull-out/plug-in module (see diagram below). The third form of reliability came from research observations that noticed that when power was lowered to a certain level, vacuum tubes that were about to fail would indeed fail. This became a crucial part of routine maintenance and was built-in to the operation of the AN/FSQ-7. A graph from the original research note is shown below.

Overall, a SAGE site was down three hours a year with a 99.7% reliability. When most computers at the time could, on the average, only sustain continuous operation for a couple of hours, the instrumentation, design, and architecture of SAGE were phenomenally successful.

PART 2

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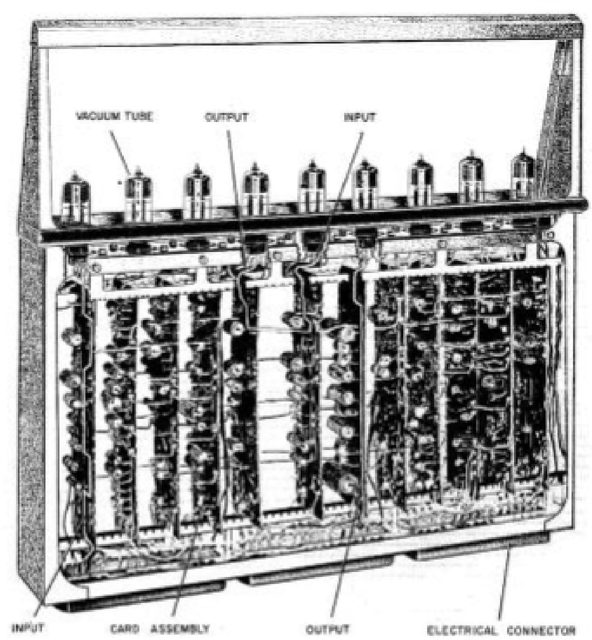
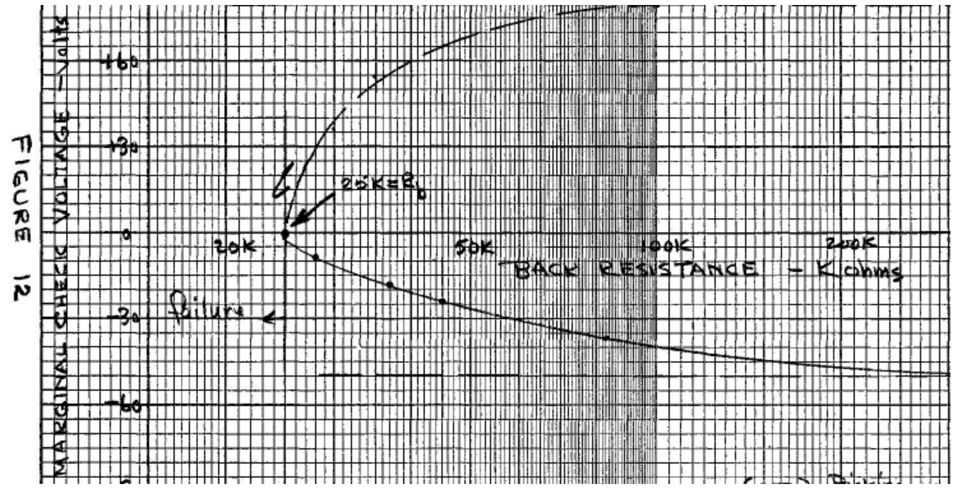


Figure 2–6. Typical Pluggable Unit

(Source: IBM (1957) Basic Circuits of the AN/FSQ-7 Combat Direction Central IBM: Kingston NY)



(Source: Hal Boyd, 1953, Memo to Group 62 and Group 63 Engineers: High Speed (5965) Flip-Flop, MIT Digital Computer Laboratory February 24, 1953)

Encoding

Digital computers operate through electric pulses. Pulses by themselves do not represent anything nor do they perform any work. However, when pulses are organized into patterns, then these patterns can be used to represent or correspond to other meaningful signs. Samuel Morse invented a technique like this for his new telegraph system which sent pulses serially over wires. Not long afterwards, Émile Baudot developed a more sophisticated system for teleprinters, merging an encoding system with a paper punch tape (which he borrowed from Jacquard loom cards). Baudot's code was still the dominant coding scheme (through a series of improvements by William Murray and Western Union) at the time the SAGE system was being modelled. However, the coding scheme was not ideal for devices not reliant on teletypewriters and teleprinters. Bell Labs introduced a new scheme for its modem devices which after some adjustments by standards committees came to be known as the American Standard Code for Information Interchange (ASCII)--which is the most widely used computer encoding scheme in use. IBM, however, was slow to participate in the standardization effort and its computers (after the AN/FSQ-7) wound up using its own proprietary coding system (EBCDIC).

What is significant about coding systems is that they represent the boundary between the real world (representation) and the virtual world (codes). As such the presence of encoding lies at the margin of materiality before it's disappears into the ether. The fact the ASCII coding paradigm was slipped into the SAGE system at the boundary between the computer and the radars (sensors) is a significant marker of the dematerialization of what was detected and its representation in the man-machine interface (which is a simulation of what was detected) -- between the real and the virtual.

Data

The decision to use a digital computer had other consequences besides the ways in which data was represented. The crucial source data from radar signals was analog. This data not only indicated the azimuth of a target object, but also calculated the speed that the object was moving from Doppler readings. Successive readings added crucial data of an object's trajectory. The coordination of this data at the point of collection (the radar station) was merged into a single data event as digital coordinates and identifiers. However, to be forwarded to a SAGE Direction Center, where the computers were required transmission over standard telephone lines which utilized analog signals. This had never been done before, so a new device called a modem was developed that multiplexed and de-multiplexed signals.

Commercial air flights need to be logged so data from the civilian agency responsible for private flight plans sent data to the ADS centers. Similarly, real-time flight plans from military operations needed to be integrated into the database based on time and location. Finally, weather data from the National Weather Service was crucial in filtering out noise in radar data that might be attributed to thunderstorms or other inclement conditions. At the end of the day, all of this data needed to be synchronized and formatted into computer-determined fixed data lengths. All of this was stored in real time registers and external magnetic drum storage until new data pushed the oldest data off the online system.

Data Structure

SAGE was built as a CPU surrounded by peripherals. Each peripheral had its own representations of the world with which it was connected. Thus, the data structures of each of these representations were unique. But within the computer (we would speak of a 'bus' today), the data structures were organized into thirty-two bit words. These words were comprised of data address, instruction, and flags. In addition, data that came into an AN/FSQ-7 would have been structured in a seven-bit ASCII code (plus a one bit parity flag). That meant that external data had to be converted into the data structures that each data storage mechanism employed. Below is the data structure for long-range radar information when it was written to an external storage drum.

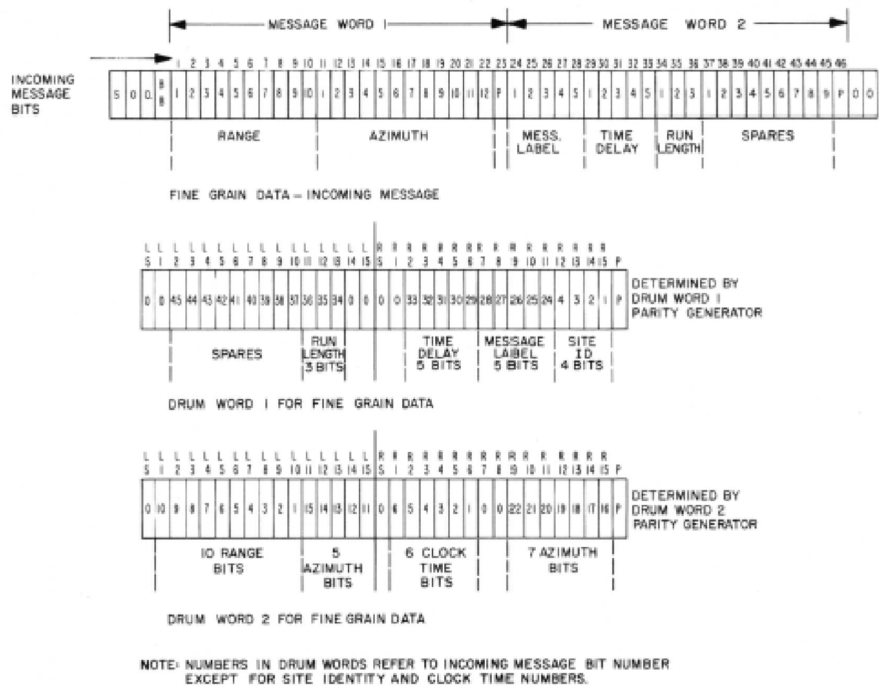


Figure 2—3. Message and Drum Word Layout, Fine Grain Data Message

(*Source: IBM Theory of Operation of Drum System, 1958 IBM: Kingston NY*)

Data Integration

Given all the different sources, it was not expected that the data would all arrive synchronously and neatly. John von Neumann was consulted about how to approach the problem. Recognizing that up to seventy radars may be tracking over one-thousand targets, data needed to be cleaned from errors, sorted by date and time order and organized by location, and duplicate data from different radars tracking the same object needed to be synchronized -- every fifteen seconds as the radar sweep would update all of the previous data.

In addition to directing sensing threats, an accurate ADS also needs to know the location and identity of friendly aircraft, such as commercial airliners and allied military flights, weather patterns that might create anomalies in data sensing, and the availability of forces to respond to inbound threats. All of this data needs to be fed into the computer and processed through algorithms that can "flatten" and synchronize the disparate data into common coordinates of time and space.

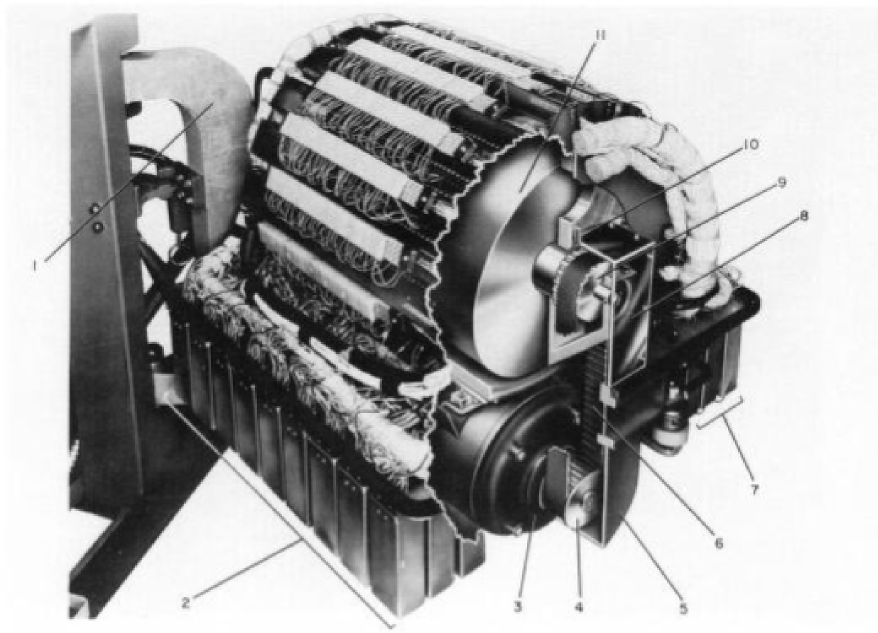
Offline-Storage

> The purpose of the Drum System is to store tactical data being transferred from the Input System to the Central Computer, or from the Central Computer to the Output or Display Systems. In addition, the Drum System provides auxiliary memory space for tabular data and program information from the Central Computer. In the process of data transfers, the Drum System acts as a time buffer stage which allows the system of destination to receive the data at its own pace. For example, tactical data from the Input System arrives in large quantities and at random times. The drums store this data in an orderly manner and have it available for rapid transfer to the Central Computer....The Drum System being a time buffer, storage device performs no computations, i.e., data enters and leaves the system without alteration. (IBM 1958: 15)

Each AN/FSQ-7 had six main drums for data and six auxiliary drums for program and other data. Each drum stored a maximum of one megabyte of data and weighed 450 pounds. The drum system was largely mechanical. The drum was rotated by a pulley belt at one end. At the other end an optical reader managed timing as the device "read" fine grained notches that circulated with the rotation of the drum. Backup of drums was offloaded to a new device developed by IBM called a magnetic tape backup system (the IBM 728 Tape Drive).

PART 1
CH 2

3-42-0 SAGE Fig. 1–5



1 Drum Cradle
2 CD Field Diode Switch Cans
3 Drum Motor
4 Drum Motor Pulley
5 Drum Motor Pulley Guard
6 Drum Belt
7 OD Field Diode Switch Cans
8 Transparent Drum Rotor Pulley Guard
9 Drum Rotor Pulley
10 Static Grounding Brush, Sectional View
11 Drum Rotor

Figure 1–5. Magnetic Drum Assembly, Pulley End

(Source: IBM Theory of Operation of Drum System, 1958 IBM: Kingston NY)

Display Devices

The vision that underlay all of the aspirations behind the SAGE system was the integration of the intuitive intentionality of human beings and the relentless and inerrant machine. That vision, however, could never be achieved unless the machine was capable of interactive communications in a way that human beings could easily absorb all of the data a computer could generate-- specifically visually.

Ever since the cathode ray tube had been invented at the end of the 19th century, there had been multiple efforts at harnessing its technology for representing information more commensurate with the way human beings processed information.

Oscilloscopes were widely used in engineering applications, but their application corresponded more to analog information and not the discrete representations with which computers operated. Television demonstrated that visual images could be re-presented, but again for analog data. What was required was a device capable of display alphanumeric characters along with the generated sweep indicators of the radar signals. When a user selectively focused on a specific target of interest, the display must be capable of discarding the remaining data. Convair Corporation developed a novel approach which they called the Charactron. The vacuum tube was comprised of a cathode ray gun, a phosphorous screen, and an alphanumeric mask which filtered the cathode ray as it illuminated the phosphorous screen. The SAGE development team assembled this display device which they termed the OA-1008 Situation Display with a keyboard which gave users the ability to directly enter alphanumeric data into the display and the computer.

Light-guns

After detection, the most important function of an ADS is tracking. The radar-computer interface is very good at identifying and displaying individual objects. In the mid-1950's and even today, the machine requires human input to identify the relative significance of a particular detected object. Given limited capacity, computing resources needed to be focused on objects of primary importance. This challenge proved to be an important harbinger of the problems of man-machine interfaces.

The initial consideration of the engineers was to use a joy stick-type device by which an observer could mechanically toggle a stick in 360 degrees to move a circle of light on the display screen. "The joy stick consists of a mechanical coordinate resolver which actuates switches. There are three switches for each of the four motions of direction (up, down, right left), and this provides three spot speeds in each direction or any combination. The increment switches operate relays which control crystal gates in one of the flip flop registers of (the computer)." (Quoted in Redmond and Smith 2000: n. 7: 459). However, given the reliance on electro-mechanical devices, this process proved to be too slow in practice.

The next alternative the engineers considered was a so-called "light gun", which looked like a futuristic Buck Rogers ray gun. "The light gun contained a photoelectric device which is placed over the desired spot on a display scope. The next intensification of the selected spot produces a pulse in the light gun, and this pulse is fed into the computer to select the proper subprogram." (Redmond and Smith 2000: 81-2)

(Source: IBM)

Multi-processing

One of the more important features of the AN/FSQ-7 was its ability to manage computational tasks simultaneously. It accomplished this with multiple memory partitions, one for data and one for instructions. By switching back and forth, for example, while the first task was writing to a storage drum, task 2 could utilize the CPU. This model became to the model for timesharing computer systems.

XIII. Connections

Systems are things and their relations including their connections, flows, directions, networks and organization.

Networks

The plan was to link dozens of radars in a single sector to what was called a Direction Center of which there were twenty-two around the U.S. These Direction Centers had the responsibility for analyzing all of the data in real-time, and automatically forwarding the most crucial threat data to a Combat Center of which there were nine. Combat Centers, in turn, were connected to the North American Air Defense Center (NORAD) in Colorado. In addition, Direction, Combat, and NORAD centers were connected to Air Force bases around the country, which hosted the fighter interceptors and to Army bases, which hosted air defense missiles. All of this was done by building telephone lines across the North American continent connecting all of the centers. For radar stations in the far north, the project initiated the first experiments in point-to-point microwave communication.

Coordinating signals from such disparate locales would require telecommunications capabilities that didn't exist at the time. More importantly, the volume of potential signals and the complexity of tracking inbound threats in real-time was not a problem reliably solved in human-time. The use of digital computers meant that the analog signals from radars would have to be converted to digital encoding. Signals would have to be made interchangeable at key points in the distribution of data. More importantly, signals sent through Public Switched Telephone Networks (PSTN) are often disturbed by noise caused by static electricity, lightning, and faulty connections. Thus, a mechanism for self-correcting error needed to be added.

Modems

The first solution, at least where existing leased-line telephone systems were available, was to use these lines to connect computers, peripherals, and sensors. Bell Laboratories, a division of the American Telephone and Telegraph Co. (ATT) manufactured a device that could convert analog and digital signals back and forth, a process called modulation and demodulation. The device was called a MoDem and became commercially available in 1958. It transmitted data serially, one bit at a time at a rate of 110 bytes per second. The encoding scheme used on the BELL 101 was the first use of what would become the American Standard Code for Information Interchange (ASCII) now used on nearly all computers, except IBM mainframe computers.

Microwave

For locations not within reach of a PSTN connection, Western Electric, the manufacturing arm of ATT, created a microwave communications network starting with the first DEW radar stations in Alaska. Called the WHITE Alaska Integrated Communications and Electronics (or WHITE ALICE), the microwave system leveraged the behavior of the troposphere to bounce signals over the horizon. Eighty stations were eventually connected with each station using two antennae to communicate along different tropospheric paths in case one path had degraded weather conditions. In addition, each antenna transmitted in multiplex, so a single channel could carry multiple signal streams by taking advantage of dead spaces in any one stream. (Johnson 2008: 16).

XIV. Perturbations

No connection or flow is evenly distributed. It is interrupted by noise, other signals, or logic. These create perturbations. Some are intentional and some are random.

Software

The word "software" is notoriously ambiguous in terms of what it refers to, and its wide usage can often connote an "environment", or collection of things, processes, and practices, rather than a specific object. For example, it is usually inclusive of the computer machine code, the application language that was used to generate that machine code, the generator itself, which translates the application code into machine code, the editor that is used to write the application code, or the operating software that allows the machine code to use a particular piece of computer hardware. Software also refers to the "language" that is used to construct programs like ALGOL, PL/I, C++, or

Java, each of which has different syntax, flows, and logical constructs. There are also the memorandums and flow chart that were used to design the application code, the test scripts used by engineers to validate the logic and the flow of an application, and the documentation that instructed end-users in the operations of the application. Then there is another type of software that some refer to as user interfaces, including visual display forms, pointing devices, user program flow, output devices like printers, audio speakers, or other hardware devices. There are also cases where application data is part of a software environment, as in simulations.

While software today is generally considered a domain distinct from hardware, this has not always been the case. Early mechanical systems were "programmed" by setting hardware pins or switches and the logic of what a computer could do was largely fixed by the mechanical structures of the machine. Electro-mechanical, like the ENIAC, had universal stored memory independent of any pre-considerations of the hardware, but the flow of the logic that was encoded in that stored memory was determined by switches, levels, and cable connections set by "programmers" or "coders" which had to be talented in both program logic and mechanics.

Digital computers work with "words" of binary digits (e.g., 01101110). In this mode, software was comprised of instructions to the machine ("add"), a reference to a location in memory as to the first and second values to be added, and a storage location to put the result. All of this had to be written in binary machine code. Given that the SAGE system was estimated to require over one million lines of code, this was no small undertaking. In 1958, because of the burden of training programmers, maintaining code, and keeping the projects within scope, a machine translator was developed that took a more human readable "code" (A for Add) that programmers could use to write an application and translate this code into a machine binary. The first such language for military programs like SAGE was ironically called JOVIAL.

Programmers

What distinguished the SAGE computer system from earlier systems was that program logic was abstracted from the hardware and required an entirely new skill set that didn't exist when the SAGE computer was built: programmers. To meet this requirement, the first software company had to be established. Initially, it was a division of the RAND Corporation (an Air Force sponsored organization focused on consulting on man-machine interfaces and organizational architecture). As the systems division expanded, it was spun off as the System Development Corporation (SDC) and eventually recruited, trained, and managed thousands of technicians that became known as "programmers". In 1956, SDC employed seven hundred programmers alone, which represented sixty percent of all the programmers in the U.S. (Ensmenger 2010: 60). Two years later, SDC had two thousand programmers. (Baum 1981: 53)

Operations Research and Systems Modeling

SAGE was not simply a technological behemoth -- it was a social one was well. The logistical challenges of World War II, from managing production to distribution to coordination, had inspired the development of a new field called "operations research" (OR). (cf. Rau 2000). OR was particularly successful at managing problems of scheduling and network connections where the biggest challenge was synchronization. SAGE was a challenge of a different magnitude -- the uncertainties in schedules were only the least of the project's problems. Most of the technologies required to successfully implement air defense were unknown or untested for the kinds of applications to which they were going to be utilized. This introduced problems of integration, validation, and quality assurance which could only be addressed by a new discipline, which came to be known as "systems engineering" (SE). (Cf. Schlager 1956)

Every computer was responsible for integrating and synchronizing multiple radar images. Multiple radars were likely to pick up reflected signals from the same plane as it moved through space resulting in a single image being responsible for different azimuth calculations, distance, and heights. The computer had to integrate these signals into a single coordinated image, an interpretation or simulacrum of the original data. This synchronization had to occur in near real-time, as the next radar sweep in fifteen seconds would generate a whole new set of data points.

Tying these technologies together into a seamless information system was software. But, in 1956, there were only two hundred programmers in the world, and the SAGE system would eventually require more than one million instructions. Single-handedly, the SAGE system created the software industry -- first with the establishment of the world' first software company RAND Corporations, System Development Corporation. (Baum 1981). Second, as Everett Pugh points out, "although SAGE provided less than4 percent of IBM's total U.S. Revenue from 1952 through 1955, it contributed almost 80 percent of the company's revenue from stored-program computer systems." (Pugh 1995: 219). Between 1957 and 1958, "IBM employed over seven thousand people to manufacture, install, service and improve the SAGE systems." (*ibid*). And from what it learned in building SAGE, IBM programmers went on in 1962 to build the first real-time, online airline reservations system for American Airlines (SABRE).

SAGE is a classic lesson in surveillance technology in terms of the entanglement of objects, events, processes, data, actions, and relations. In many ways, it is the prototype for nearly all forms of surveillance in the last half century and as will become clear shortly, is the foundation for nearly all the innovations we have seen in information technology in the same period. The methods and desires of those implementing a mass surveillance program were completely aligned with the interests and desires of the technologists charged with building out the SAGE program.

Simulation

Simulation proved to be an extraordinary part of daily SAGE operations and has become essential to modern computer-based systems for operations validation, technical testing and quality control, training, and scenario planning. Harold Sackman, in his study of SAGE, observes that "simulation is the man with a thousand faces. Simulation is analogy and the human capacity for analogy is unlimited." (Sackman 1967: 301). From the very beginning, RAND and SDC engineers and psychologists utilized simulation to test use cases of how air defense should work. Lincoln Labs used simulation to verify components and installed software. SDC field engineers, working with trainers from Wright-Patterson Air Force Base, used simulation to train new SAGE operators. The Air Force used simulation drills to verify human readiness and technical worthiness.

But, a closer examination of the SAGE architecture reveals that the system itself was a simulation. When direction control operators looked at their displays, the blips they saw were not direct feeds from radars, but computed plots of these feeds coordinated with data feeds from other commercial and government sources such as weather reports. The use of a light gun to track a "bogey" was attaching to a simulated tracking pattern, delayed by the time it took for the signal to be received by the radar, translated into plot coordinates, transmitted to a SAGE computer, merged with other data sources, and then plotted on a display screen.

XV. Ontologies

Given all of these kinds of things, systems, flows, and processes, what is their ontology? What can we say about the ways they exist in the world?

Space and Time

For cosmologists, space and time are integrated into a single continuum. In a similar way, SAGE is entangled in space and time and is designed to master both. On the one hand, SAGE maintains a repetitious sweep of space, at any one moment independent of time. On the other hand, each successive sweep marks the difference between present and past. The experience of watching the radar screen seems to only confirm two distinct experiences -- one of space and one of time. But long before the SAGE operator perceives that difference-- measured in milliseconds -- the dimensions of the space-time continuum of SAGE are traversed in a virtual world of encoded information.

The presentation of this information is divisible and measured, discrete moments mapped out in vectors. But the source of this presentation is a continuous stream of events that continue to flow through the multiple channels of the SAGE computer. It is only when those streams are framed and blocked into temporal rhythms, that the succession of these frames, like the successive frames of a movie, present the illusion of scalars -- in the ways that we humans can make meaningful interpretations.

The distinction between the real and the symbolic in the SAGE environment has to do with the way SAGE must mediate the real world of information events and the symbolic world of representation. The realization of the intersection between the two is a virtual world. Time, for example, is a continuous stream which is inherently indivisible. The symbolic world of time is sequential, marked by past, present, and future or is synchronous -- the presence of one event confirms the cognitive perception of another -- its absence. In the virtual world, these distinctions are marked out as differences that simulate the sequential and the synchronous, even when the real world has no such distinction. The key to this irreconcilable difference can be traced to events.

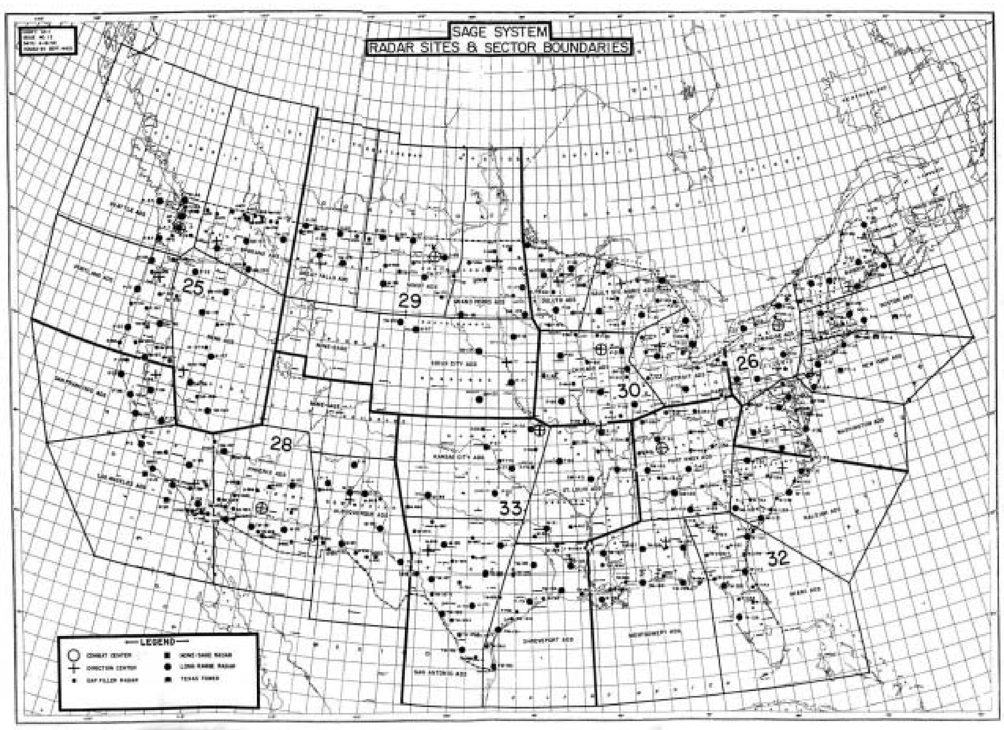
Events

SAGE is, if it is anything holistic, a system of flickering events. From its sensors, which pulse hundreds of times a second, to its telephone network which pulses in waves of amplitudes and frequencies, to the AN/FSQ-7 whose clock pulses regularly synchronize another set of events, which are recorded on Drums. CRT displays, a hundred or more flicker and pulsate synchronously and asynchronously simultaneously.

The real, the symbolic, and the virtual all flicker past and in and around each other. SAGE only exists for events that perturb, irritate, coalesce and disperse.

Flow

SAGE events assemble into sequences through channels. These sequential assemblages constitute a persistent presence which is documented in SAGE as an information (or data) flow. On the one hand, the system is its assemblages of components. On the other hand, the system is its assemblages of flows. Whereas, we gravitate towards reading SAGE as spatially territorial (see map below), an inverted interpretation can read SAGE as territorial flows -- not something divisible and measurable, but something continuous and sensuous (see chart below).



(*Source: U.S. Air Force*)

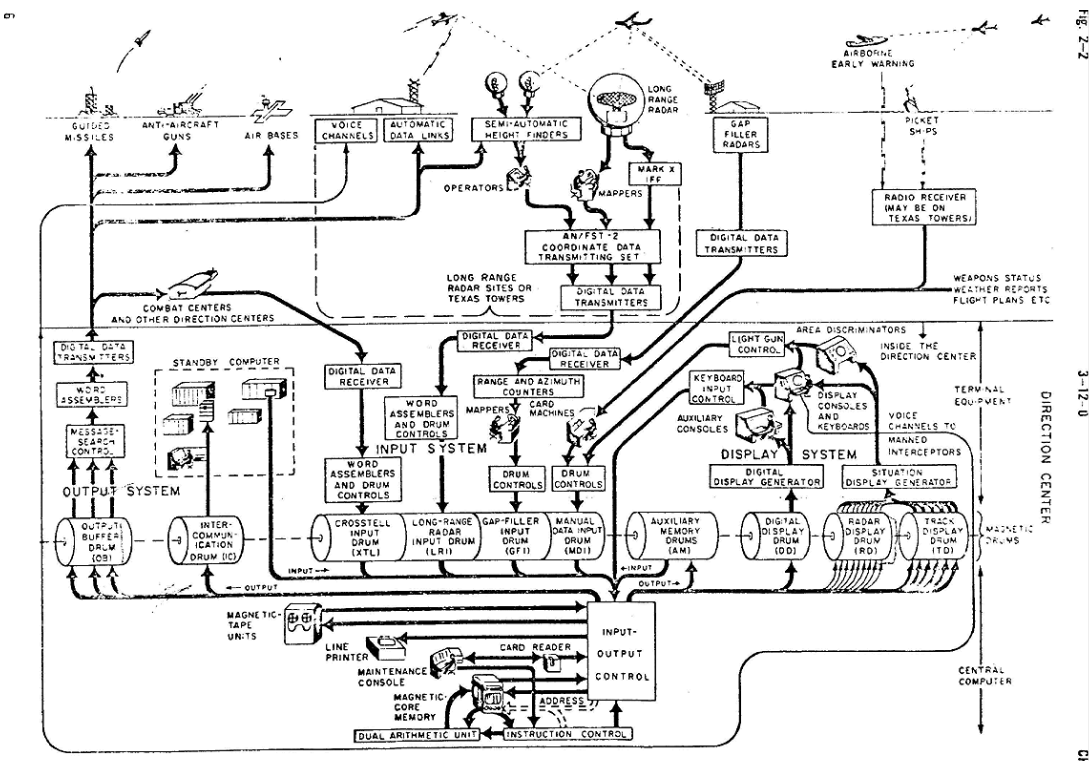


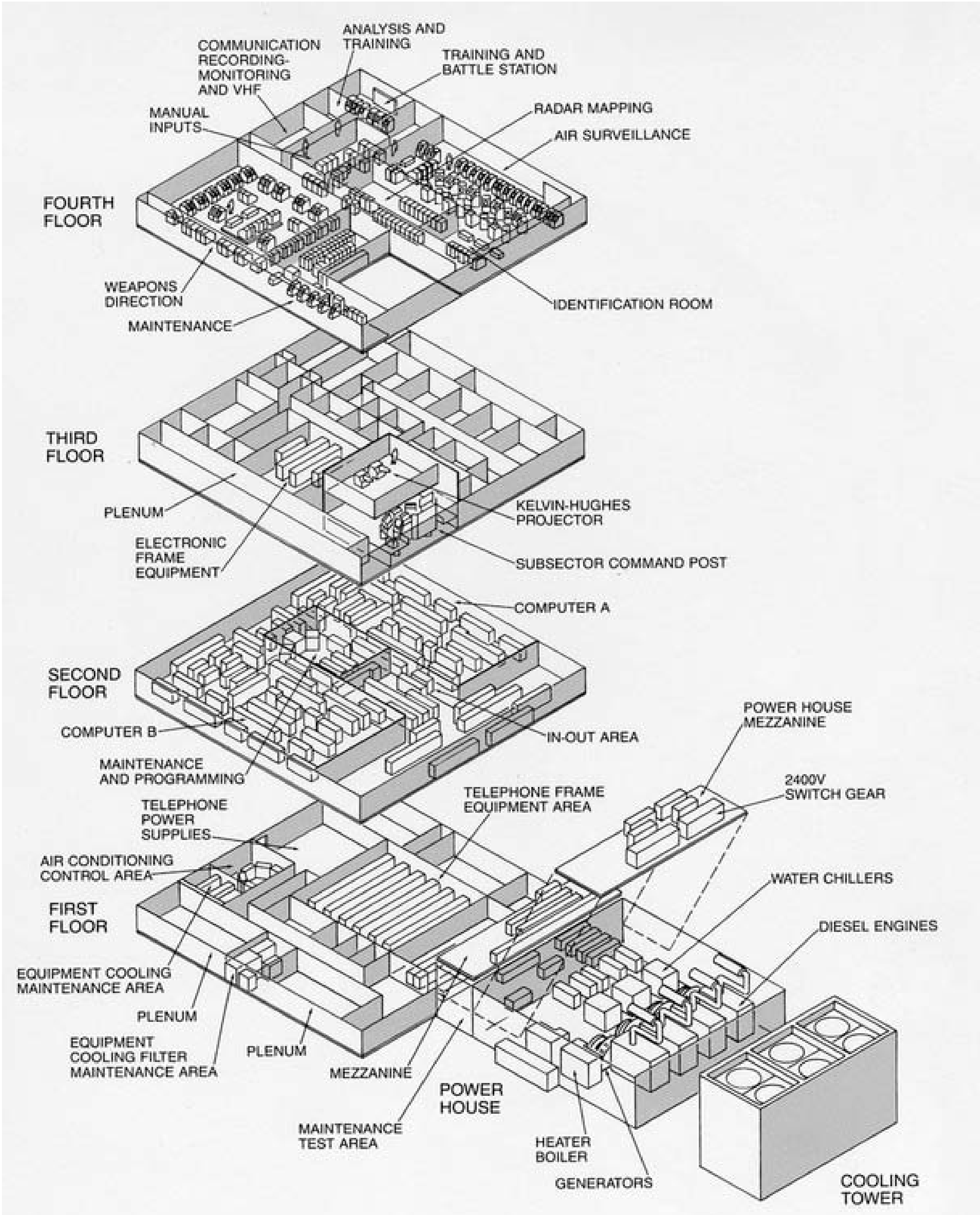
Figure 2—2. Information Flow in the Sector

XVI. Materialities

Lest we forget, these things all have a materiality -- not necessarily corporeal -- but ones rooted in matter, and thus in reality.

Blockhouses

All of this technical capacity and personnel were housed in a massive, windowless, four story structure, one-hundred-fifty feet square. An adjacent one story structure housed a SAGE Direction Center's own power generators and a separate structure held the cooling towers necessary for keeping the AN/FSQ-7 computers at an even temperature. Twenty-three of these blockhouse structures along with housing and administrative facilities were built. In addition, eight Combat Centers (using only three floors) were distributed around the U.S. The walls of each building were made of reinforced concrete that was poured six feet thick. (Despite the magnitude of this construction, the walls could only withstand pressure of 5 psi, or, substantially less than the blast pressure of a nuclear bomb targeting a facility.) In addition, a 40,000 sq. ft. basement served as a bomb shelter. In all, the floor capacity of a Direction Center, including auxiliary power and cooling plants was 150,000 sq. ft. to serve 860 Air Force personnel and 150 civilian support technicians. The duplex computer system took up the entire second floor. Two eight ton elevators provided access to each floor. (USAF 1992; Edwards 1996).



(Source: MITRE)

Lighting

Experience from World War II had shown that radar operators could only work at a radar display for a couple of hours before monotony and exhaustion set in. The designers of the SAGE blockhouse environment were concerned about this problem, as well as the fact that the amount of information to be displayed on a SAGE display was substantially more than a corresponding display just ten years earlier. Researchers focused on this ergonomic problem and found that a combination of "blue" lighting, intentional avoidance of glare and reflection, and improved contrast in display events positively impacted the ability of air defense technicians to read displays for longer periods of time.[19]

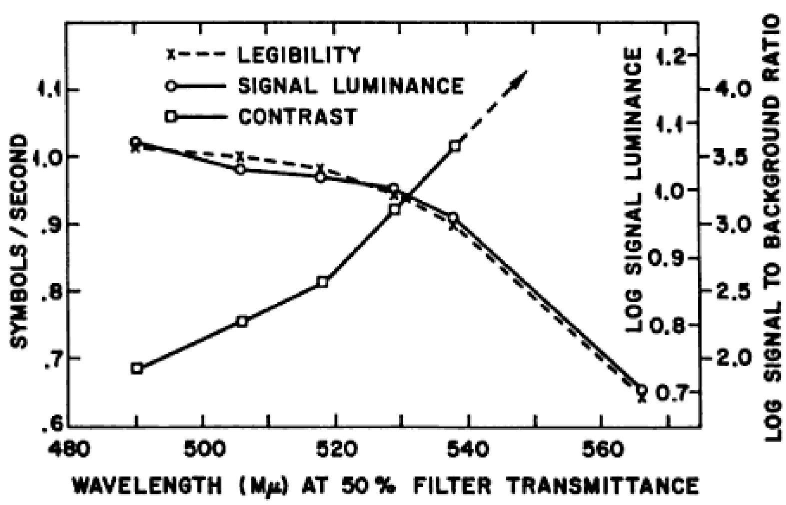


Fig. 1. Effect of trading signal luminance for contrast on the legibility of a SAGE Charactron display.

(Source: R.T. Mitchell (1958) in Robert Brown (1958))

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[19] For a full color reproduction of the effect of blue lighting, see "Pushbutton Defense for Air War" in LIFE Magazine February 11 1957.

Cigarettes

Every SAGE console came with its own built-in ashtray and electric cigarette lighter so that technicians would not have to leave their station in order to enjoy a cigarette break.

Documentation

Because SAGE was the first distributed system to be used by thousands of individuals and maintained by tens of thousands more, nearly all components of the system came with documentation: installation and training manuals, operation guides, detailed testing and maintenance texts, as well as functional graphs and system maps.

Institutions

A project the scale of the SAGE system was a massive endeavor that required the inspiration, knowledge, experience, and skills of thousands of individuals. At MIT alone, resources were drawn from the physics, electrical engineering, aeronautics, mathematics, and psychology departments as well as from the teams of the Servomechanisms and Radiation Laboratories. After the project concluded, MIT insisted that the air defense project be spun off into a separate research laboratory to be managed by the Air Force. This distinct institution became known as the Lincoln

Laboratory based at Hanscom Air Force Base in the Boston suburbs. Here engineers successfully built a prototype that linked radars, simulated targets, telephone networks, and a primitive digital computer. (Redmond and Smith 2000). In 1953, the experiment was expanded to Cape Cod with long-range radars based in Maine and on Long Island NY.

The Air Force also drew upon its own resources at the Cambridge Research Laboratory (focusing on interception problems), Rome Development Center (for radar communications), and Wright-Patterson Air Force Base (for psychological research). The Office of Naval Research, which had funded the original *Whirlwind* project and the Army Ballistics Research Laboratory in Maryland, also contributed resources for problems related to accuracy.

Once the project was officially launched, private industry was brought in to manage project workflows, contracting, manufacturing, installation, field testing, and maintenance: Bell Laboratories, Western Electric, Burroughs, Raytheon. Perhaps most significant was the selection of IBM to develop, manufacture, and support the AN/FSQ-7 computers. For IBM this assignment proved to be an inflection point in its leadership of the emerging computer industry. Crucially, the engineering tasks given to IBM for building a radically new memory architecture proved crucial in distinguishing IBM systems from many of its competitors. (Ceruzzi 2003: 53). As IBM's role in SAGE began to phase out, IBM transferred its engineering and system management resources from SAGE to building the first on-line travel reservation system -- SABRE -- which is still being utilized today.

But perhaps most peculiar were the set of non-profit institutions that emerged from the unique demands of the SAGE project, which today we refer to as "think tanks". The RAND Corporation had already been established during World War II, itself a spinoff of Douglas Aircraft Corporation and specialized contracts with the Army Air Corps. But as SAGE ramped up and the demands for software development became crucial, RAND Corporation itself spawned the first software development company in the world called System Development Corporation (SDC). This entity, like RAND, was based in Santa Monica, California and developed nearly all of the software used in the AN/FSQ-7 computer.

In 1958, yet another not-for-profit research laboratory was spun off from the USAF/MIT Lincoln Laboratory to focus on air defense. As the SAGE system reached maturity, MITRE Corporation, a not-for-profit think tank, was created and quickly assumed responsibility for the transition, employing much of the same technology for a new U.S. commercial air traffic control system.

Interception

From the very beginning, the SAGE system was intended to provide a cybernetic loop between radar detection, SAGE filtering and tracking, and response. To fulfill this last mission, the Air Force reassigned its Cambridge Research Lab to work with Lincoln Lab to develop a common message protocol system to coordinate interception by fighter jets and anti-aircraft missiles with hostile targets. The Army had already deployed thousands of NIKE missile systems around the U.S. with their azimuth and height-finding radars. The NIKE missiles were in constant radio contact with these base stations and were designed to explode near or slightly behind and enemy target. With full SAGE deployment, the Air Force equipped a number of fight aircraft with a similar radio control. For example, the F-106 fighter was equipped with a radio controlled data link to SAGE Combat and Direction centers that could be used for target acquisition, identification of a friend or foe (IFF), and coordination of air attack tactics with ground control. As SAGE came on-line, the Army built an auto-data link into its new surface-to-air missile system called BOMARC. A SAGE Combat center could launch and direct a BOMARC to a hostile target.

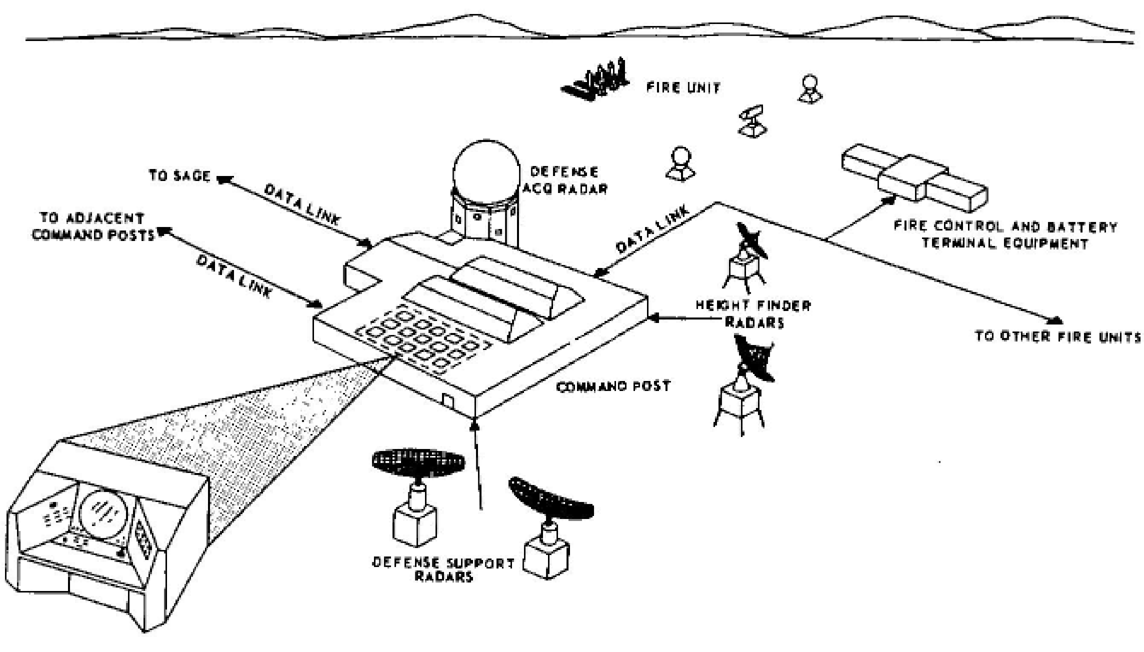

Figure 1. Fire distribution system AN/FSG-1 (Missile Master).

(*Source: U.S. Army Field Manual (1962) 44-1 U.S. Army Air Defense Deployment* Washington DC: U.S. Army)

Money

As one SAGE executive remarked, "We had all the money we wanted until Sputnik". (Redmond and Smith 2000: 125). Total costs are uncertain, but public data suggests that SAGE cost (in 2011 US dollars) three times the Manhattan Project, and slightly more than Phase I of the Strategic Defense Initiative. The commonly cited cost estimate for SAGE are between $8-12 billion (1954 dollars) or $60-90 Billion (2011 dollars). The Manhattan Project cost $30 billion 2011 dollars). (Schwartz 1998).[20] To put the commitment to SAGE in perspective, the annual budget for the *entire* Department of Defense in 1954 was $40 billion. [21]

XVII. Ironies

Following from Virilio, we can assert that built into every artifact is an accident. I would further argue that built into everything -- natural and built -- is irony.

Sputnik

On October 4, 1957, the Soviet Union launched Sputnik-1, a two foot in diameter globe with antenna, into an orbit around the earth. Not only was Sputnik-1 visible from the earth, but its radio beacons were detectable by nearly any radio hobbyist. Like First

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[20] *SDI, though never fully deployed, was estimated by the Reagan administration to require $26 billion (1984 dollars) or $35 billion in 2011 dollars.* Lawrence Cavaiola and Bonita Dombey (1984) *Analysis of the Costs of the Administrations' Strategic Defense Initiative 1985-1989* Washington DC: Congressional Budget Office (May 1984)

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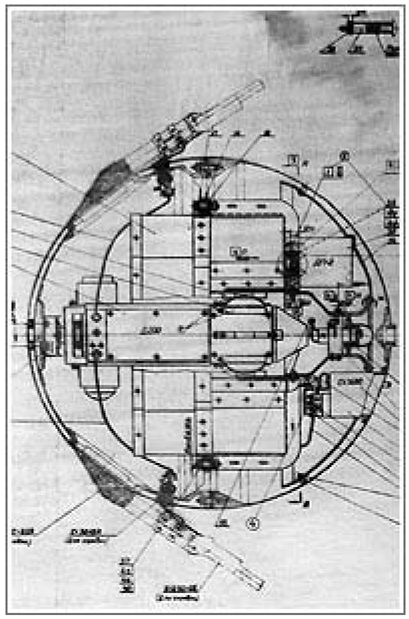
Lightning, the Soviet success shocked Americans. Having been told that the Soviet system was decades behind the technical miracles of the West, the visible wonder of a Soviet satellite contradicted these claims. For the USAF, the success was troubling for another reason -- evidence that the Soviet's had built a rocket capable of reaching long distances.



(Source: http://www.russianspaceweb.com/sputnik_design.html)

R-7/R-11FM

The rocket turned out to be the *R-7* series of rockets (referred to as the SS-6 series by the West), Utilizing multiple boosters, liquid fuel and kerosene as a propellant, the R-7A could reach distances of 7,000 miles. The Soviet's had delivered the first Inter-Continental Ballistic Missile (ICBM). This success completely changed the mix of strategic options for the U.S. Its air defense system (SAGE) was predicated on detecting bombers, not atmospheric flights of missiles. Moreover, SAGE wasn't even ready to go operational for another year. The Soviets simply by-passed investment in long-range bomber technology and went to the next best option -- ICBM missiles.[22]

In addition, the Soviet Navy began experiments in the early 1950's with placing medium-range ballistic missiles on their submarines. These tests culminated in the deployment on February 1959, of the *R-11FM*, a somewhat primitive single-stage rocket, still known today as the SCUD missile, on a new class of submarines designed to launch missiles (SLBM). This allowed the Soviet Union to not only move and hide the location of their nuclear weapons, but to place them close off the shore of the United States.

MAD

Given the spiraling increase in the total number of nuclear weapons, as well as their indeterminate locations, it became increasingly clear that air defense was not a strategy for defending the homeland, but a tactic for delaying an attack on the forces necessary for the U.S. to retaliate. In a meeting of the National Security Council on December 5, 1963, Lyndon Johnson (who had become President only two weeks earlier) asked his advisors about their views on the status of nuclear deterrence between the Soviet Union and the United States. The opinion of Defense Secretary Robert McNamara is summarized,

> In a nuclear exchange, there would be no winner, even though after such an exchange the U.S. would retain a superior capability than that remaining to the Russians. A nuclear exchange involves the loss on each side of from 50 to 100 million lives. Thus, any rational use of nuclear weapons is deterred. However, the nuclear situation does not deter other uses of military force, such as halting convoys on the Berlin autobahn. Neither side now has a deployed anti-ballistic

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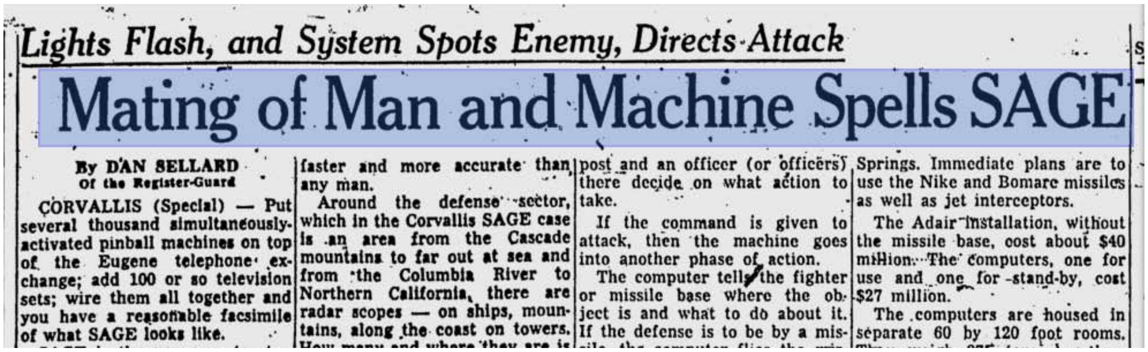
[22] http://www.energia.ru/energia/launchers/rocket-r7.html

> missile system. It would cost $15 billion to give 30% of our population protection. As of now, neither side can blunt an attack by the other. (National Security Council December 5, 1963)

The following day, McNamara sent to President Johnson a memorandum clarifying his view,

> An essential test of the adequacy of our posture is our ability to destroy, after a well planned and executed Soviet surprise attack on our Strategic Nuclear Forces, the Soviet government and military controls, plus a large percentage of their population and economy (e.g. 30% of their population, 50% of their industrial capacity, and 150 of their cities). The purpose of such a capability is to give us a high degree of confidence that, under all foreseeable conditions, we can deter a calculated deliberate Soviet nuclear attack. The calculations made to test this ability are our best estimates of the results of possible Soviet calculations of what we could do to them in retaliation if they were to attack us. This calculation of the effectiveness of the U.S. forces is not a reflection of our actual targeting doctrine in the event deterrence fails. I will call this objective "Assured Destruction. (Draft Presidential Memorandum December 6, 1963)

From this memorandum was born the strategy of Mutually Assured Destruction (MAD). Though SAGE continued to operate for another twenty years, new investments were reduced. Two planned Direction Centers were never built, the Mid-Canada sensor line was largely abandoned, and investments began to shift towards civil defense, recognizing that nuclear destruction was probably inevitable and that minimizing civilian deaths and injuries would be a more viable strategy, at least politically.



Lights Flash, and System Spots Enemy, Directs Attack

Mating of Man and Machine Spells SAGE

By DAN SELLARD
Of the Register-Guard

CORVALLIS (Special) — Put several thousand simultaneously-activated pinball machines on top of the Eugene telephone exchange; add 100 or so television sets; wire them all together and you have a reasonable facsimile of what SAGE looks like.

faster and more accurate than any man.

Around the defense sector, which in the Corvallis SAGE case is an area from the Cascade mountains to far out at sea and from the Columbia River to Northern California, there are radar scopes — on ships, mountains, along the coast on towers.

post and an officer (or officers) there decide on what action to take.

If the command is given to attack, then the machine goes into another phase of action.

The computer tells the fighter or missile base where the object is and what to do about it. If the defense is to be by a mis-

Springs. Immediate plans are to use the Nike and Bomarc missiles as well as jet interceptors.

The Adair installation, without the missile base, cost about $40 million. The computers, one for use and one for stand-by, cost $27 million.

The computers are housed in separate 60 by 120 foot rooms.

(*Source: Corvallis Register-Guard July 19, 1958, p. 7a*)

The ultimate irony is that SAGE was a phenomenally disastrous success. It is the proving ground for the convergence of thinking and perceiving machines, first as an extension of human anxiety and projection of power, and then as the sublimation of man into the machine itself. How we could conceptualize this convergence is the subject of the following three chapters.

Chapter Three: Epistemic Faults

This chapter outlines why epistemology is not the appropriate "first" approach to understanding things like surveillance and technology.

Part I: *Philosophic and Methodological Issues*

I: Introduction

Surveillance practices, and even what activities we definitively bracket as constituting these practices, have evolved so quickly that theorists who have been trying to grapple with this rapidly growing phenomenon find it difficult to explain just what is driving it.[23] In this chapter, I assert that the failure of so much of surveillance theory to account for the phenomenal expansion of the diversity of types of surveillance, as well as its exponential growth, arises from a fundamental theoretic blindness that is philosophic in origin. This chapter outlines the nature of this myopia and suggests we need to seek an alternative path of investigation.

The Discipline of Surveillance Studies

Admittedly, the analysis of surveillance is a nascent discipline. In 2006, David Lyon introduced a collection of readings on surveillance theory in which the reference to "surveillance studies" was so new that the term itself had to be put in parentheses. (Lyon 2006: 3) Six years later, Lyon and his collaborators Kirstie Ball and Kevin Haggerty

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[23] The challenges of technology theory parallel that of surveillance theory, but have developed a separate corpus of research. They are sufficiently congruent, however, that the discussion of one suffices for the discussion of the other.

write, "Surveillance studies is new. That is to say, very recently something called surveillance studies did not exist...Interest in surveillance studies has mushroomed, generating considerable excitement about the potential for new ways to understand human behavior." (Lyon, Ball, and Haggerty 2012: 1).

But this new field has already stumbled onto the problem so many other social studies have encountered. In the words of theorists Kevin Haggerty and Richard Ericson,

> Analysts...seem to be faced with one of two possibilities. They can continue to try to articulate statements about surveillance that are generally true across all, or most, instances...moving to higher and higher levels of abstraction. Alternatively, they can adopt a stance towards surveillance that mirrors recent approaches to the conceptualization of power...as a tool to goals that meet particular interests. As such, analysts are encouraged to attend to how power is exercised, over whom, and towards what ends. A comparable approach towards surveillance would acknowledge that the proliferation of surveillance now means that it has few inherent attributes or universal forms." (Haggerty and Ericson 2006: 22).

Missed Opportunities

The scope of this dilemma is revealed in any cursory review of the volume of surveillance literature. Excluding studies on topics related to epidemiology, petrochemicals, meteorology, etc. the number of studies on surveillance in the Google Scholar database exceeds 800,000 as of the summer of 2015. Perhaps most discouragingly, following from Haggerty and Ericson's concern about the options analysts have in studying surveillance, a more detailed inspection of the literature reveals that most researchers have focused on the particularities and minutiae of specific types of surveillance, avoiding generalizations about broader trajectories. As a result much of the extant research obsesses over the aptness of typological categories and how these definitions accurately account for past behavior. Consequently, most studies are post-hoc and reactive. These interpretations often miss the heterogeneity of the phenomena they are so otherwise diligently trying to categorically define and the ambiguities that these same multiplicities spawn. Consequently, they too quickly dismiss rich veins of persistent patterns in surveillant practices that do not conveniently fit with preconceptions of what is significant.

For example, in a collection of surveillance papers, researchers note that "a primary candidate in trying to understand this growth of surveillance has been the new information technologies which can relatively inexpensively and easily monitor more people in detail than was previously possible." (Lyon, Ball and Haggerty 2102: 2). But, technology, they conclude, "is not a sufficient reason to account for this change. Instead, it is better to think of a process of causal over-determination where a confluence of factors make surveillance often appear as the most appealing way to advance any number of institutional agendas." (*ibid*). However, as I shall illustrate in this study, if there is anything that persistently characterizes the direction and possibilities of surveillance, it is the technology that it employs. Ignoring technology because of a presumption of instrumental neutrality is a reflection, not of choices, but of blinders. The question is, why?

Epistemic Faults

In this chapter I set out to explain why the kinds of research that is carried out on topics like surveillance and technology are as they are. I begin by observing that surveillance is inherently obscure and deceptive in its operations. This makes it hard for researchers to understand precisely what is going on. Second and much more importantly, I posit that the theoretical blindness, to which I alluded above, is not caused by the methodological issues which researchers fall back on to justify the value of their research, albeit these often interfere in the development of prescient theoretical perspectives. Rather I assert that the underlying blindness is *a priori* to methodology and arises from philosophical choices which prioritize questions of *how* we know something (i.e., epistemological inquiry) by subordinating questions about *what* we know (i.e., ontological investigations). As a result, the *what* is invariably derivative of the *how* despite the fact in basing our analysis on the latter perspective we are on no firmer ground than before. Third, these philosophical issues did not just arrive *de novo* in the middle of the twentieth century, but are rooted in five hundred years of historical developments in science, technology, literature, economics, as well as theology. The material success of this circuitous historical course has only served to affirm the validity of how we cognitively perceive the world and, as a result, how we conceptualize our role in it. Fourth, the history of this epistemic shift corresponds to another prejudice -- anthropocentrism -- which prioritizes the human domains such as knowledge, ethics, and politics over inquiries which evaluate all objects -- human/non-human, animate/inanimate, real/imaginary -- as having equal ontological status. This consideration results in treating artifacts as less valuable objects of truth-finding than natural objects, particularly human subjects. Fifth, and finally, there are methodological limitations that arise from the philosophical choices that have been made. If the objects that we confront in the world are primarily treated as things to be epistemically evaluated, then it is far easier to treat those things quantitatively and categorically, than qualitatively. By assigning categories that can be divided and measured, which turn out to be primarily things in spatial relations, we can also define borders and boundaries to objects and prioritize those boundaries over ambiguities and fluidity. For example, the current debate over what constitutes gender (genital, chromosomal, identity, couture, etc.) underscores how problematic the issue of categories can be.

Following this discussion, I examine how one of the most important social theoreticians of the last quarter of the twentieth century -- Michel Foucault -- confronted these issues, the theoretical constructs he formulated to explain their resolution, and how these constructs resulted in his reading of surveillance and the technics that underlay the emergence of surveillant discipline. I conclude this chapter by suggesting that the paradigm Foucault proposed has erupted into a panoply of theoretical models that illustrate precisely the concern that Haggerty and Ericson suggest above -- a disarray of hundreds of accounts that explain very little.

II. Problems with the Epistemic Paradigm

Opacity: You Can't Know What You Can't See

Surveillance, by its very nature, is a hard object to discern. Surveillance is generally a secretive affair because, more often than not, the objective is to watch a person's behavior or speech without them knowing they are being observed in order to discover intentions or actions that they might not otherwise want to be seen. Surreptitious observation is a clandestine pursuit. As the sixth century BCE Chinese strategist, Sun Tzu, said, "of all matters none is more confidential than those relating to secret operations. [To which Tu Mu adds] these are 'mouth to ear' matters" (Sun Tzu 1963: §13.12). In general, government agencies like the U.S. National Security Agency (NSA) and Britain's General Communications Headquarters (GCHQ) go to great lengths to maintain secrecy around their respective programs. In these environments, researchers of surveillance largely gain access to these programs only when an insider like Edward Snowden releases files to the press or a spies such as Robert Hanssen, Aldrich Ames, or John Walker are arrested. (Greenwald 2014; Wise 2002; Grimes and Vertefeiulle 2012; Hunter and Hunter 1999). Even then, much of what these individuals know or could disclose to the public is shielded by secrecy laws. Nor is secrecy just an operational component of surveillance -- it may be the objective itself. Any opponent -- foreign or criminal -- may be just as disrupted in their activities simply by believing they are being watched without having certainty of being observed. As Gary Marx observes, "secrecy may be the 'end of intelligence, not the means'". (Marx 1988: 88).

Perhaps even more furtive and less well known is corporate or industrial espionage which is increasingly being conducted by state-supported entities. The lack of transparency arises from economic and competitive concerns, wherein both victim and perpetrator, neither of whom have little to gain in disclosing intrusions. Only when such activities become overtly blatant are they exposed -- mostly by private-sector security research firms who, as a result of the privileged access to proprietary data they have been granted by private corporations, are in a position to document the intrusions.[24]

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[24] See for example the reports on two PRC People's Liberation Army Units that have been tracked down in Shanghai. For PLA Unit 61398, see report from Mandiant released February 19, 2013. Found at: http://intelreport.mandiant.com/MANDIANT_APT1_Report.pdf. For PLA Unit 61486, see report from

By contrast, consumer-targeted espionage, or hacking-for-profit, entailing the theft of massive amounts of credit card data, has become far more publicized because of mandatory disclosure laws. The laws have exposed the scale and scope of these activities with respect to the firms that have been attacked. On the other hand, perpetrators are very hard to identify and are rarely arrested or prosecuted, let alone convicted. As a result, few researchers outside of journalists and technical specialists have devoted much effort to understanding this marginal form of surveillance.[25]

Then there is consumer-focused surveillance conducted by data marketing firms, banks, and manufacturers who wants to know nothing more than what every consumer wants to buy next. While the NSA is excoriated for collecting meta-data on the phone calls of all Americans, barely a question is raised about the massive aggregation of data on credit card expenditures, travel routes taken by personal automobiles, movie preferences, as well as tracking the networks of our friends. Adding to this the open-sourcing of social media data from Facebook, Twitter, Instagram, or Reddit, the magnitude of personal surveillance for commercial purposes appears to dwarf government initiatives. When companies like Acxiom, Epsilon, and credit reporting database firms such as Trans-Union and Experian have a far greater impact on our freedom of choices and movements than most government programs, one has to ask why don't we know more about these operations.[26] The answer is quite simple. They

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Crowdstrike released June 8, 2014. Found at: http://cdn0.vox-cdn.com/assets/4589853/crowdstrike-intelligence-report-putter-panda.original.pdf

[25] Cf. The blogs of Brian Krebs (www.krebsonsecurity.com), Bruce Schneier (www.schneier.com), Richard Bejtlich (www.taosecurity.com) and Dan Kaminsky (www.dankaminsky.com).

[26] There is little published apart from business news articles that rarely examine the practices of these firms. As this thesis was being finalized (2015), Stewart Sumner's book *You: For Sale: Protecting Your*

are private firms and the data, its sources, and the algorithms they use are considered intellectual property and of proprietary value. Therefore, researchers have no access to understanding what data marketing firms are doing. The irony is that neither do the consumers who willingly (though usually unwittingly) sign contracts allowing their personal data to be collected in the first place.

As a result of all of these factors, many researchers seeking to theorize about surveillance largely have to work with speculation, presumptions, and sensational revelations from whistleblowers and arrests.[27] But it does not have to be this way. Most social researchers are not technically trained and therefore often miss many opportunities to interpolate among data points what is likely to be occurring in surveillance practices.[28] While the public appeared to be aghast at the magnitude of the NSA PRISM program disclosed by Edward Snowden, most security professionals were not at all surprised. The biggest challenge the NSA confronts (as well as most other data-driven intelligence agencies and data marketing firms) is the aggregation of enough data that the proverbial "needle in a haystack" can be found -- "what we have is never

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Personal Data and Privacy Online Waltham MA: Syngress Publishers was released. Cf. Natasha Singer (2012) "Mapping, and Sharing, the Consumer Genome" in *New York Times* June 16, 2012. Downloaded from http://www.nytimes.com/2012/06/17/technology/acxiom-the-quiet-giant-of-consumer-database-marketing.html?_r=0. Also Gretchen Morgensen (2014) "Held Captive by Flawed Credit Reports" in *New York Times* June 21, 2014. Downloaded from http://www.nytimes.com/2014/06/22/business/held-captive-by-flawed-credit-reports.html

[27] Not all researchers are so limited. Technical analysts in United States-based not-for-profit privacy organizations like the Electronic Frontier Foundation, the Electronic Privacy Information Center, and the American Civil Liberties Union do have these skills, but are limited in resources.

[28] A good example is the development of the NarusInsight 6000 originally designed in the early 2000's. The NarusInsight is a deep-packet inspection device. Which means it opens the message contents of an internet data packet and assembles it with related packets in order to read the entire message. It can do this at nearly the speed of light and therefore is ideal for attaching to fiber optic network lines. This is precisely what was disclosed in a lawsuit filed in San Francisco which documented that a NarusInsight had been installed at a AT&T telephone switching center that routed all Internet traffic on the west coast to Asia. Anyone who was aware of the NarusInsight capabilities, the cost to build it, and the otherwise limited market for such a technology was surprised at the application to which it had deployed.

enough". As unfettered uncertainty knows no bounds, there is no limit to the amount of data one can desire to collect. The interesting technical impediments are how to efficiently archive, index, filter, sort, retrieve, and connect the dots on so huge a data store and do it in as close to real-time in order to make meaningful differences in the decision-making process. If surveillance theorists could apply their critical experience to the same path of technology choices, they might begin to better surmise exactly what is driving surveillance programs.

Theoretic Blindness

If technical incompetence was all that was limiting surveillance research, this shortcoming could be easily remedied. Unfortunately, there is a far more trenchant obstacle to rethinking surveillance -- namely, the way by which we actually frame how we *think* about surveillance. This is not a question of methodology, but one of philosophic difference, for methodology is derived from philosophical foundations, not the other way around. Which is to say that underlying any research methodology are presumptions about the nature of reality and existence, the things that comprise that existence, and the presuppositions we establish about how we cognitively apprehend that reality. The theories we hold about existence and our perceptions about this existence, constitute our best approximation of what it is to be in this world.

Far too often, the debates we have about how to construct social theory hinge on differences we have about things like causality or the reality of something, thereby assuming that we already understand what it means for one thing to have a relationship with another or what it is for that thing to exist. But this project argues that this is far from being a settled matter. There is a far greater difference between thinking about *what* something is and the question of *how* we can know it -- a distinction between the possibilities of nature and the limits of human reason and sensibility to know them. In other words, it is a contest between an ontological inquiry and one based on epistemological constraints. For a variety of reasons, philosophical, historical, and ontological questions have been displaced by epistemological ones. Because the subordination of ontology to epistemology so defines what we can think about methodologically, I will devote the next few pages to uncovering just what this paradigm shift has entailed and its implications for thinking about the future direction of surveillance practices.

I want to emphasize that the displacement of ontology was not effected by its replacement -- but by its forgetting. We can still discover faint traces of ontological presuppositions underneath the epistemology upon which modern social theory is constructed. For example, take the line of reasoning laid out by Descartes in his *Meditations*. He begins from an argument of doubt wherein he has a series of sensory encounters that lead him to uncertainty about what he knows and to ask whether this knowledge is simply the consequence of a dream, a delusion, a deception perpetrated by God, or the work of an evil demon. But even then, he reflects, if I am being manipulated, this deception requires that I am thinking about it and this very truth confirms that I exist. Therefore, the first ontological certainty is: what is true implies that it exists.

What Exists is Real

Similarly, Descartes asserts that no effect can have a greater amount of reality than its cause. That is, everything that comes into being must be made to be by something that has an equal or greater amount of reality. For instance, a stone can be made by chipping off a larger piece of rock, since the larger rock has more reality, but a stone cannot be made out of a color, since a stone has more reality than a color. Descartes grants that ideas can be caused by other ideas, but that there must ultimately be something more than an idea that is the cause of these ideas. The first cause of an idea must be something with at least as much formal reality as the idea has objective reality. The second ontological certainty establishes that what exists must be real. But how do you know what exists?

An Epistemic Fallacy

But here, modern philosophy introduces what Roy Bhaskar calls the "epistemic fallacy", which he defines as "a persistent tendency to read the conditions of a particular concept of knowledge into an implicit concept of the world" or as he puts it more bluntly, "the epistemic fallacy thus covers or disguises an ontology based on the category of experience."(Bhaskar 2008: 18, 20). In this way, any questions about "what we know" are re-conceptualized as "how we know". Bhaskar is particularly interested in how scientific knowledge can be construed. Critiquing Kant's take of what is real, and thus, what is true as being a problem for the subject, not of the world, Bhaskar turns Kant's proposition upside down and asks what must the world be like for knowledge of the world to be possible? Rather than asking how reality is determined by the subject (an epistemological problem), Bhaskar asks what kind of reality must exist and be true (an ontological question), for there to be knowledge of it?

Seeing is Believing

For Descartes, there is an epistemic uncertainty about sensory-based knowledge. Thus, how do we then *know* anything about the world? His answer, in *Meditations on a First Philosophy* (Descartes 1984), is that there is an important distinction to be made between imagination and understanding. Only from the latter can we have "clear and distinct perceptions" of what is true. For example, I can *imagine* a simple octagon-shape geometric form. But I cannot imagine a thousand-sided polygon. The latter I can only grasp through introspective insight (*intuition*). Much of what exists in the world is made up of these very complex entities -- which Descartes posits can only be understood through a form of analytic intuition. Imagination (and the attendant risks of illusion and misperception) Descartes poses arises from our reliance *res extensa* -- that which lies outside of our minds (and which is determinatively true).

Though Descartes is skeptical about the veracity of any of the senses, he admits, "sight is the most comprehensive and the noblest…" (Descartes 2001: 65) and, in spite of his ambivalence about the reliability of "seeing", he argues that knowledge is attainable through a "clear and distinct *perception*" of what is true. Perspicuity grants transparency to what is real. As a result, the first epistemological principal asserts that what is real must be "seen". The "how" we know is handled by an ontological sleight-of-hand that asserts a second epistemological principal that what can be "seen" can be known.

The Thing in Itself

It is this contest between existents and existence, reality and truth, mind and world, knowing and sensing that leads Kant to establish what he describes as a "Copernican revolution" in philosophy by synthesizing all of these conditions within the domain of the subject. This synthesis is reduced to his conclusion: "Thoughts without content are empty, intuitions without concepts are blind." (Kant 1999: A51/B75). The emergence of the subject as a unique identity takes place in a multiplicity of forms and techniques across many geographies and cultures. It is not a single formation in practice, but it is sufficiently similar that Kant can define a transcendental subject with its *a priori* categories of judgment which are applied to receive sensations of the world around the subject. The intersection is the "transcendental unity of apperception" which locates what can be known about the world. The object which lies outside of the subject, Kant calls a "thing in itself", cannot be fully known, apart from what is shows. The subject becomes the sole arbiter of *knowing* what is real and true. Except, there is a complication -- there is a limit to what we can know.

Kant concludes that understanding the metaphysical status of human beings is a contradiction. To study human beings requires standing outside of (or before) oneself, which is to say, to study the thing-in-itself, which, as he has already declared, cannot be known in-and-of-itself.[29] If the possibilities for understanding human beings are reliant

[29] At least this is the challenge that Michel Foucault interprets Kant as posing in his (Kant's) lecture notes entitled *Anthropology from a Pragmatic Point of View*. I will return to Foucault's interpretation and its consequences in a moment, but it is important to dwell on this putative crisis for a moment.

on the *pre-conditions* of those possibilities and, if every original possibility suggests another set of possible understandings, etc. -- we have a hall of endless reflections.

Positivism

This was precisely Auguste Comte's concern in proposing that only the scaffolding progress of knowledge would allow us to escape the illusions of self-reflection. Comte argues that human knowledge has passed through three stages: theological (or mythical), metaphysical (or abstract), and positive (or scientific). The law that drives this passage is the tension between observing facts (appearances in Kant's terms) and accounting for them in theory (judgments). Comte writes, "Thus, between the necessity of observing facts in order to form a theory, and having a theory in order to observe facts, the human mind would have been entangled in a vicious circle..." (Comte 1893: 4). The necessity for the theological stage of knowledge, according to Comte, was to ground this circular indecipherability by reference to substances and powers which were independent, albeit, reifications, of this reflexivity. Similarly, the metaphysical stage offered to substitute for the mythic objects an abstraction that, while not measured, was a further idealization and abstraction. For Comte, this progression allowed the observer to give less attention to magical power and more to the facts themselves, making possible what Comte described as the highest stage of explanatory power, positivism. Here, the scientific model, so well established since the Enlightenment could be brought to bear on the last and most important of the domains of knowledge -- sociology.

A Dull Apparatus

While Descartes offers a subjective objectivity grounded in "clear and distinct perceptions", Kant seeks to establish an objective subjectivity located at the intersection of the "transcendental unity of apperception". Despite their differences, these interpretations bracket an objectivity and subjectivity founded on assumptions that prioritize the epistemological over the ontological, and leave the bifurcation of the subject and object intact. Comte's effort at bridging the difference is a reduction of the difference to sheer instrumentality. The effect, as Max Horkheimer writes, is an,

> ...emancipation of the intellect from the instinctual life [which] did not change the fact that its richness and strength still depend on its concrete content...An intelligent man is not one who can merely reason correctly, but one whose mind is open to perceiving objective contents, who is able to receive the impact of their essential structures and to render it in human language; this holds also for the nature of thinking as such, and for its truth content. The neutralization of reason that deprives it of any relation to objective content and of its power of judging the latter, and that degrades it to an executive agency concerned with the how rather than with the what, transforms it to an ever-increasing extent into a mere dull apparatus for registering facts. (Horkheimer 1987: 55).

As important as the epistemic turn was for the natural sciences, it spawned a more expansive phenomenon -- the rise of social analysis and social theory. The emergence of a public and the autonomous man established an object and a subject that could be turned on itself -- Vico, Rousseau, Smith, Malthus, Ricardo -- each established a domain of interest in the social based on the same epistemic principles that had been applied to insects and distant planets.

III. Social Epistemics

What social theorists actually struggle with on a regular basis are not epistemological problems, but methodological ones, which apply epistemological pre-suppositions to how to think about and understand empirical evidence. Thus, the consequences of the epistemic turn for much of social theory are not exposed in philosophical issues, but in procedural and interpretative issues. In contemporary social analysis, there are four broad approaches to thinking about things like surveillance and technology: instrumentalism, determinism, social constructivism, and co-evolutionary development.

Instrumentalism

Of these, instrumentalism is the most widely attested, because it is most commensurate with the problems routinely faced by engineers and business managers who are seeking to justify costs, delivery schedules, and product efficacy. Instrumentalism generally assumes that technology and technical practices are value-neutral and not determinative of or by social interests. Thus, the development of the first atomic bomb was a question of feasibility, cost-benefit options, and a mission (to end the war more quickly).

Determinism

By contrast, determinism assumes that social values and organization are driven solely by the technology or the economic system that is applied to it. Thus, Lynn White (1962) argues that the introduction of the stirrup in the early Middle Ages gave equine-enabled soldiers greater power to charge and harm opponents. This capability, in

White's view, defined the nature of feudal power. Determinism, of any stripe, is not widely adopted, but remains prevalent among media theorists who, in my opinion, misread the work of Marshall McLuhan and Friedrich Kittler.

Social Construction

The third approach, social constructivism is, undoubtedly, the most influential theory in use today among historians and sociologists whose work focuses on the interactions between science, technology, and society . (This includes the critical theory of the Frankfurt School -- Adorno, Horkheimer, and Habermas among others.) Social construction theory developed as a reaction to the earlier models of instrumentalism and determinism. Because of its importance not only to current social analysis, but to surveillance and technology studies specifically, I summarize its principle features below.

Social construction theorists argue, contrary to the instrumental paradigm, that things like surveillance and technology are never simply implementations independent of the social forces that cause their development in the first place. That is, social constructionists are critical of the notion that technology (or surveillance) is value-neutral. Social construction theory also dismisses the instrumentalist concept that inventors make discoveries that are isolated from the social milieu in which the inventions take place. Instrumentalists might argue, for example, that technical discovery sparks interest, invention creates possibilities, social opportunities enable investment, deployment incites innovation creating new applications, etc. until a new discovery offsets the advantages of an older technology (computers over typewriters) or creates the possibility of a new need (social media). By contrast, the social constructionist interpretation of what drives technological development begins with an assumption that social needs and context define what is technologically problematic and interesting. Each successive step in the process of technological development is embedded in the social constraints, semantics, and opportunities surrounding the technology. (Mackenzie and Wajcman [eds.] 1999; Bijker, Hughes, and Pinch [eds.] 1987).

At the same time, and perhaps more importantly, social constructionists reject any form of economic or technological determinism. Social constructionists argue that the relationship between society and objects, such as surveillance or technology, mutually shape each other, so that the development of artifacts cannot be separated from the social structures that define the possibilities of these objects, their uses, and their evolution--nor can social structures or behaviors be said to be independent of the artifacts that extend and materialize social relations.

Formation of Social Constructions

Ian Hacking observes that there is a form of knowledge and understanding, that once established, leaves only the content of truth to be evaluated. He gives as an example the problem of missile accuracy. The problem should seem obvious -- accuracy is achieved by hitting the bull's eye. But citing the work of Donald Mackenzie, Hacking reports that the problem of accuracy is anything but simple. The tolerance, for example, of being off-center is dependent on objectives, kinetic force, and most important, the emergent standard for what constitutes accuracy. (Hacking 1999: 181-183) These standards define the options, the discourse, and the rules for that discourse, such that no one then asks whether missiles are a solution, because the discourse has already excluded those kinds of questions. The valuation of the discourse is restricted to the question of accuracy. Once questions about accuracy have been established as the domain of the discourse the possibilities for other conversations have been eliminated.

Epistemology and Social Construction

It is tempting, but misleading, to identify the epistemologic turn with social constructionism or some variant thereof. Social constructionism, broadly construed, is concerned with the effect of human agency on objects and the affect of objects upon human agency, while epistemology is more narrowly focused on how external objects are cognitively apprehended by individuals. It is a difference that John Searle describes as ontologically subjective and epistemologically objective (Searle 1997: 62).

In this sense, the interventions by Bruno Latour and Michel Foucault are, in some way, different from the more mainstream approaches (largely Anglo-American) of the majority of social constructionists. At the same time, not all social theorists who rely on an epistemological foundation are social constructionists and not all social constructionists, such as Latour, deny that some significant part of their work is ontological in nature.

For Latour, the fundamental agency of technological development lies with the connections that comprise the technical domain and are manifested in what he refers to as sites. That these connections and sites are instantiated through human agency is, for Latour, secondary. Similarly, for Foucault, as we shall shortly see, the fundamental structures of technology, medicine, insanity, prisons, or educational systems reside in the architecture of conceptualizations, of knowledge itself. Nevertheless, there are, of course, a number of similarities between social constructionism and theorists like Latour and Foucault, in that all of these approaches are anthropocentric -- wherein the signification of events and artifacts is established through human agency.

Wherein the Knowing of the Object and the Object that is Known

The boundary between epistemology and ontology is not always clear. For example, the analytic philosophers Arnold Davidson and Ian Hacking provoke precisely this kind of problematic boundary based on collaborations with Michel Foucault. Arnold Davidson (2002) considers a concrete problem, the answer to which begs a more abstract inquiry. He asks how did the idea of "sexuality" arise in the nineteenth century, and more abstractly, how do concepts form? He sees these as interdependent themes that self-constructed around and through each other, in much the same way the contemporary concept of surveillance has in the late twentieth century. Davidson argues, following from Georges Canguilhem, that the "discovery" in the nineteenth century of sexual pathology, problematized the nature of sexuality, which, in turn, complemented a generalized theorization of sexuality. Thus, sexuality as theme, emerged over time from a set of questions about difference and commensurability, and became the basis for its own epistemological system.

The Construction of Knowledge

Davidson turns to an early essay by Ian Hacking in which Hacking posts five rules for "styles of reasoning" around which epistemological systems are constructed.

(Hacking 1982). First, there are different (and often concurrent) styles of reasoning with their own life cycles. Second, truth propositions that require reasoning rely on the style of reasoning from which they emerge. Third, the categories of the possibilities of truth are contingent on the historical state of the style of reason. Fourth, there arises, then, the possibility of other truth systems. Fifth, it is impossible to independently evaluate alternative truth systems based on the style of reasoning in our own truth system. (Davidson 2002: 128-129). Davidson refers to this analytic process as "historical epistemology".

The Formation of Objects

Ironically, Ian Hacking, takes the distinctions laid out by Arnold Davidson and comes to a parallel, but "mirrored" conclusion. He sets out to illustrate epistemological ruptures and the formation of identities that sustain the emergence of new knowledge systems. Aware that Richard Rorty in his seminal history of western epistemology, has designated the territory of modern epistemology as the search for the "foundations of knowledge", rather than a theory of knowledge, Hacking refers to what he wants to accomplish as "meta-epistemology" or "historical ontology". For Hacking, this approach brackets the study of "objects or their effects which do not exist in any recognizable form until they are objects of scientific study". (Hacking 2002: 11). These become the structures of knowledge.

Part II: *Michel Foucault and His Legacy*

I. Introduction

Structures of Knowing

What then constitutes these structures? I turn to the work of Michel Foucault, specifically his text, *The Order of Things* (1970), which focuses on the ways in which knowledge is organized into different sets of rules in different historical periods -- he critiques the distinctions among the pre-classical (i.e., the Renaissance), Classical (or what we in the English-speaking world refer to as early modern), and post-Classical (modern) periods. At the same time, he posits there is a common deep structure among these disparate periods, a shared way in which the underlying rules of these periods are similar. He refers to this deep structure as an *episteme*. (Foucault 1970: 30). This structure is a framework which defines how the ways and things of the world are ordered within a specific historical period. Most significant, this order is expressed or manifested in a semiotics of the experience of that order.

Resemblance

For example, the pre-classical period was, in Foucault's interpretation, an epistemology constructed on resemblance, in which a ternary relationship of signs -- significant, signified, and a "conjuncture" -- were linked together in an ever shifting set of meanings and references. (*ibid* 42). Thus, meaning was local, specific, and universally indeterminate through relations of proximity, distance, analogy, and sympathy. Foucault offers the example of Pierre Belon who analogizes comparison between the anatomy of humans and birds with such statements as, "the pinion called the appendix which is in proportion to the wing, and in the same place as the thumb on the hand; the extremity of the pinion which is like the fingers to us..." (*ibid* 22).

II. The Order of Knowledge

Representations

This contrasts sharply with the Classical period in which signs are organized as binary representations -- subject and object. Foucault employs Velazquez's painting *Las Meniñas* in which the painter (subject) is seen looking on the viewer, which through reflection we can see in a mirror on a far wall, the blurry representation of the King and Queen, which we, as viewers, outside the frame of the painting, stand ambiguously as substitute (objects). In the distant background is yet a third participant, a member of the royal household staring at the painter, the children which are presumably being portrayed in the painting which we cannot see, the royal personages, and we as anonymous spectators. In this spectacle, we have a much more complicated set of symbolic relationships in which lines of analysis are more stable than in the age of resemblance, the accounting of the relationships is finite, the defined difference between subject and object replaces the circularity of resemblance, and language is given the responsibility for representing truth. As with Descartes, the sign is not externally identified, but is located in "clear and distinct" introspection, is universally true, and constitutes a social convention of signs organized as taxonomies, tabular classifications, orderings, and genealogies.

Modern Knowledge

The post-Classical *episteme* (via Kant, Hegel, and Marx) turns away from representations as the ordering of ideal signs towards a materiality grounded in historical space, between what the French refer to as the Classical and post-Classical periods. Linguistic representation had evolved in the Classical period in a multiplicity of literary forms -- Cervantes' *Don Quixote* represents the earliest form in the transition from resemblance in the pre-classical to the signification of difference of subject and object. The post-Classical period represents a loss of and subsequent search for recovery of its pre-eminent status of meaning. Language becomes a tripartite practice of formal expression (Frege, Russell, the early Wittgenstein) to formalize the purity of language as a truth function; as an empirical exercise (Durkheim, Darwin, Marx); or as philosophic practice (Freud, Nietzsche, or in novels such as those of Thomas Mann). For Foucault, Kant is the inflection point in the transition from Classical to post-Classical *epistemes,* where idealized representations differentiated in a linguistic binary of subject/object are rejected for a pure subjectivity that is itself an objective object. Foucault summarizes,

> Withdrawn into their own essence, taking up their place at last within the force that animates them, within the organic structure that maintains them, within the genesis that has never ceased to produce them, things, in their fundamental truth, have no escaped from the space of the table; instead of being no more than the constancy that distributes their representations always in accordance with the same forms, they turn in upon themselves, posit their own volumes, and define for themselves an internal space, which to our representation, is on the exterior. (*ibid* 239)

III. Foucault and Surveillance

Discipline

In 1977, Foucault published *Discipline and Punish* in which he introduces yet a new methodology -- genealogy -- to account for the process he had uncovered in the application of his archaeological research. Ostensibly a study of the origins of the modern prison, it turns out to be a study of the transformation of one episteme to another, not as an evolutionary or progressive succession, but as something new and different -- a punctuated moment between fields of equilibrium. *Discipline and Punish*, nearly single-handedly, set the agenda for surveillance studies for the next thirty years, while framing a parallel conversation about technology.

Like *The Order of Things*, Foucault begins by establishing a contrast between two historical periods -- not far apart in time -- but with widely disparate different treatments of the problem of social order. On the one hand, there is the 1757 spectacle of the execution of a condemned man accused of attempted regicide. The disordered goriness of the death sentence issued by the royal sovereign is in marked contrast to the treatment of prisoners some eighty years later, in which the authority of the imprisonment emanates from a judicial bureaucracy. The regime of punishment is a set of measured disciplines designed not to inflict bodily pain, but to instill inner regimentation, and a system of methods of control that are hidden from public view. The spectacle, with its arbitrary and gruesome mortification, blood, and public signs of the power of the sovereign began to be replaced by a form of punishment masked by a larger penal process that made predictability and certainty an essential objective. The latter exemplified "…a time when, in Europe and the United States, the entire economy of punishment was redistributed….It saw a new theory of law and crime, a new moral or political justification of the right to punish; old laws were abolished, old customs died out." (Foucault 1977: 7).

Power as a Discourse

The rescission of punishment from the sovereign displaces not only the projection of power and control as a public spectacle; but, the removal of the body from its direct placement in the organization of discipline. The physical body is now mediated between its somatic presence and the idea of its freedom to move at will. What is new is that liberty is an extended property of the body, and it is liberty, not the body, that is constrained. "From being an art of unbearable sensations punishment has become an economy of suspended rights." (*ibid* 11). In place of the body, the object of punishment is the soul. But this shift masks a myriad of alterations in the system of criminal punishment. No longer is the criminal act the only object of investigation, but now the intentions, circumstances, predilections, desires, passions, incapacities, infirmities, and a host of other considerations are inserted into the inquiry. Motive and incentive are as culpable as the act itself.

> For it *is* these shadows lurking behind the case itself that are judged and punished. They are judged as 'attenuating circumstances' that intrude into the verdict not only 'circumstantial' evidence, but something quite different which is not juridically codifiable: the knowledge of the criminal, one's estimation of him, what is known about the relation between him, his past and his crime, and what might be expected of him in the future." (*ibid* 18).

As Foucault observes, the investigation, judgment, and punishment is part of an integral system so that "the judge is not alone in judging". (*ibid* 21). Rather, there is an entire system manned with judiciary, investigators, administrators, therapeutic assessors, and penal bureaucrats.

The Technics of Power

But with this substitution of authority comes a displacement of the systems of knowledge and technical capacity to define, discern, and adjudicate. Analogous in a Marxist sense of a new mode of production, there comes to be a new mode of knowledge -- what Foucault refers to as "a micro-physics of power". (*ibid* 26). The displacing techniques, however, represent not a status, but a process, of methods, applications, and information that codify, normalize, and interpret the adjudicatory subject. There is introduced into the system an entire economy of discipline that affects not only the subject, but all those who are touched by the intervention. According to Foucault, this is not arbitrary. This process follows a set of rules which are within the logic (the regimentation) of the system of knowledge that governs not only the intervention, but the possibility and necessity of the intervention itself: Only punishment sufficient to offset the value and the advantage of the crime is justified; the punishment must have a particularly deterrent effect on those that have not committed the crime; the punishment must neither be arbitrary or uncertain; the authority for punishment must lie in the knowledge system itself, not in the judge or sovereign; and there must be a published specification of offenses, rules, and regulations, and their corresponding consequences and punishments.

The Object of Power

Following from his earlier analysis of the emergence of representation, Foucault argues that the techniques (as an art) of punishment, even of adjudication in its initial forms, "must rest on a whole technology of representation". (*ibid* 104). But the evolution of these techniques is, in turn, displaced by a coercive discipline that operates not in the intermediary of representation, but on the habits, "the everyday gestures and activities", in such a way that "the body and the soul, as principles of behavior, form the element that is now proposed for punitive intervention. Rather than on an art of representation, the punitive intervention must rest on a studied manipulation of the individual…" (*ibid* 128). This new system of knowledge operated at the level of the individual, but not *qua* individual, but at the processes that surrounded and comprised the possibilities of that individual. The object of control was found in the forces of these processes, such that the coercion was complete and unceasing and focused solely on their efficacy and efficiency. It is at this moment, Foucault claims, that the "art of the human body was formed." (*ibid* 137).

However, this discovery, is neither sudden nor a single invention. Rather it arises from the cumulative effect of hundreds of small, incremental, oftentimes accidental developments. Most of these individual developments originate from different sources and with different purposes. The intersection and synchronicity among these emergent developments give rise to new formations of both conceptualizing and concretizing disciplinary practices. These were the discoveries

> of essential techniques that most easily spread from one to another. These were always meticulous, often minute techniques, but they had

> their importance: because they defined a certain mode of detailed political investment of the body, a 'new micro-physics' of power…Small acts of cunning endowed with a great power of diffusion, subtle arrangements, apparently innocent, but profoundly suspicious, mechanisms that obeyed economies too shameful to be acknowledged, or pursued petty forms of coercion -- it was nevertheless they that brought about the mutation of the punitive system…(*ibid* 139)

The Practice of Power

Foucault then outlines a taxonomy of these practices. First, there is a new conceptualization of how subjects are distributed in space--first as enclosures, and then into more interchangeable partitions that reflect the diversity of disciplinary objectives (*ibid* 141-149). Second, there is an elaborate control of activity within this space: borrowing from the medieval table of hours wherein time is filled with activity to avoid wasting time, the new technology "extracts ever greater usage of time for greater uses of force". (*ibid* 149-155). Third, time and the activities that fill it are re-conceptualized as durations of "successive or parallel segments" (*ibid* 159). Time is thus not simply quantified, it is reorganized, manipulated, and utilized. Activity within this series of temporal units is managed as exercises are "both repetitive and different, but always graduated". (*ibid* 161). Finally, the combinatorial interchangeability results in new, and heretofore unimagined, assemblages. The effect of these practices is to create systems of organization, templates of regimentation within this organization, prescriptions for acting out these templates, and what Foucault calls "tactics" by which he means, "the art of constructing, with located bodies, coded activities and trained aptitudes, mechanisms in which the product of the various forms is increased by their calculated combination are no doubt the highest form of disciplinary practice." (*ibid* 167)

The Panopticon

What are these tactics? Foucault identifies three, the cumulative effect of which establishes the logic and the language of the Panopticon. First, there is the formation of hierarchical observation, an architecture and a discipline that is not to be seen, but rather makes it "possible for a single gaze to see everything constantly". (*ibid* 173). Second, is that judgments made as part of the disciplinary process are normalized. What is crucial is that the boundaries of socially acceptable behavior are narrowly circumscribed and that all else is published as non-conforming, the response to which must be consistent and definite. As Foucault notes, "disciplinary punishment has the function of reducing gaps." (*ibid* 179). But it is not a systematization of punishment, but an application of gratification offset by punishment. It is this duality that establishes an adaptive cycle of training and correction. An order of privileges arising from the incentives and disincentives reinforces the omnipresence of the disciplinary process. Finally, there is the methodical examination that applies both the effects of the persistent observation and the normalized judgments to effect a unique assessment for each individual which Foucault identifies as a "case".

The Microphysics of Perception

Foucault's interpretation of Jeremy Bentham's Panopticon builds on these microphysics of tactical discipline "to induce in the inmate a state of consciousness and permanent visibility that assures the automatic functioning of power [and] to arrange things [so] that the surveillance is permanent in its effects, even if it is discontinuous in its action." (*ibid* 201). The genius of the system is the employment of a central tower around which the inmates are deployed in a circumference such that each can always be observed, inspected, and surveyed at all times. The presence of the tower assures, not symbolically, but in effect, the permanent visibility of each inmate. This presence is acknowledged and internalized subjectively by each inmate. However, the inspector, who may or may not be present, can never actually be seen – he remains invisible. Every inmate acts as if he is actually being observed. Within this environment there are then the rules, regimens, exercises, and practices that guide the molding of the subjectivities of inmates, establish the character of inmates, and the correction of aberrant behaviors. Foucault observes that this architecture is “polyvalent”, capable of being deployed in a variety of applications – prisons, social welfare, hospitals, schools, and the military. More importantly, the techniques, the microphysics, which make the Panopticon so effective, are not limited to the practices *within* the institutions. The institutional techniques that work creep beyond the walls where the presence of the “inspector” becomes a specter among the general public and the social, economic, cultural, and relations, as well as daily practices for society at large.

Surveillance as Discursive Practice

From this purview, Foucault anticipates the ways in which surveillance arises among the institutional legacies of power and the interstices of existing practices to define a new way of manipulation. Practices that had once constituted the discipline of the flesh, re-emerge as determinates of the soul. "The exercise of discipline", Foucault asserts, "presupposes a mechanism that coerces by means of observation; an apparatus in which the techniques that make it possible to see induce effects of power." (*ibid* 170-

171). This engenders methods, hierarchies, and architectures to establish the persistent gaze and the consequential transformative effect of power. In other words, "the perfect disciplinary apparatus would make it possible for a single gaze to see everything constantly."(*ibid* 172).

The persistent gaze is accompanied by a series of other techniques: the standardization of judgments which guide the normalization of behavior (or at least the expectations thereof); a deliberate process of examination which regiments the normalization of judgments; documentation of the examination and its outcome which establishes its facticity as something real and historical; the origination of the concept of a "case" that ties the documentation to an individual; the division of observable space into discrete limits; a method of "permanent registration" that links the documentation to the entire hierarchy of surveillance; and the correlation and classification of status, location, and motion. (*ibid* 177-197). When these techniques are encapsulated in the Panopticon, the result cultivates two formulations: an edifice of discipline (as structure) and the techniques of discipline (as functions). In one sense, the Panopticon is both an "invention" and a metaphor.

Foucault observes that the institution of the Panopticon, as an organization of discipline, does not stay within its own boundaries. Rather, the disciplinary functions tend to inculcate practices that are applicable and useful outside the institution itself. As the "micro-physics" of the disciplinary process tend to "swarm" (Foucault's term) outside of the institution, they get reconstituted in new forms, where "compact disciplines are broken down into flexible methods of control, which may be transferred and adapted." (*ibid* 211). Thus, Foucault establishes a reasonable hypothesis of how surveillance evolved and proliferated, but the question of *what* surveillance is remains elusive. We have here a surprising discovery midst the Foucauldian epistemology. First is the relationship of power as cause (an ontological problem) with the truth function of knowledge (an epistemological problem bound as one entity). We have a flow of micro-physics in the form of almost invisible events that swarm through the institution(s) which in turn have the status as objects brought to life while events flow through them. The flow itself is sustained and guided by the gaze. In other words, within the epistemologic foundations of Foucault's argument we discover an ontologically rich environment. One that needs amplification and clarification -- in short, it needs to be cleared and seen.

IV. Panoptic Clutter

Foucault's theorizing about surveillance has resulted in the development of an entire industry of "surveillance watchers", which, though it has produced interesting perspectives, has led to an incoherent theorizations of surveillance. And to return to an earlier point, research remains caught in its anthropocentric roots without the ability to see surveillant practices and entities as things-in-themselves.

The early reaction to Foucault's Panopticon metaphor was slow in coming, but by the end of the 1980’s, the trope was showing some stickiness, albeit with little imagination. Diana Gordon (1987) proposed that criminal databases represent an electronic , while Shoshana Zuboff (1988) focuses attention on the increased use of surveillance in the workplace, which she refers to as an information Panopticon.

Superpanopticon

Mark Poster (1990) links Foucault's theory of discipline with the confining characteristics inherent in digital database. He seizes on the implications of new forms of surveillance by linking the integration of media, data, and surveillance observing that the reduction of information to the storage requirements of a database forces the interpretation of data to conform to the semantics of the database language -- a trend he referred to as a "superpanopticon". Recognizing a similar problem, Oscar Gandy (1993) proposes surveillance databases constitute a panoptic sort in which interpretations arising from the data, its structure, and the algorithms applied by its sorting and categorization to define the limits of our choices, access, and rights.

Panoptic Empowerment

By the mid-nineties, the Panopticon trope was widely adopted: Stephen Gill critiques a world without borders in a global Panopticon (1995); Butchart (1996) describes an industrial Panopticon; the poor are the object of social panopticism for Luc Wacquant (2001); education systems offer the pedagopticon (Sweeny 2004) as well as panoptic performativity (Perryman 2006); while the business literature finds much to admire in panoptic discourses (Berdayes 2002), panoptic control (Sia, Tang, Soh, and Boh 2002), and panoptic empowerment (Elmes, Strong, and Volkoff 2005).

In short, the metaphor of the Panopticon has emerged as a panoply of panopticons with an abundance of exceptions, corrections, and alternatives. As Kevin Haggerty (2006) observes, there is something analogous in this plethora of panoptic tropes with Thomas Kuhn's notion of anomalous exceptions to the normal paradigm of science. As anomalies accumulate, the burdens of accounting for (or ignoring) observational and theoretical exceptions rise to the point that the existing paradigm is no longer the best or easiest explanation for what is seen. The elegance of parsimony is lost in a blizzard of exceptions. Under the status of "normal science", an older, more complicated paradigm is displaced by the simplicity of a newer paradigm. What has gone wrong?

The Failure of the Metaphor

We have arrived at a point where some critics now posit that the Panopticon model is no longer applicable. Zygmunt Bauman (1993, 1998, 2007), for example, concludes that a production society has been displaced by one driven by one driven by consumption. This has altered, on the one hand, the role of the spectator from one of observing others to, on the other, one of observing commodities and being observed. The viewer herself becomes the one who is viewed and commodified simultaneously. This transformation occurs not through panoptic discipline, but as the result of being "willingly" seduced -- a process that culminates in what Anders Albrechtslund (2008) refers to as a participatory surveillance.

Roy Boyne (2000) builds on Bauman's analysis of the consuming society, but adds four other conditions to support an argument that we are in a post-panopticon age. First, the internal logic of the Panopticon presumes that the imposition of discipline will encourage self-discipline which in turn will result in self-regulation and inevitably culminate in the dissolution of a need for the Panopticon. Second, the reaction to the lessons of what is learned in the imposition of discipline in the Panopticon will be incorporated into a predictive anticipation of discipline. This foreshortening of time similarly contributes to the dissolution of the Panopticon, which in its initial state is primarily reactive. Third, it is empirically obvious that while a few watch the many, there is also the many watching the few (a point expanded below). And fourth, "panoptical regimes are now self-defeating, generating sufficient subject 'malformations'" making "post-Panoptical compromises inevitable"(Boyne 2000: 299).

Another set of critiques build around the assumption that in any contemporary Panopticon, the view will always be technologically mediated, and that this media inevitably distorts what is seen. Majid Yar delineates how a strict interpretation of Foucault's Panopticon can, in his words, "pathologise the relationship between subjectivity and visibility". Citing Foucault, he notes "the major effect of the Panopticon [is] to induce in the inmate a state of *conscious* and permanent visibility…for what matters is that he *knows* himself to be observed." (Yar 2002: 261). His critique is,

> that the functioning of panoptic power rests in its essence not upon *visibility* (the fact that the subject is visible to the eye that observes), but upon the *visibility of visibility* i.e. that *conscious registration* of being observed on the part of the subject (*seeing* and *recognizing* that he is *being seen*) is what induces in the subject the disciplining of his own conduct. The centrality of the consciousness of the subject runs counter to all of Foucault's avowed intentions, as he clearly purports to reject the 'philosophy of consciousness' that once dominated French philosophical life (manifest most explicitly in the phenomenological tradition… (*ibid*).

Directions, Inversions, and Fractals

Leman-Langlois (2003) suggests that behavior observed through mediated technics such as CCTV, frames the context of what is seen and constrains reaction, a condition he refers to as a myopic Panopticon. A similar form of mediated distortion is documented by Mann, Nolan, and Wellman (2003) by what they call a neo-panopticon which entails an inversion of what and who is seen from the utilization of "wearable computing devices", provoking what they call "sousveillance" (or what Michael Welch (2011) calls "counterveillance"). Turning the perceived into perceiver, the authority of what constitutes the Panopticon is not so much inverted, as subverted, which, in turn, raises questions of the relationship between surveillance and voyeurism or exhibitionism. Finally, DeAngelis (2004) proposes that the instantiation of a multiplicity of points of singular observation creates a fractal Panopticon in which each view, independently, create points of control (and resistance), but which, as a whole, represent a fractured point of control.

Synopticon

Third, there are a series of theorists who proffer that the unidirectional views of the Panopticon have given way to a multiplicity of views. First, Tim Mathiesen posits that the synopticon has emerged in parallel to the Panopticon, where it is the many who watch the few. More importantly, the panoptical and synoptical have "developed in intimate interaction, even fusion, with each other". (Mathiesen 1997: 223). Groombridge (2002) extends the implications of Mathiesen's synopticon by asking whether we might gain greater transparency in the viewing process if all of us were to be watching everyone else -- a condition he calls the omnicon.

Oligoptica

Bruno Latour proposes a much more elaborate theorization of the Panopticon. His interpretation arises from an ontological presupposition that all entities, human and non-human, comprise a network of relationships (some of which are material and some of which are semiotic). These relationships intersect at nodes which are capable of calculations. But in Latour's reading, these nodes, or as he calls them, sites, are limited in what they can "see" or compute: "oligoptica are just those sites since they do exactly the opposite of panoptica -- they see much too little to feed the megalomania of the inspector or the paranoia of the inspected, but what they see, they see it well…From oligoptica, sturdy but extremely narrow views of the (connected) whole." (Latour 2005: 181).

Surveillance, Speed, Simulation -- Living in the Matrix

Finally, there is William Bogard's synthetic perspective in which the Panopticon (Foucault) is assembled with simulation (Baudrillard) and hyper-speed (Virilio's dromological effect). Building on Bergson and Delueze, Bogard argues that surveillance constitutes the recording of "flows of events", translations of activities into information that can be sped up and slowed down, cancelled, or modified. (Bogard 1996: 43). The observer also has the ability to intercept and modify the translation. The reflection of the Panopticon is, ironically an illusion, a source of resistance to the system of domination. Just as the Panopticon can simulate the presence of the inspector, Bogard notes, borrowing from de Certeau, the inspected can invoke *la perruque*, the faking or simulation of compliance. (*ibid* 110). Similarly, following from Virilio's analysis of the "logistics of perception", Bogard observes that the simulation is itself an illusion of what is, as the time for what was seen has already passed. (*ibid* 91). In each of these critiques, the power of the Panopticon is challenged, resisted, even dissolved in a myriad of views, simulations, and finite perspectives.

V. Shadows of Forgotten Ancestors

For than thirty years, Foucault's metaphor of the Panopticon has produced a dazzling array of innovative analogies, corrections, addendums, and extensions. Even the rejection of the trope has resulted in a bewildering number of inventive alternatives. Some theorists claim now that Foucault's Panopticon needs to be resuscitated (cf. Caluya 2010). How do we assess this prodigious output? A success? A failure? Or something else?

The important question isn't why the metaphor has been so durable, but what does it tell us about surveillance and technology? Though this project is in no way intended to be a critical reading of Foucault, I want to suggest that Foucault has been, at least with respect to understanding surveillance and technology, misread. Or perhaps, not so much misunderstood, as his work requires a re-reading, not to find what the reader may have missed, but to determine what Foucault did not think needed to be excavated.

I outlined in the first half of this chapter a series of events in the sixteenth and seventeenth centuries that entailed embracing a different set of cognitive experiences and emergent identities. This difference led, in turn, to a philosophic questioning of *how* we know something and *how* we can determine the certitude of that knowing. My contention is that Foucault, on the surface, represents the apotheosis of this centuries-long epistemological shift, where the centers of interest moved from unity to multiplicity, from objects to subjects, and from things to discourse. This primarily becomes the challenge of interpreting the correspondence between the appearances of the world and our representations of those appearances. But three or four hundred years of this obsession with correspondence, coherence, deflation, and pragmatism, and a multitude of other theories of truth has resulted in what Levi Bryant (2014) refers to as an "epistemic closure" to the possibilities about which we can speculate, but of which we cannot see, and a "confirmation bias" about the certitude of that which we have already, of necessity, determined must be true. The discourse of truth in modern epistemology has excluded not only the questions, but the grammar, syntax, and semantics of the quiddity of things.

In the next chapter, I lay out one possible response to this vacuum -- a set of propositions built around ontology. There are many advantages to an ontological reading for things like surveillance and technology that move us beyond the reflexivity of epistemic understanding. But, as we shall see, ontology imposes some equally significant limitations.

Chapter Four: The Ontology of *Things*

Ontology is the study of what things are at their most fundamental level. The Litany of SAGE gives us an enormous display of the kinds of things that exist in the world, specifically those kind of things that entail surveillance and its use of technology. What can ontology tell us (and not tell us) about these kinds of things? That is the question this chapter sets out to answer.

Introduction

In this and the following chapter, I introduce two alternatives to an epistemic approach to understanding things like surveillance and technology. The first of these, presented in this chapter, is called *ontology*, or the study of the existence of things. In the following chapter, I introduce a second approach which I refer to as *ontigeny*, or the study of how things come to be. In many ways, these are related interpretations in that they share a common interest in determining *what* constitutes the world, as opposed to focusing on *how* it is we as human beings interpret the world. But there are fundamental differences between ontology and ontigeny that radically diverge when explaining something such as SAGE and related techno-surveillant phenomena. Though I argue that ultimately ontigeny corresponds more closely to the way the world actually works and behaves, the legacy of ontology fundamentally inheres, albeit, largely unconsciously, in the conceptual ways Westerners think of the world. As a result, we need to excavate these ontological presuppositions before we understand how ontigeny critiques this older metaphysics and moves to establish a new paradigmatic interpretation.

In this chapter, I approach ontology from two movements: "classical" ontology which has its origins in Aristotle; and the second, a contemporary revision of Aristotelian ontology informed by systems theory research in biology (Humberto Maturana and Francisco Varela), development and organization theory (Susan Oyama), and communications (Niklas Luhmann). I refer to this latter approach as "neo-classical". Underlying the difference between these two approaches is a return, following a lapse of five hundred years, to the question of what it means for something to exist (i.e., *to be*). The inflection point in this *re-turn* is the work of Martin Heidegger who contributed much to resuscitating and legitimating ontological research, while drawing our attention to the significance of technology. I conclude this chapter by illustrating how ontology can be applied to explaining something like SAGE.

What is Ontology?

While epistemology is the study of *how* we can know the world, ontology is the study of *what* kinds of things there *are* in the world that can be the object of such knowledge. As simple as this distinction is, the details about what constitutes or justifies ontology exhibit an extensive, and frequently conflicting, range of opinions, which can be thought of as comprising three broad categories..

Ontological *realists*, for example, presume that the world is constituted independent of how or whether we think about it and that things like color exist independent of our perceptions. In this way, some realists argue, a red-like color inheres in an apple because the apple partakes in a more universal quality called "reddishness".

Thus, realists usually assume the existence of abstract universals which transcend immanent qualities found in particular instances of things.

By contrast, ontological *nominalists* assume that there is no such thing as a universal "reddishness" that can be applied to individual things. To be a universal means that it transcends (lies outside of) any particular instance, which suggests that some things are more real than other things. For an extreme nominalist, to say that a red apple and a green apple are both apples is only to predicate "X is an apple" and any ontological similarity between the two apples is only a consequence of language.

Somewhere in between these two polar opposites is a *conceptualist* ontology arising out of the Kantian tradition. This approach assumes that the world is independently real, but that the way in which we know this reality is through *a priori* categories which we cognitively conceptualize and apply to our experiences.

Though nominalism and conceptualism have made important contributions to understanding ontological problems, in this chapter, I will pursue what I believe is singularly distinctive about a realist ontology and why I think it is applicable to the study of surveillance and technology. To frame this conversation, there are three fundamental principles of ontological realism, which are applicable to both classical and neo-classical ontology:

- To say that a thing *is* is to assert that the thing exists;
- To say that a thing exists is to assert that it is *real*; and,
- To say that a thing is real is to assert that it is *mind-independent*.

In other words, to claim that a thing *is* is to simultaneously assert that thing's existence and, reality, and that its existence can theoretically be established independent of human beings. These are strong claims, considering the alternatives posed by modern epistemology. However, when they are applied uniformly, they form the basis for a coherent ontological realism.

Part I: Aristotle and an Ontology of Substance

The starting point for most investigators in thinking about ontology usually begins with Aristotle, whose considerations of ontological problems spans a number of his diverse texts. Of his corpus, I am specifically interested in four questions: what is the metaphysical basis of *things*, how things change, how we use these qualities or properties to know things, and to understand the distinction between the idea of a thing and its concrete manifestation,

I. Deconstructing Things

Aristotle's investigation of natural *things* in the world and the relationships among these things is found in his book entitled, *Phusis* ("Nature"). In this text, he examines the presence of all kinds of natural things, of the change and causality (or coming to be) of things in general, of natural order and regularity, of natural things that come to be of their own generation and things that are made, and of the ways natural things exist because of their shape (*μορφή*) and form (*εἶδος*) which, when combined with matter (*ὕλη*), instantiate material things. But, Aristotle believes there is more to things than shape, form, and matter -- that there is something constitutive to things above and beyond what is empirically observed.

Being and beings

What this something constitutive might be is developed in Aristotle's *Metaphysics*, or "beyond physics", in which, his goal is to uncover, at a fundamental level, what makes the world the way it is. He sets forth two objectives: to understand the first cause *(αἰτία)* of things and to uncover the fundamental principle (*ἀρχή*) that underlies the existence of such things. (981b28). In Book IV, chapter 2 of *Metaphysics*, he establishes that questions of substance and Being are simply two aspects of the same underlying problem. He goes on to conclude that it is something called substance (*οὐσία*) which is both first cause and the fundamental principle. (1041a6). Thus, to the extent that there is an object to be investigated, not in and of itself, but in terms of what it can tell us about Being, it is something called *substance*.

To conduct such a study is to investigate the nature of Being, not as an object, but as it is "to be" or what Aristotle refers to as *being qua being* (*ὂν ᾗ ὄν*). (1003a23). Thus, broadly construed, ontology is the study of existence as a general phenomenon and the relationship this has with the existence of specific things -- to find in what way *Being* constitutes the viability of *things* and the ways *things* come to be a manifestation of *Being*. Martin Heidegger refers to this distinction as the fundamental ontological difference between *Being* (existence) and *beings* (existents).

At the Root of Things

To be clear, the most elementary object of Aristotle's investigations into things is called a substance. But, what is this “substance”? It turns out there is not a simple answer to this question. Take, for example, a cooking pan that is filled with water. At this point, what is in the pan is a liquid. If I place the pan on the burner of a stove and start heating the pan, the liquid will be begin to evaporate into a gas of steam. Alternatively, if I place the pan in the freezer, eventually the liquid will solidify into ice. In each of these cases, the basic element with which I am working is something we call H_2O which has been transformed into different states. The materiality is the same, but the form and shape have been altered. Similarly, I could, with the right apparatus, apply direct electric current to a stream of water and chemically convert the water into hydrogen and oxygen molecules through electrolysis. In this case, I am altering the matter, form, and shape of an original substance into something else. Yet we all know that at the molecular level, nothing has been so radically altered as not to be restored to its original state. An ontologist would claim that at the most fundamental level, the Being of everything remains constant. If that is the case, then what is Being such that it is also substance?

Substances and Predicates

In the *Metaphysics*, Aristotle acknowledges this confusion when he states, “There are many senses in which a thing may be said to 'be', but all that 'is' is related to one central point, one definite kind of thing, and is not said to 'be' by a mere ambiguity.” (1003a21). While, the science he seeks to establish is confounded by the many meanings of the word “being”, these meanings all converge around one common nature -- “one definite kind of thing” -- the primacy of which is found in the “what” of “what-is”. “[T]hat which 'is' primarily is the 'what', which indicates the substance of the thing.”(1028a13).

In one of his earliest essays, *Categories*, Aristotle establishes that the structure of reality is reflected (though not established) in how we speak about the world. He says that when we speak of a thing we refer to a substance and its predicates. Substances are the fundamental things we encounter in the world, while predicates refer to the properties or qualities of these substances. Aristotle observes that there are two principal forms of predicates: those that are *said-of* a substance and those that are *in* a substance. The first type of predicate links the name of a subject with its definition. For example, the subject "human being" is *said-of* an individual named "Jane" and "rational animal" is *said-of* a "human being". This form of predication corresponds to a taxonomical organization of substances in which the most generic predicates are at the top and the most particular substances are at the bottom. Aristotle observes in *Of Interpretation* that that "which is of such a nature to be predicated of many subjects" is known as a *universal*. (17a37).

On the other hand, to be *in* a subject is to describe a quality of the subject, e.g., the apple is red indicates that the color red is *in* the apple. Such a predicate exists only to the extent that it is actually *in* a subject. It has a dependent existence -- without the subject, the predicate does not exist. Thus, we can speak of Jane’s being white, in which the whiteness is a property that inheres to Jane as a subject. But we cannot speak of white as existing independent of Jane (or the sum of all such subjects), nor is the whiteness a part of Jane. It is a predicate property *in* Jane. In this way, predicates are not some ancillary part of a subject (as a hand is to a body), but *inhere* within the subject as a property of that subject. These predications are contingent or accidental.

Primary Substance

Most importantly, there are things which are neither *said-of* nor are *in* a subject. These kind of things do not predicate another thing, but are individual and particular things which Aristotle refers to as *primary substance*. These kinds of things can only exist as subject and never predicate anything else. These primary substances always have the quality of “this” – a thing that is unique and different. Primary substances also persist in remaining the same kind of thing, even when they possess or exhibit contrary qualities. Thus, it is *said-of* Jane, that she is a human being, while nevertheless, she is at one moment pale and other quite tan. This suggests that primary substances persist in some way that is different than the substances that are *in* primary substances like color. The relationship among things -- natural and artificial -- are organized into an inverted arboreal configuration in which the trunk represents an apex which is populated downward by branches of inherited properties. No entity is independent of the hierarchical relationships in which it is situated.

Matter, Form, and Hylomorphs

Aristotle suggests that there are three fundamental kinds of basic "stuff” found in any substance: matter, form, and the combination of matter and form – which he refers to as a “hylomorph”. Take the example of a table which is a hylomorph (matter-form). The matter of a table is wood. The form of a table is a set of upright shafts connected to each corner of and support a flat surface. Now it should be obvious, that the most intuitive and direct way of thinking about the substance of a table is what comprises its material existence (wood). After all, our first sensible encounter with any individual thing is its materiality. But take away the properties of a thing (quality, quantity, or place) and you are left with an indistinguishable collection of matter – materiality without form which has no “thisness” (*haecceity*) and lacks a “something”. Without the matter of wood (or stone), all we are left with is the form of a table as a concept. For this reason, Aristotle argues, form precedes matter. And if form precedes matter, then form must also precede the combination of matter and form as well. Thus, neither matter nor a hylomorph can be what constitutes substance. What remains is form – but is that what comprises the Being of substance?

Essence

To address this problem, Aristotle turns to the question of the “whatness” or essence of a substance. “The essence of each thing”, he posits, “is said to be what it is for its own sake.” (1029b14). There is an identity between the whatness of a thing and the thing itself, and that this identity is not accidental. “Clearly, then, each primary and self-subsistent thing is one and the same as its essence.” (*ibid*, 1032a5). Claiming that form precedes matter, Aristotle asks whether, form inheres in the making of a thing, and if it does, then there is a connection between form and essence and the constitution of substance. Indeed, this is precisely what Aristotle proposes, “when I speak of substance without matter, I mean the essence.” (1032b15). It is important to note that for Aristotle, form has two aspects: one is its sensible morphology and the second is its conceptualization as an idea. Form is embodied in a thing, which is also is its essence. While thinking of a thing is founded in the form, the instantiation of what is thought is a making, or product. The essence of the form remains constant from conception to production. Essence is not just a part of a substance, it is its principle and its cause. (1041b8). Therefore, essence precedes existence.

II. The Way Things Are

Deconstructing things presumes an already constituted world -- a world that is given. It is this "giveness" that confirms our engagement with the materiality of the common, everyday ways of being in the world. This is a materiality we know as spatial. At the same time, this "giveness" of the material is transitory, already becoming something other than what it was just a moment ago. The temporal dimensions of things are not as tangible as those that are spatial, so we have learned to subordinate the temporal by metaphorically accounting for our transitive experiences in spatial-like terms as we find in Western theories of causality or origin.

Causality

Aristotle observes that there must be a reason for why things are the way they are. Aristotle's explanation for the origination of things is what he calls "cause" (*αιτία*), for which he posits that there are four ways in which things come to be:

a.) a material cause which demonstrates the matter out of which something is comprised;

b.) a formal cause which accounts for the essence of what something is;

c.) an efficient cause which articulates how something comes to be as it is, for example, by an agent; and,

d.) the final cause or the ultimate function of what something is. (*Physics* 194b24-36).

In acknowledging that *things* change, Aristotle establishes an ontological uniformity by demonstrating that the kinds of causality underlying this change is the same for all kinds of things.

Non-contradiction

The uniformity which Aristotle establishes is based on a set of assumptions arising from the principle of non-contradiction, an axiom with its origins in Parmenides. The great division in western philosophy between being-as-it-is and being-as-it-is-becoming has its first articulation in the dispute between Heraclitus (things are in constant flux) and Parmenides (things are as they are). For Parmenides writes, "that being is ungenerated and undestroyed, whole, of one kind and motionless, and balanced. Nor was it ever, nor will it be; since now it is, all together, one continuous." He continues, "for if it came into being, it is not." (Parmenides 1982: 178).

Aristotle's interpretation of this edict is extended by his principle of non-contradiction of substances where he writes, "such a principle is the most certain of all...it is, that the same attribute cannot at the same time belong and not belong to the same subject." (11005b19). This axiomatic assertion establishes that not only can a *thing* be and not be simultaneously, but that attributes of such a *thing* cannot both be and not be. Clearly Aristotle recognizes that things change or are altered arising from the modes of causality. But this is only with respect to difference over time. But even here, Aristotle is careful to identify change of a *thing* at the surface level, not at its essence. The justification for this interpretation arises from Aristotle's commitment to the persistence of a *thing*'s unity and identity in and across time.

Persistence, Unity, and Identity

Having declared that things cannot both be and not be, Aristotle confronts the question of whether things that are, can come to be, and in what ways they retain their unity in time and their identity over time. Aristotle uses the example of a piece of unshaped clay that is shaped into a sculpture. Clearly, once the sculpture is completed, there is longer a raw piece of clay. Yet, intuitively we know that the lump has merely been transformed and from the four modes of causality we can explain this transformation.

But Aristotle is interested in a far more deeply-rooted phenomena -- namely the essence of the clay which retains its unity in time -- the clay is still a silicate based matter and still retains its ability to be shaped and formed until all of the water is removed from its content. This dehydration alters the form of the clay. But isn't the essence of clay in its form? Aristotle's answer is that the pile of clay always has the *potentiality* to become actualized as a sculpture. It is through this potentiality that the essence of clay persist over time.

As a result, Aristotle establishes, at the most fundamental level, that the essence of a thing persists in both its unity *in time* (different properties do not affect a thing's essence) and its identity *across time*. This conclusion, I argue, has had as great an effect on western philosophy as the substance/essence theory has had for the fundamentality of a thing. Western philosophy struggles with creation and degeneration, on the hand, and temporality, on the other.

Privation

This is not to say that, for a given thing, the Aristotelian tradition doesn't recognize that things change. However, their account for what changes is not the essence of something, but its properties. The persistence of the essence of a thing, namely how a thing may take on contraries as a predicated subject, while retaining its essence is accounted for Aristotle's theory of privation. For example, a woman that was pale that now becomes tan does not change her *thisness* as a woman. Following from the principle of non-contradiction, something is either a *this* or *not-this* and a *this* cannot arise from a *not-this*. But Aristotle argues that this binary condition ignores a ternary possibility of “privation”. This is not the existence or non-existence of a substance, but its *absence* which has yet to manifest itself. The principles of change, he declares, arise from contraries. (189a10). What was not-white becomes white, a woman that was pale, becomes tan, etc. “The alteration from non-subject to subject, the relation being that of contradiction, is 'coming to be'…e.g., a change from not-white to white is a coming to be of the particular thing, white..... Change from subject to non-subject is 'perishing'”, (225a5-19). What is persistently present is the being of the thing -- a beingness that is only potentiality -- which is not realized until the transformation has been realized.

Being and Becoming

This raises the question of how do substances actually come to be as they are? Recalling that the origins of ontology is in the study of first principles or causes, Aristotle returns to this problem. The question, as he puts it, isn't why is a house a house, but rather why do the bricks and wood that comprise a house come to be this thing called a house? His metaphysical explanation is, in fact, derived from his study of nature, wherein, he asks three questions: why do things belong together, why do they persist, and how do they become the things that they do, i.e., how do they change?

The first problem is one of causality, namely, how is it that one substance is predicated of another, i.e., how is it they have cause to belong together? As Aristotle writes, "What we seek is the cause, i.e. the form, by reason of which the matter is some definite thing; and this is the substance of the thing." (1041b6). Given that substance arises from form, which is the essence of the thing, what we come to identify in this relationship is the cause of the being of the thing itself. It is not the matter of the existence of a man's flesh, but the form that the matter, as flesh, takes that is most elemental – namely that of a human being. (1041b26). This is the question of becoming, which is a problem of primary being. "Only substances (primary beings) are said to 'come to be' in the unqualified sense." (190a32). However, this coming to be arises, not from something new, but, as I noted above, from the potentiality of an essence that already exists.

Potentiality and Actuality

The difference between what is and what is “coming to be” (*γένεση*) is defined by Aristotle as the distinction between potentiality and actuality. Potentiality or power is “in a sense the potency of acting and of being acted on is one (for a thing may be 'capable' either because it can itself be acted on or because something else can be acted on by it)”. (1046a22). The absence of power is simply impotence, or the privation of potentiality. This power can exist in two ways: as a source of movement or kinesis, or as a capacity to be different. This should not be interpreted as a latent power, but as an active capacity to be acted upon. Aristotle calls this capacity when it is realized, *energeia*, or actuality. Thus, a person who is sick becomes well. The status of the primary being who is ill is altered by the effects of a physician or medical treatments in order to restore the primary being to wellness. In a similar way, a person who walks around with her eyes shut attains a more complete actuality when she completes the same act with her eyes open. Actuality is prior to potentiality in two senses: first, the outcome of what is potential is unknown until the transformation is realized, and second, as we are talking about natural things, whatever is potential has its genesis in something that was already actual. As Aristotle writes, “man generates man.” (193b10).

III. How We Know Things

Having depreciated the over-blown significance of epistemological questions in the prior chapter, I want to return to these same questions to acknowledge that *what* we think about things does in fact shape *how* we think about those same things.

Natural Things and Artifacts

For example, Aristotle's insistence on uniformity does not extend to all the kinds of things that exist in the world. In particular, he distinguishes between natural things and those that are made (artifacts).The former, Aristotle says, is a kind of thing which "has within itself a principle of motion and stationariness (in respect of place, or of growth and decrease, or by way of alteration)" (192b12) as well as a capacity for replication and regeneration. This capacity inheres in the properties of a *thing*'s form, within which resides the potentiality to be some *thing* or somewhere. This, Aristotle concludes, "is one account of 'nature', namely that it is the immediate material substratum of things which have in themselves a principle of motion or change." (193a27). In fact, natural things are always subject to a continuing and internal necessity to change. Causality for natural things can arise from *within*.

By contrast, Aristotle differentiates that which is natural (self-generating) from artifactual things, which do not reproduce themselves, change of their own accord, or generate their own mobility. (192a8). What distinguishes an artifact is its materiality (the stuff out of which it was made) such that a brick made of different kinds of clay materials will be different, even though the maker intends both products to be a brick. So it is with all other artificial products. There is nothing inherent in artifacts that gives them any power. Thus, despite the fact that everything has a form (shape, function, and purpose), natural things are ontologically unique in form because the properties of a natural form inhere to a subject, while the genesis of form for artifacts lies outside of itself, with its maker: "none of them has in itself the source of its own production." (192b27). For artifacts, causality only arises from *without*.

As a result, the primary focus of Aristotle's ontology is on what is natural, mobile, and regenerative, at the expense of understanding that which is made and fixed in the absence of any self-generated cause for motion. This interpretation of an inherent difference between natural and artificial things persists today and is a latent presupposition of much of research into surveillance and technology -- both of which are viewed as man-made activities with man-made artifacts. This kind of distinction is what makes it so hard to interpret the kinds of things we find in surveillant and technical practices. These are existents without ethics, politics, or sublime aesthesia. The essentiality of an artifact lies outside of itself -- namely with the human being that makes it, be it an artist, or an engineer. This distinction affects not only how we think about what we can know, it also blinds us to how we think we should know.

Episteme and Techne

This approach to unity and identity has consequences for how we know things. Propositions that are true, for example, should always be true. And things that are made once were not and when they are broken, they are no longer. As a result, there is a contingency or an accidental quality to things that are made. Natural things, on the other hand, because they have the capacity to perpetuate themselves over time and across space have a universality that makes them profitable objects of investigation for what is true. Thus, different kinds of things are the focus of different kinds of knowledge.

In Book VI of the *Nichomachean Ethics*, Aristotle says that the first kind of knowledge is theoretical (scientific) knowledge which he refers to as *episteme* (*ἐπιστήμη*)-- a type of knowledge (i.e., justified belief) ascertained from understanding what "causes" something to exist as it does. All kinds of knowledge start with things already known. (*Posterior Analytics* 71a) But new knowledge (i.e., judgments) is derived from a process of induction and syllogism -- the former constituting the kind of judgment that presupposes knowledge of universal laws, while the second begins with universals and deduces conclusions from them. (*Nichomachean Ethics* 1139b30-34). *Episteme* is thus "a judgment about things that are universal and necessary...and follow from first principles". (1140b31). *Episteme* is the foundational capacity to apply reason in knowing the world and for the study of things which persist.

He posits that there is another kind of knowledge which is practical (of the arts) or *techne* (*τέχνη*) which is about *doing* something, either a kind of "doing" (that produces something as in carpentry or farming), or entails acting (which does something without the goal of producing something). *Techne*, Aristotle writes, "is concerned with coming into being, i.e., with contriving and considering how something may come into being and whose origin is in the [artist] and not in the thing made; for [*techne*] is concerned neither with things that are, or come into being, by necessity, nor with things that "come into being of their own accord and nature. (1140a10-15). For Aristotle, the fundamental distinction between how one can know something resides in a difference of how something comes to be and the origin of that genesis, it turns out, depends on a distinction Aristotle makes between natural and made things.

IV. Objects and Things

Having progressed through Aristotle's account of what accounts for a thing, it is important to observe that a *thing* is still a conceptual entity. It does not have any materialized presence as an object. The visual theorist, W. J. T. Mitchell offers a compelling trope for understanding the difference between objects and things,

> Objects, objectives, object lessons, and objecthood put things into circulation within a system. 'Things' themselves, on the other hand, have a habit of breaking out of the circuit, shattering the matrix of virtual-objects and imaginary objectives...Objects are the ways things appear to a subject -- that is with a name, an identity, a gestalt or stereotypical template, a description, a use or a function, a history, a science. Things on the other hand, are simultaneously nebulous and obdurate, sensuously concrete and vague. A thing appears as a stand-in when you have forgotten the name....So things play the role of a raw material, an amorphous, shapeless, brute materiality awaiting organization by a system of objects. Or they figure the excess, the detritus and waste when an object become useless, obsolete, extinct, or (conversely) when it takes on the surplus of aesthetic or spiritual value, the *je ne sais quois* beauty, the fetishism that animates the commodity.... (Mitchell 2005: 156).

This distinction sets apart the object, which we behold, and the thing, which has its own vitality and sparkle, some part of which is visible and much of which is invisible, retaining the potentiality to be more than the object at which we objectively gaze. This hidden reserve becomes an essential power of a thing to manifest itself as different kinds of objects -- a power Aristotle refers to as "potentiality". But there remains no account for just what this potentiality is, nor how it is materially transformed. In the next section we examine a neo-Aristotlelian approach that does seek to explain this process of potentiality, as a process of information and development.

Part II: Speculative Realism and the Ontology of Things

I. Starting with Heidegger

At the beginning of the twenty-first century, a group of philosophers, media theorists, political scientists, and literary critics began to return to some of the same questions Aristotle had posed--turning away from anti-realism and obsessions with epistemological issues and towards questions that inquire into the structure of what is real and how it is constructed. This initiative -- to call it a movement is premature -- is striving toward laying out the conditions of what constitutes a systematic accounting of what is real. At the same time, these philosophers want to avoid returning to a pre-critical rationalism that presumes that reason, unaided by empirical experience, can derive the foundations of this reality. This work is very recent and exploratory, and commensurately, those contributing to this interpretation have termed it "speculative realism".

The initial set of questions was formulated by Graham Harman (2002) in a critical elaboration of Martin Heidegger's theory of equipmentality (*das Zeug*) and what has often been translated as "tools". Heidegger, in *Being and Time* (1962) seeks to re-establish ontology as a crucial enterprise and the problem of Being as the critical issue of philosophy. In insisting on the ontological question, Heidegger rejects Edmund Husserl's approach to understanding the phenomena of existence as something that we can bracket (*epoché*) and examine objectively. Instead, Heidegger argues that the relationship between Being and the world is comprised of a spectrum of valuations, or modes of Being. Heidegger defined three such modes -- ourselves as Beings, or what he called *Dasein*, things-in-the-world, upon which we held a "theoretical" gaze and are present-at-hand (*Vorhandenheit*), and things-in-the-world with which we used to extend our relationship to the world or things that were ready-to-hand (*Zuhandenheit*).

Tools exemplified the things which enabled the mode of ready-to-hand -- tools were a means of being-in-the-world for Dasein. Heidegger's argument was, at the time, radical. It challenged Kant's concept of Being as a function of the mind where *a priori* cognitive structures made sense of the world's appearances. Similarly, Heidegger's model broke the dualist conundrum of Descartes, in which knowledge of *res extensa* (the world) could only be derived from *res cogitans* (mind).

The Broken Tool

Harman had two significant problems with Heidegger's approach. First, the structure of Being was anthropocentric. *Vorhandenheit* and *Zuhandenheit* derived their status from the perspective of *Dasein* -- that is, us as human beings. While this is a theoretical problem, it might not have been persuasive, if not for the second problem. Tools derived their status from the degree to which they enabled a readiness-to-hand for *Dasein*'s being in-the-world. Harman asks, what happens to the status of a tool if it is broken or not appropriate for a given task? Heidegger's response is that the tools slip back into a state of present-at-hand. Does this mean, Harman asks, that tools lose their status as tools? Has their status as an object changed? Heidegger's reply would be that their status derived not from the status as an object, but from their *relationship* to *Dasein*. This, for Harman, is a fundamental problem, because the tool as object hasn't changed, only its relative usability.

The Centrality of Objects

In fact, Harman conjectures, the tool, as an object, withdraws into itself as the object it always was before it was considered a tool. If its status has changed, that is because its functional status for *Dasein* has changed, not the status of the object. In fact, from the tool's perspective, its usefulness as a tool for *Dasein* is simply a manifestation of a much larger capacity (most of it hidden) reserved to the object itself. Another individual might see in the object a completely different usefulness (perhaps aesthetic), unrelated to its earlier status as a tool. As a result, Harman argues that objects need to be brought to the center of philosophical investigation, a shift he initially referred to as object-oriented philosophy.

II. Speculative Realism

In April 2007, Harman, Meillassoux, Iain Hamilton Grant, and Ray Brassier joined moderator Alberto Toscano at a conference at the University of London's Goldsmiths College entitled "Speculative Realism".[30] Though each of the authors ultimately had very different interpretations of what they were undertaking, they nevertheless established a common set of assumptions that represent a shared critique of the legacy of modern philosophy. The conference title -- speculative realism -- stuck as the denomination of a re-vitalized approach to a realist ontology. There are four common principles that emerged from this conference and to which nearly all subsequent "speculative realists" have subscribed.

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[30] The papers from this conference were published in Robin Mackay [ed.] (2007) *Collapse III: Speculative Realism* Falmouth: Urbanomic

Correlationism

First, Quentin Meillassoux argues that modern philosophy suffers from what he refers to as "correlationism", by which he means "the idea according to which we only have access to the correlation between thinking and being, and never either term considered apart from the other." (Meillassoux 2008: 5). In this interpretation, correlationism is a form of anti-realism in which the *idea* of an object, rather than the object itself, is what can be known and manipulated. In this sense, objects are nothing more than mediated fictions in the form of judgments or associations by which we can never apprehend "things in themselves". This position is inherited from Descartes, Locke, Hume, and Kant -- each of who, as rationalists, empiricists, or transcendentalists, assume that our knowledge of the world is mediated by the perception of a subject and shifts the understanding of the world from an ontological problem to one of epistemology. In the *Critique of Pure* Reason, Kant holds that what we can know about a thing is subjectively realized through the unity of intuition and the innate categories of judgment. In his interpretation, while the noumenal world is real, it can never be known apart from what appears to the subject. Without denying the materiality of the world, its existence as an "affair of knowing" is entirely cognitive. In this sense, modern philosophy has made the question of "what is real" subsidiary to *how* we know it, rather than asking what is the kind of world that would make our kind of knowing possible.

Finitude

Meillassoux extends this critique by arguing that Kant established the finitude of human understanding at the limits of the transcendental unity of apperception. This boundary justified Kant's claim that we could never know the "thing in itself" but only its appearances as judged by transcendental reason. Objects and the stuff of the world were always outside the bounds of our true understanding. In this way, warranted correlationism justified thinking of our relationships with the world as problems of language, discourse, power, etc. Ironically, Meillassoux saw in mathematics the source of a pre-human, archaic form of knowledge by which to know the true nature and structure of objects. Of course, this method is no less transcendental than Kant's critique of reason, and simply replaces categories of judgment with an *a priori* intuitionism. But Meillassoux's critique of "correlationism" stuck and has been a common denominator in object-oriented approaches to ontological problems.

Something More, Something Less

There is a general consensus that philosophy (as well as the social sciences) suffers from a strong propensity to inflate and deflate objects into something other than which is immediately apprehended. Harman (2005) refers to this as over-/under-mining, while Tristan Garcia (2013), a second-generation speculative realist, refers to these objects transformations as "more than itself" and "less than itself". In either case, the reference is to the tendency to inflate an object into something more than what presents itself or to decompose it into more basic components--the sum of which is less than what is originally presented. For example, Platonic idealism locates the real (the Form) in a transcendental (and transcendent) aspatial and atemporal realm. The reality of the table upon which I am writing is less than that of the ideal table as a Form. My table is merely a representation of that ideal. Similarly the sociological reading of an individual -- at least in the Durkheimian tradition – is, more often than not, transformed into the reading of a social entity, where individual agency is subsumed into the social. The "less than itself" results from a decomposition of an object into its components--a position representing, among others, eliminative materialists who seek to deflate phenomena, such as consciousness to electro-chemical reactions (e.g., the work of Paul and Patricia Churchland). In either case, the object at hand is not taken as a significant end in itself, but as a participant in something larger, or as the aggregation of something smaller.

Flat Ontology

As should be clear from the first two moves, speculative realists seek to take objects-at-hand seriously. But perhaps their most radical reorientation of how to apprehend objects is the way in which they give every object, big or small, long- or short-lived, equal status among all other objects. There is no hierarchy or predication of subjects. The result is what Manuel DeLanda (2002) calls a "flat ontology". This equality in ontological status among objects does not equate to making all objects the same or equivalent, nor does it equalize the individual intensity among objects. It simply asserts that no object can be relegated as ontologically inferior or superior to any other object.

Conceiving of a World Without Humans

By discrediting correlationism, conceptual inflation/deflation, and hierarchies of objects, speculative realists deflate the centricity of human beings in the configural accounting of the world with its accompanying positing of the subject as the focal point for the conformance of the world-to-mind and the cognitive making of the world. Nor is this critique of anthropocentrism limited to early modern philosophy when it is extended to Nietzsche (perspectivism), Husserl (*epoché*), Heidegger (*Dasein*), as well as Derrida ("*il n'y a pas de hors-texte*"). Thus, speculative realists seek to interpret a world, in spite of the presence of human beings. Beyond these four principles, the original participants of the Goldsmiths conference have radically different takes on how to develop a realist ontology and, in some cases, they now completely disavow the notion that there is any coherent or common agenda.[31]

III. Speculative Realism Redux

Not long after the 2007 conference, a number of new theorists emerged, influenced by Graham Harman (some in direct support and some in sympathetic reaction). In this project, I build on the work of two second generation theorists in particular. The first is Levi Bryant, a philosopher who began his early research working with Deleuze and Lacan, and has published two important works, *The Democracy of Objects* (2011) and *Onto-Cartography: An Ontology of Machines and Media* (2013).[32] The second primary theoretical foundation from which some of my insights have been drawn is Tristan Garcia, whose work is entitled *Form and Object: A Treatise on Things* (2014).[33]

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[31] See the Collapse III collection, op. cit. as early takes by each of the original principals as to fundamental differences.

[32] Bryant (2011) refers to "objects" and in his (2014) text as "machines". In both cases, they are included as a significant subset of what I mean by "things".

[33] In addition, media theorists Eugene Thacker (2010) and Ian Bogost (2012) have made significant contributions to materialist media theory, as have another set of theorists concerned more with a vitalist interpretation, Jane Bennett (2010) and Tim Morton (2013a, 2013b). As will be clear by the end of this chapter, I find speculative realism to be an important starting point for an analysis of the kinds of objects,

Transitive and Intransitive Things

Facing a problem similar to Aristotle's dispute with Platonic idealism, Bryant is seeking the "grounds for a realist ontology". He notes the task is formidable, given that the starting point we must confront is "a general distrust, even disdain, for the category of objects, ontology, and above all, any variant of realism." (Bryant 2011: 34). Bryant turns to a philosopher of science, Roy Bhaskar, whose research question is summarized in chapter three, namely "what must the world be like if empirical science is to work?" That is, Bhaskar asserts, there must be a world of things and relations independent of how we know of these things. After all, if there were no human beings around to "know it", "see it", or "hear it", a large falling tree would still cause vibrations to move through the air, a cloud of dust to rise, and other things to be crushed underneath the tree's weight. These things, in this case, trees, Bhaskar calls "intransitive". Bhaskar doesn't dispute that there are things that are produced as the result of human knowledge which he calls transitive.[34] Bryant observes that saying that something is intransitive (i.e., is perdurant as a thing) is not to deny that the same things cannot be invariant (i.e., changes properties over time). These conditions are ontological, meaning that they are transcendental to the existence of things in-and-of themselves.

Open and Closed Systems

Bhaskar proposes his claim about intransitive things reveals its significance when we distinguish between open and closed systems. In open systems, things may or may

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things, or stuff upon which the practices of surveillance and technology are constructed. But for reasons that will similarly become clear, I think that speculative realism is blind to the instabilities, nuances, and vitality of natural processes and to what is common among them. But I am getting ahead of myself.

[34] In parallel fashion, speech act theorist, John Searle, demarcates the boundary between the physical and social worlds in referring to "brute facts" and "institutional facts". (Searle 1995).

not react or even come into conjunction with other things, and even where things do meet, things may not always react in the same way. That is because, Bhaskar asserts, in open systems, the multiplicity of relations may deflect or not affect the kinds of reactions that a thing is otherwise capable of exhibiting. He terms this as a "thing being out of phase". By contrast, the same thing placed in a closed environment, what scientists would call a "controlled environment", will, in all likelihood, consistently display the kinds of effects we call "laws", or predictable events. This suggests that things have internal powers, or what Bryant calls "generative mechanisms" that, under closed conditions, will consistently generate the same effects.

Here is the dilemma. Apparently, we cannot "know" these generative mechanisms. They are reserved and hidden from outside observation. However, given the effects arising from conjunctions in a closed system, we do know that in the "actual world" things have these transcendental powers. We can also observe the effects and we can have the experiences of the presence of the thing and its effects. This is the "domain of the real". Absent the transcendental presumptions of generative mechanisms, we are still left with events and experiences, or what Bryant (borrowing from Bhaskar) calls the "domain of the actual". The empiricist, denying any transcendental causality, is left with experience, or the "domain of the empirical".

Independence of Objects

Bryant is clear, however, that the relations an object has with other things do not define the object, that is, "objects or generative mechanisms must be *independent* of their relations. (Bryant 2011: 68, emphasis in the original). This premise sets things as separate and apart from other things, making them distinct in ways that are quite alien to theories like social constructivism. That does not mean that objects do not have relations with other things, but simply that objects are not constituted by their external relations (or what Bryant calls "exo-relations").

Internal Relations

By contrast, the generative mechanisms of an object comprise a thing's endo-relations, or what Bryant terms a thing's "virtual proper being". Here, the inheritance from Aristotle becomes clear as Bryant observes that the generative mechanisms, which constitutes the internalities of an object, are the same as Aristotle's use of the word "substance". (*Ibid* 69). Intermediating between the "virtual proper being" and what lies outside the thing is something that makes a difference between what a thing does and what Bryant calls a thing's "local manifestations".

What is Held in Reserve

These manifestations are not all of what virtual proper being is capable, because a thing may always hold what it may do in reserve. Graham Harman, perhaps, uses better terminology by describing this reserve as withdrawal. However, one significant difference between Harman and Bryant is that Harman holds that things are always inaccessible and in a state of withdrawal, whereas Bryant argues that, while external relations cannot affect the internal relations of a thing, the difference engine is affected by these external relations -- an important distinction with significant implications which will reappear in the next chapter. In short, as Bryant frames this position as, "substances are independent of or are not constituted by their relations to other objects and...objects are not identical to any qualities they happen to locally manifest." (*ibid* 70). Note as well, for Bryant these local manifestations are not something that have to be experienced in order to be deemed to have occurred. They are events independent of observation.

Substance as Power

What, then, is "substance", in an ontological sense? The answer to that question surely must dispositively indicate what constitutes a thing? Bryant's answer is circular, but intriguing, demonstrating, not only, an indebtedness to Aristotle's effort at coming to terms with the status of becoming, and Nietzsche's discovery of the will, but also Foucault's ontological proposition that what is at the heart of things is power. Bryant writes, "My thesis is that the substantiality of objects is not a bare substratum, but rather an absolutely individual system or organization of *power*." He goes on,

> powers are the capacities of an object or what it can *do*. The powers of an object are never something *directly* manifested in the world... [T]his is because the qualities of an object ever *local manifestations* of the object's power. That is, the domain of power possessed by an object is always *greater* than any local manifestation of the object's power or actualization of an object. (*ibid* 89)

The implication of this arrangement sets up the argument that when considering an object, it is not a question of what a thing is or that of which it is comprised, but what it does. Thus, when evaluating a thing, what must be considered is its acts, both those manifested and held in reserve -- in other words, a thing is its power. The difference between manifested and reserve, and here Bryant turns to Deleuze, is not the difference between actualized and potential, but between actual and virtual. As Bryant puts it, "the virtual consists of the virtual powers coiled within an object." (*ibid* 95).

Phase States

I extend Bryant's analysis, perhaps or perhaps not, in ways with which he would agree; but I see in his difference between virtual and actual a contrast between the pre-individualized substance which is "coiled" with power and has yet to take form and the substance which is manifested and has completed its generation. What links them together is that they are the same substance but in different modes. Elsewhere, Manual DeLanda refers to this difference as "phase transitions". (DeLanda 2002: 11). On the other hand, what cannot be connected to the notion of virtual and actual is the notion of qualities. The virtual does not have a reserve of qualities, Bryant posits, waiting to be manifested. As we do not have access to the virtual, all we can speculate about are the local manifestations and the external relations.

Accounting for Difference

However, the difference between how one characterizes the status of the virtual and actual has caused friction among speculative realists, the significance will become apparent in the next chapter. Harman (2009) argues that "the recourse to potentiality is a dodge that leaves actuality undetermined...it reduces what is currently actual to the transient costume of an emergent process across time, and makes the real work happen outside actuality itself." (Harman 2009: 129). Bryant responds that Harman has no interpretation for how a thing remains the same thing and also changes. Every change would entail a new thing, leading to the very point that substantive realists like Harman and Bryant aver -- a process-based ontology of events.

It is clear that what makes a thing unique for Bryant and gives it its identity is the internality of a thing. But, this uniqueness can only be known speculatively (rather than empirically), as we are restricted in our access to the interior of a thing. A thing is a black box by which we can observe its inputs, evaluate its outputs, and thus surmise how and in what ways a thing functionally manipulates this flow -- a perspective we should term "philosophical functionalism".

Individuation

Bryant's starting point for interpreting this internal functionality is to establish some boundary conditions around about which we can and cannot speculate. Bryant's earlier studies focus on the work of Gilles Deleuze, and it is on Deleuze that he relies for the first condition of this knowledge perimeter. He observes that the externalities to a thing are flows of information, not as formal content, but as perturbations to the surface of a thing. This is not information that flows *into* a thing, but disturbances that sensuously stimulate or irritate the surface boundary of a thing. There is in this flow, a compulsion to individuate -- a term borrowed by Bryant and Deleuze from Gilbert Simondon. (Simondon 1992). Individuation is a process of successive differences in maturation. This succession, which introduces temporality to the analysis, can be read in one of two ways -- purposeful (entelechy) or random (entropy). Bryant adopts the former stance. (I will return to the problem of entropy in the next chapter).

Deleuze conjectures that the difference of individuation arises from within a thing. It is important to note the distinction Deleuze makes when he is referring to what occurs within a thing (or entity). One way of thinking about this is to say that a thing has inherent, within it, the possibility or the potentiality of being *X* which, if it were to occur, would make this possibility an actuality. This approach, however, leaves the germination of this potentiality as less than something real for *X*. Deleuze axiomatically asserts what can happen is real, and thus the proper way of addressing this state is as a virtuality. It is true, that the actualized state may be only one of several virtual states, but all of the virtual states are real. Moreover, these virtual states are relational *within* the thing itself. Thus, for Bryant the capacity for a thing to change arises from its internal powers *and* the inherent differences between a thing's virtual states and what it actualizes. The powers effect the individuation, while the transformation (or what I will refer to in the next chapter as the transduction) give the powers a channel in which to maneuver. The net effect of this capacity is a tension between the power of a thing to change that lies wholly within itself and the adaptive response a thing has to the power that lies without.

Autopoiesis

Clearly, however, not all things are the same. As Aristotle proposed, there are things that are self-generating (motile) and those that are not, and that is a difference that intuitively makes sense. Bryant agrees and turns to the work of two different system theorists to amplify this distinction: the evolutionary theorists, Humberto Maturana and Francisco Varela, and the communication systems theorist, Niklas Luhmann, who also employs Maturana and Varela's concepts in his own work.

The key concepts that Bryant and Luhmann turn to in Maturana and Varela's study (1972/1980) include thinking of things as "machines" and that these machines, in turn are of two types: those that generate and sustain themselves (autopoietic) and those that exist only because they were assembled by external forces (allopoietic). As Maturana and Varela put it,

> an autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components that produces the components which (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine as a concrete unity in the space in which they (the components) exist by specifying the topological domain of its realization as such a network. (Maturana and Varela 1980: 78-79).

Autopoietic machines also "strive" (in the sense of entelechy) to maintain their organization over time. As Bryant summarizes it, "they paradoxically constitute their own elements through interactions among their elements." (Bryant 2011: 163). Allopoietic machines, by contrast, exist through a "concatenation of processes [which] are not processes of production of the components". (*ibid*). Unlike the distinction that Aristotle makes between natural things (animate and inanimate) and made things, Maturana and Varela are primarily interested in the difference between living things and non-living things. Thus, rocks, which are natural things for Aristotle, are presumably allopoietic for Maturana and Varela.

An Ontology of Emergence

As Bryant acknowledges, it may seem odd to rely on Maturana and Varela as their approach is what Bryant terms "radical constructivism". (Bryant 2011: 137). However, Bryant interprets Luhmann's expansion of their work as a way of ontologizing autopoiesis as a system of communicative relations. Bryant interprets Luhmann's view as hypothesizing that the "identity of an entity is an effect of the distinction that allows for observation not a substantial reality that precedes observation." (Bryant 2011: 138). The irony here is that Maturana, Varela, and Luhmann are all starting from an epistemological foundation. Nevertheless, Bryant dismisses Luhmann's constructivist argument by noting that Luhmann, who wants to establish the reality of the systems with which he works, can only do so if there is, following from Bhaskar, a world that is constituted in such a way that one can, in fact, reliably and consistently return to it repeatedly with the same ontological expectations of its behavior. As Luhmann indeed expects that that sort of repetition is precisely what one expects in the kinds of systems he describes, it must be, *ergo*, an operationally closed system and the properties of autopoiesis are ontologically transcendental.

What are those properties? Bryant extracts from Maturana, Varela, and Luhmann a number of key principles. First, systems are subject to operational closure. "The identity of autopoietic machines is specified by a network of dynamic processes, whose effects do not leave that network." (*ibid* 140). Second, systems are always homeostatic -- self-governed to manage their stability. (*ibid* 142). Third, systems exist autonomously of their environment -- though they are not immune to the limits and perturbations of the environment. (*ibid* 144). Fourth, systems are self-referential. Bryant remarks, "it is the *system* itself that ‘draws’ the distinction between system and environment.". He continues, quoting Luhmann, "[t]he environment receives its unity through the system and only in relation to the system." (*ibid* 146). In short, there is no such thing as an environment -- it is the extension of the systems themselves that constitutes the boundaries of something we choose to call an "environment. Systems do not maintain communication with their environment, Bryant argues, "because systems only relate to themselves and 'information' is a purely system internal quality." (*ibid* 148).

IV. Information

Bryant then turns his attention to explicating the problem of information, which, as I will argue more completely in the next chapter, is quite opaque for speculative realists. In Bryant's case, his theorizing about the nature and implications of information is largely derived from his readings of Luhmann and cyberneticist Gregory Bateson, which, in the latter case turns out to be, in my opinion, a misreading of Bateson.

We have already seen that the concept of information is used in several ways. First, it is interpreted as a set of perturbations and irritations, on the one hand, and on the other, a set of local manifestations. This is a theory of signals, not of information. Second, information is never described as having any content. As a result, Bryant's descriptions of information sound more like a theory of communication (methods) than a theory of information (interpretable signs). "Information is not something that is exchanged between systems." (*ibid* 153). Information is solely reserved by the system that produces it. Harman describes this kind of interaction as "vicarious". (Harman 2005: 91).

Bryant, citing Luhmann, states, "above all, what is usually called 'information' are purely internal achievements. There is no information that moves from without to within a system." (Quoted by Bryant 2011: 153). In one sense, Bryant and Luhmann are right. There is no phlogiston of information floating about in the ether of a system's environment. However, that is quite different than saying there are no methods of exchange, no forms of communication, no syntax of signals that are not exchanged among systems. We assemble glyphs (or phonemes or other primitive signs) into communication channels ("mediums") all of the time. And it is true that these "messages" are never more than material affects that perturb another system that takes those perturbations and reassembles them into internal forms. The effects and reliability of these mediums and messages is a question of communication theory -- selecting the most probable state of a message from all possible states. Information theory, by contrast, "is possible only for structures that delimit and presort possibilities. Information presupposes structure, yet it is not itself a structure, but rather an event that actualizes the use of structures." (Luhmann 1995:67).

Information as Difference

What kind of event might this be? Bateson proposes that information is "a difference which makes a difference." (Bateson 1972: 315). It is granted that the consequence of information is measured by the ways in which a system manifests its reaction. As Bateson goes on to observe, "the sense organ transforms these differences to differences in some efferent message. [The result] is determined, in other words, by the behavior of the other parts of the system, and indirectly by its own behavior at a previous time." (*ibid* 316). Bryant limits the implications of this reading when he concludes, "information is thus not so much a property of substances themselves, but is something that occurs within substances." (Bryant 2011: 155). In this way, Bryant doesn't differentiate communication as a process from information as an effect.

Self-referentiality

According to Bryant, how does this work? First, information differentially links an object to itself (self-referential) through a connection made between the internal state of the thing (virtual proper being) and its local manifestations. This connection is Bryant's "difference machine". Second perturbations generate differences of difference transforming perturbations into local information (from Bateson). Third, Bryant then adds a whole new dimension by conjecturing that "events of information link difference to difference through a linkage of different withdrawn objects to one another." (Bryant 2011: 156). He goes on to declare, "information is not a property of a substance, but rather an event that befalls or happens to a substance and which selects a system state -- information always entails some element of surprise." (*ibid*).

Entropy

This has important parallels to Claude Shannon's notion of information entropy. (Shannon 1948). Shannon postulates that the technical problem of information is simply the challenge of getting a message from one point to another. The greater the number of variation in signals, the greater the amount of information that can be transmitted. A steady state signal provides virtually no information. On the other hand, a signal which is chaotic provides an extremely high content of information. The difference between steady state and chaos is the probability that a particular message is selected. The greater the difference among signals, the greater the amount of information being transmitted. This variability is what Shannon describes as the entropy state of information.

Genesis

What is the source of this information? Recalling that autopoietic machines produce themselves and undertake actualization through the process of utilizing information, Bryant argues that allopoietic machines, which are constructed from something outside of themselves, also utilize information for actualization. This implies that information -- and here we are taking about data, not the communication mediums used to transmit data -- is both inside and outside the things themselves. For if a thing acts on something which results in its actualization, there is some exchange of information. Even if we want to assume, which I think is reasonable, that the data is transmitted to the surface of a substance as perturbations and translated by the substance for its own internal use, there remains a form of exchange by formal or informal protocol. He writes, in "allopoietic and autopoietic systems, information is an event that makes a difference by selecting system states." (Bryant 2011: 166).

Meaning

Earlier, Bryant considered that "information is premised on a prior distinction that allows events in the environment to take on information value, it follows that systems in their relation to other objects, always contain blind spots." (Bryant 2011: 160). Later, he writes, "objects are only selectively open to their environments." (*ibid* 168), But if systems have "blind spots" and simultaneously are open to their environment (albeit selectively) then, how is it that systems do not, in fact, exchange information?

Referring to Luhmann, Bryant observes that information contains meaning wherein "meaning is the unity of difference between actuality and potentiality...[where] each actualized meaning simultaneously refers beyond itself to other meanings that could have been actualized [such that] meaning has an air of contingency." (*ibid* 160). Here the term *meaning* is referring to the differences among messages and the difference between what is transmitted at one point and received at another, perhaps through multiple waypoints. This ties back to Bateson's thesis that information is altered as it is processed, suggesting that information is a Markov process in which the probability of any future state is a combination of the current state independent of any past states that affected the probability of the current state. Why this is not extended beyond the edge of the "difference machine" is simply not explained. In fact, he implies that this is exactly what is happening when he notes, "while objects are independent of their relations, objects are only ever encountered in and among relations to other objects", referring to these networks of external relationships as "regimes of attraction". (*ibid* 169). Finally, he draws on Bruno Latour and his network theory to suggest that objects always interpret one another through translation and transmission. These translations serve not as notifications, but as constraints, signaling not only what may be done, but limiting what may *not* be done.

Limits on the Edge

Bryant observes that the real blindness of autopoietic theory is its "utopianism", its failure to observe the constraints imposed upon systems. Following from Karl Marx, he notes that autopoietic systems do make themselves, but not as they see fit. Rather, they do so subject to the limitations of that which surrounds them. (*ibid* 194). The dynamics of this intra-constitutional agency are played out by an autopoietic self-construction that is self-determined, but only to the extent that what is possible is what the environment will let be possible. Thus, Maturana and Varela ignore the limited boundaries of the self-constituting object, while Deleuze, in his concern for the control over agency, fails to acknowledge the self-motivated resistance that an object is capable of mounting in its own interest.

Given that Bryant is rejecting the passivity of agency, he is acknowledging that there is a degree of interactivity between an object and its encounters with other objects. Objects are not windowless monads. Rather, he suggests, objects have a "selective openness" and inversely, the interactivity among objects "play a role in the local manifestation of an entity" (*ibid* 200, 202). Lest, this reading be construed as an admission that external events define the object, Bryant is careful to distinguish between the construction of an object by its own selective openness to that which lies outside of itself and the construction of the events that participate in connecting with that openness. The latter, quite reasonably, is the basis of interactivity without inferring interdependence, at least at the level of communication. This is a shift from Bryant's early position in which objects were closed -- a reading aligned with Graham Harman's more rigid position. As we shall see shortly, this amendment is a significant hint for Bryant's revisionary tact in his next publication (Bryant 2014).

Referring to developmental biology and quoting Susan Oyama, whose work on the ontogeny of information figures prominently in chapter six of the present text, “information ‘in the genes’ or ‘in the environment’ is not biologically relevant until it participates in phenotypic processes. It becomes meaningful in the organism only as it is constituted as “information” by its developmental system. The result is not more information but significant information”. (Bryant 2011: 198, Oyama 2000: 16). As Bryant observes, Information is not something that exists, but something that is constructed. But here, I think he misses the essential point (which he acknowledges in his later text), that information is not simply pre-existing or agentially-constructed, but is constituted out of mediations between one object and another. Indeed the mediation is the information. One object selectively chooses with what it wishes to mediate, holding in reserve that which is not relevant. However, from what it may select is not a *potpourri* of events, but bits and pieces of information events and streams that are selectively offered and accessible.

Regimes of Attraction

Bryant refers to these moments of selectivity as "regimes of attraction” wherein "the objects that populate our world tend to exist in fairly *stable* sets of exo-relations" (Bryant 2011: 94). These regimes are networks of sustained relations among objects. There is a tension between what is reserved, what is selectively open, what is connected, and what underlies this "regime of attraction" by which networks of relations are formed and stabilized. But it is a tension that arises specifically from the difference between the kinds of questions one asks epistemologically and ontologically. Bryant writes,

> The concept of regimes of attraction entails that it is not enough for inquiry to merely gaze at objects to “know” them, but rather that we must vary the environments of objects or their exo-relations to discover the powers hidden within objects. Knowledge of an object does not reside in a list of qualities possessed by objects, but rather in a diagram of the powers hidden within objects. However, in order to form a diagram of an object we have to vary the exo-relations of an object to determine that of which it is capable. And here, of course, the point is that knowledge is gained not by *representing*, but, as Aristotle suggested in a different context in the *Nicomachean Ethics*, by *doing*. (*ibid* 172).

Just what these diagrams of regimes of attraction and their networks precisely look like is not really spelled out, but, three years later, Levi Bryant published a second volume that is, at one and the same time, an expansion of *The Democracy of Objects* and a significant revision of his ontological premises. In *Onto-Cartography: An Ontology of Machines and Media* (2014), he sets out to explicate and expand upon these unresolved problems.

Part III. Things as Trans-Corporeal Machines

Bryant started out with a deep indebtedness to Graham Harman's work, but it became clear in *Democracy of Objects*, as he worked through several intractable problems, that his background in Deleuze and Lacan was putting distance between he and Harman's work. Bryant's next attempt to explain these problems illustrates just how great that difference is and how Bryant is working to resolve the conflicts in his own thesis. As a result, he lays the groundwork for a more plausible form of realism that remains committed to the speculative tradition.

I. Machines

Bryant begins by acknowledging that by referring to things as objects, he introduces a set of problematic issues, including the implication of subject-object dualism. So he replaces "objects" with "machines" noting that machines "produce" based on "inputs" and "outputs" (Bryant 2014: 38). Thus, the connotation of machines is that they are enclosed entities that operate upon selective events and produce, as the result of their own internal operative processes, a set of local manifestations, or products. Bryant is fully exposing his machines as functional paradigms that exist as black boxes, by which we can control inputs to measure outputs and infer what processes are at work. This, of course, preserves the integrity of the machine from reductionist decomposition. At the same time, it similarly continues to preserve the mystery of what the machine does. Just as he demarcated the division between the inside and outside of an object as a “difference machine", he continues to distinguish the reserved powers of a machine and what it produces. (*ibid* 40).

II. Machines as Organisms

Machines are not, in Bryant's definition, the rigid, inanimate entities that we normally associate with factories or similar facilities. Machines can be viruses, texts, flowers, anything that we similarly use as denoting objects or things. Machines are more than mechanical devices which are fixed in terms of their connections. There is a danger in Bryant's turn to the machinic metaphor that is amplified by Georges Canguilhem when he writes, "nearly always, the organism has been explained on the basis of a preconceived idea of the structure and functioning of the machine; but only rarely have the structure and function of the organism been used to make the construction of the machine itself more understandable." (Canguilhem 1992: 44). Canguihelm analyzes how the machine as metaphor has stood in for much of the history of western technology. Concluding, however, that as machines have been designed to accommodate the human organism, the machinic metaphor has been inverted as the result of "a systematic understanding of technical inventions as if they were extensions of human behavior or life processes". (*ibid* 63). Thus, it is not a question of the organism constituted as a machine, but the machine as a composite of the mechanical and life processes. It is with this interpretation that Bryant can assert that, "being is composed of machines all the way down". (Bryant 2014: 24)

III. Media Machines

To be clear, Bryant rejects any explanation of things as driven by teleology or entelechy. While a machine has a function, often many functions, there is no *purpose* to a machine. There is a process of unfolding, but a process that is held in reserve and revealed only through local manifestations. In his new approach, Bryant offloads the mystery of reserve to that of the medium that lies between two machines. Inspired by Marshall McLuhan, Bryant argues that a medium connects one machine to another without regard to the meaning or significance of its connection. It is of "ontological significance", Bryant writes that,

> The concept of media provides us with a theory of relations and interactions between machines. To study media is not simply to investigate technologies, tools, artifacts, and forms of communications, but rather the way in which machines are structurally coupled to one another and modify one another regardless of whether humans are involved. (Bryant 2014: 35).

The implication of this approach is that, "machines can function as media regardless of whether or not humans are involved, [therefore] this theory of media is post-human in the sense that it is not restricted to how various entities function for human beings." (*ibid*).

IV. Coupling

Of these principles (ontological, functional, and post-human), Bryant declares that the focus of our studies should be on what he defines as onto-cartography: a mapping of the structural couplings among machines and "their vectors of becoming, movement, and activity". (*ibid*). This is no small reorientation of the ontological project which has sought the dimensions and properties of substances and hylomorphic entities. He appears to be shifting the focus of the investigation from one of Being to one of Becoming. This suspicion is sustained when he warns "that whenever I speak of one machine modifying the movement or becoming of another machine I am speaking of machines functioning as media for other machines." (*ibid*). Is this a redirection of a tectonic magnitude or simply a shift in connotations?

This media function is a coupling between two machines. But this coupling presents a contradictory tension for Bryant's form of speculative realism. On the one hand, couplings are constituted by productive operations -- which in Aristotle's metaphysics are accounted for by the four modes of causality. As Bryant puts it, "it is above all a machine that calls upon us to engage in this or that experiment, to act on this or that machine in this or that way, to see what happens when things are operated on in this way." (Bryant 2014: 39). It is an ontology with an ethics, for as Aristotle puts it in the *Nichomachean Ethics*, "for all things that have a function or activity, the good and the 'well' is thought to reside in the function". (1097b27). Bryant seeks to simultaneously reject Aristotle's predicate metaphysics, while aligning his interpretation with the metaphysical foundation of Aristotle's ethics, "the being of a machine is defined not by its qualities or properties, but by operations of which it is capable." (Bryant 2014: 40).

Bryant, following from Deleuze and Guattari (1983) defines machines that are in a coupled state to another machine as always producing a flow. However, Bryant rejects Deleuze and Guattari's assumption that two machines always remain coupled to each other. For Bryant, "the couplings can be severed and new couplings can be produced, both of which can generate new local manifestations and becomings in entities." (Bryant 2014: 48). Is it the machine and its productive power or the mediated flow that emanates from and provokes the excitation of the powers of the machine?

Bryant seems to want stable entities or things, the significance of which resides in their internal operations.   Yet simultaneously, the function of these operations constitute the flows which these operations manipulate and produce. Recall that Bryant, in *The Democracy of Objects*, interprets the existing tension between the endo- and exo-relations of an object as the moment of difference between an object's internal power and its external local manifestation is being also itself a machine -- what he calls a "difference machine". There is a dialectical tension -- or contradiction -- that emerges in Bryant's formulation.

V. Finitude of Knowing

Eco-theorist Jane Bennett raises the question that "perhaps the very idea of thing-power or vibrant matter claims too much: to know more than it is possible to know." (Bennett 2010: 13). This is the contradiction that Theodor Adorno calls "nonidentity" -- the moment when "the principle of contradiction makes the thought of unity the measure of heterogeneity." Adorno continues, “as the heterogeneous collides with its limit it exceeds itself." (Adorno 2004: 5) It is precisely this contradiction that incites Bryant to make a giant leap from his focus on a "thing" or a "machine" to a field of machines, in which the emphasis is on the machines, their relations, and their affects upon each other.

I want to argue here that Bryant is not simply shifting the ground from one based on ontology (Being) to one more consonant with ontogenesis (Becoming), but also moving far from Graham Harman's original notion of an autonomous entity (*thing*). Just how far Bryant is moving becomes compellingly illustrated in Bryant's turn to the work of Stacy Alaimo (2010).

VI. Matter as Meaningful Stuff

I will address how Bryant employs Alaimo, but let me first frame her primary concern(s) from which Bryant then continues. Alaimo asserts that "*matter*, the vast stuff of the world and of ourselves, has been subdivided into manageable 'bits' or flattened into a 'blank slate' for human inscription. The *environment* has been drained of its blood, its lively creatures, its interactions and relations -- in short, all that is recognizable as 'nature' -- in order that it become a mere empty space, an 'uncontested ground', for human development. (Alaimo 2010: 1-2). In particular, as her narrative unfolds, she is increasingly concerned with the discursive turn that has incorporealized that which surrounds us through signs, language, and semiotics, and through which we have lost material nature and our inter-connections. Alaimo's objective, then, is to restore a materiality to the conceptualization of nature and to the practices which are built out of this understanding.

VII. Trans-Corporeality

To address the vacuum that has emerged between our theoretical understanding and our corporeal existence, Alaimo introduces the notion of "trans-corporeality". She describes it as,

> Imagining human corporeality as trans-corporeality, in which human is always intermeshed with the more-than-human world, underlines the extent to which the substance of the human is ultimately inseparable from 'the environment'. It makes it difficult to pose nature a mere background...for the exploits of the human since 'nature' is always as close as one's own skin -- perhaps even closer.

Alaimo continues,

> ...thinking across bodies may catalyze the recognition that the environment, which is too often imagined as inert, empty space or as a resource for human use, is, in fact, a world of fleshy beings with their own needs, claims, and actions. By emphasizing the movement across bodies, trans-corporeality reveals the interchanges and interconnections between various bodily natures.

And concludes,

> But by underscoring that *trans* indicates movement across different sites, trans-corporeality also opens up a mobile space that acknowledges the often unpredictable and unwanted actions of human bodies, non-human creatures, ecological systems, chemical agents, and other actors. Emphasizing the material interconnections of human corporeality with the more-than-human world -- and at the same time, acknowledging that material agency necessitates more capacious epistemologies -- allows us to... contend with numerous late twentieth- and early twenty-first-century realities in which 'human' and 'environment' can by no means be considered separate. (Alaimo 2010: 2)

For Bryant, trans-corporeality, like coupling, is a metaphor for the ways in which everything is mutually interconnected. This begs the question of whether, if machines are all interconnected by flows among the machines, what are flows? He dismisses the idea that flows are inert operands. Rather, he suggests, flows are themselves machines with their own powers. More importantly, Bryant posits that the project of onto-cartography "is the mapping of trans-corporeal relations between machines, how these interactions affect one another, and how they structure the movements and becomings of which a machine is capable in this world.” (Bryant 2014: 49). This is a remarkable turnabout, in which the thing is now a thing constrained, infused, energized, and mutually stimulated, not simply by things, but by things called flows. In fact, the greater the priority of things over any *thing* appears to get for Bryant, the more he extends his analysis.

VIII. Worms

Lest it is not clear what Bryant and Alaimo are talking about, Jane Bennett offers several illustrative examples drawn from the work of Charles Darwin and Bruno Latour. In both accounts, the principal actants are worms -- English worms, in the case of Darwin, and Amazonian worms, in the rendition of Latour.

Darwin observes his worms for long periods of time and realizes that worms make history. They do so by investing in a symbiotic culture with human beings. Worms "pursue what appear to be prospective endeavors". Exercising what we anthropomorphize as "free will", Darwin comes to the conclusion that worms do not simply act as automatons, but rather make choices. Under normal circumstances, worms participate in the flows of materiality by dredging up digested molds to the surface, recycling the nutrients of the soil, and making it rich for human use in agriculture. But, when exposed to bright lights, worms head for safe territory deep into the soil, unless, they are otherwise pre-occupied by another task -- for example, digestive work -- in which case, the worms simply continue on with their job until they are done. The perturbations of light that would normally cause a worm to head for a safe harbor are simply ignored. Worms, as actants, as machines, participate in a continuous circulation of decaying organic matter and microorganisms producing humic and fulvic acids that encourage the growth of plants which, after reaching maturity, dry up and re-enter a stage of decay. Worms are crucial machines in both the production and the channeling of flow.

In the example given by Latour, another dynamic unfolds in which there is a mystery that transpires on the boundary between Amazonian forest and savanna. The clays necessary for deep forests is completely missing in the savanna. But at the boundary of these two eco-domains, we find aluminate clays which, as it turns out on further study, are the result of circulating flows of worms dredging up aluminum silicates to the surface. As they recycle the soil, the worms are making the soil hospitable for forest growth and over time, as the forest takes root, the soils become even more hospitable to denser development. Slowly, the forest is taking over the savanna, but only because of the symbiotic role of the worm in the recirculation of soil composition necessary for the encroachment of the forest into open spaces. (Both examples are from Bennett 2010: 94-98).

Part IV: Implications for Techno-Surveillance

Bryant has arrived at a very liquid (to borrow from Zygmunt Bauman) ontology in which stability is increasingly described as a set of forces. Can we use this model in understanding the complexities and functionality of SAGE and surveillance, or is there yet some other missing dimension that we need to consider?

I. SAGE as Being

How, then, do we read an ontology of surveillant-technology? Specifically, how is SAGE, as an exemplar of surveillance and technology, to be read ontologically? Aristotle declares that the first and most important object of metaphysics is to understand "being qua being" -- that which underlies and is incorporated in the existence of every thing.

Such a project entails investigating how things, and he means primarily natural things, are in the world. This turns out to refer to their existence as hylomorphic substances -- the combination of a separate form and a distinct matter. The form constitutes, by inheritance, the essence of a thing, while matter gives a thing its manifestation. Primary substance, or that which we can say exists without predication of another, is what is meant by Being. This is the essence of a thing -- its essential property or quality which is materially manifested through the inherence of predicated properties.

So, when we examine something like SAGE, do we find a hierarchy of predications, properties, qualities, and essentialities? Can we identify a root within the circularities of power, circuits of logic, and networks of distributed interruptions? The only way to capture the essence of something like SAGE (and by inference, any kind of complex system of surveillance or technology) is to describe it in such generic terms (e.g., air defense) that the materialization disperses. There are no natural kinds in an artifact like SAGE; the properties are all constructed as machines in which the components, if used in other applications, retain their own identity. Thus, Aristotelian ontology doesn't prove to be of much use in helping us understand something like SAGE. Nevertheless, Aristotelian ontology does capture one essential quality that persists in much of ontological research -- the relation of substance to space.

II. SAGE as a Thing in Space

Aristotle posits in *Physics* that, “Everything is somewhere, that is, in a place (*topos*)”. (*Physics* 208b35). Place is neither form nor matter. (*ibid*, 209b22). Rather it is something, or more properly, it is a relationship *within*: "a place surrounds that whose place it is; a place is not a part of what it surrounds; a thing's primary place is neither smaller nor greater than it…" (*ibid*, 211a1-3). This might suggest that place is a kind of circumscribed space--not unlike a form. But Aristotle responds that "form and place do not limit the same thing: form is the limit of the thing circumscribed; place is the limit of the circumscribing body" (*ibid*, 211b13-15). Thus, the boundary of a place is a reference to that which is contained within, whereas a boundary in space is a reference to that which lies without. The importance of the fixedness of this external boundary in relationship to what is contained within is, for Aristotle, crucial. First, he notes that "a receptacle is a place that can be transported, so a place is a receptacle which cannot be transported…Thus, the place of anything is the first unmoved boundary of what surrounds it" (212a14-15, 20-21). This implicates a place as that where an entity is surrounded by another entity (212a32), but this applies only for entities capable of moving into and out of a place, in other words a thing (212b9-10). SAGE clearly meets this definition of a thing in space -- as a thing in a place. SAGE as a thing is constituted by its internal relationships *and* its limits *within* a place. This still tells us only that SAGE has boundaries and a reference to location -- something that is so intuitively obvious that it seems trite. But I want to argue that the simplicity of this observation is far from unimportant -- not because of what it tells us, but of what it fails to inform. What is completely missing in this concern, with the fixity of things in space, is the blindness to temporality, to change, and to what passes from one to another. The obsession with place and location, in the dimensions of space, may give us assurance that what we see retains its identity through time, but it ignores how that identity shifts through acts and transformations.

III. SAGE as Actant -- Thing as Process

What we often refer to as an eco-system, is, perhaps, better described by Alaimo's universe of "trans-corporeality", in which animate and inanimate matter are deeply enmeshed in each other. I think we can find precisely the same network of relationships, flows, and circulations in the SAGE system. What starts as a laboratory prototype feeds off a series of seemingly unrelated events transmitted through a field of anxiety. A habitus of affectivity among creatures and an accommodating machinic presence in which each encloses the other encourages the expansion and growth of the SAGE system. The nervous energy which propels the SAGE project to accomplish tasks for which even the “unknowns are unknown” (to borrow from Defense Secretary Donald Rumsfeld) has never been successfully replicated in large projects since SAGE. Within this field of anxiety are actants, some human, most inanimate, which demand cooperation and connectivity in integral fitness. These machinic agents increasingly bump up against each other, disturbing each other on the surface, but individually operating on and passing through flows that, if Bryant is correct, are, in themselves, machinic agents. Informatic flows, pulsating in analog and digital rhythms course through the channels, gates, resistances, capacitances, and registers -- stopping, waiting, resting, moving, disrupted and altered in an accumulator or a modem (flows that become fluxes) are all part of this trans-corporeality. At another level, there are entanglements between objects in the atmosphere and micro-flashes of microwave radiation bouncing off the surfaces of these objects, returning to their source. These prodigal waves are transformed into patterns (data sets) and merged with other data (azimuth, height, and distance) to create a simulation of another kind of event -- a bogey. In the course of this transaction, we have encountered an APS-20 radar unit, which itself is comprised of a series of things which affect and effect flows of information. Actants establish relationships, relationships enable flows, and flows can turn into processes. SAGE follows this lineage, as components are fit together at points of interfaces that give a channel for information flows. If these flows stabilize, they establish the possibilities for processes to take shape. But components, by themselves, do not sustain flows, and certainly not processes. There must be something that aggregates these components into something more stable. More importantly, flows have no formal relationship or patterns without integrating processes that couple these components.

IV. SAGE as Assemblage

There can be no doubt that SAGE, in both its role as a surveillance system and as an aggregation of technical capacities, conforms to Deleuze and Guattari's definition of an assemblage, which they describe as being comprised of two dimensions. "On the one hand, it is a machinic assemblage of bodies, of actions and passions, an intermingling of bodies reacting to one another; on the other hand it is a collective assemblage of enunciation, of acts and statements, of incorporeal transformations attributed to bodies." (Deleuze and Guattari 1987: 88).

The ease with which we map Deleuze and Guattari's definition of an assemblage with SAGE should be clear to understand. SAGE is, if nothing else, in its most dormant state, an aggregation of bodies, of machines. Once SAGE is "lit" up, it whirs with actions that intermingle with perturbations, interruptions, and information that cause each media to excitate adjoining media, inciting a chain reaction distributed across a network of relationships. Every component is an enunciative act that propels consecutive transformations, simulations, and actions.

This brings us to Deleuze and Guattari's amplification of what constitutes an assemblage. They argue that assemblages actually exist in two dimensions. The first we described above. The second axis of an assemblage is comprised of relations that (in their words) *territorialize* and *deterritorialize* adjacencies--be they spaces, relations, components, or other systems. Territories are the boundaries of an assemblage. This is not a physical location (topos), but a set of interior relationships within the assemblage that define its connections, integrity, and stability. Thus, territorialization is the process by which the components of an assemblage establish and stabilize the relations among components of the assemblage -- what I have referred to as flows. Territorialization affects the whole of the assemblage. More importantly, territories can be extended among adjacent (exterior) relationships to an assemblage, thus, extending the boundaries of the assemblage. And, territories can emerge from within an assemblage as an emergent assemblage.

Manuel DeLanda (2006) suggests that there is a third axis to an assemblage, wherein a set of "specialized expressive media intervene" to produce processes of coding and decoding, such as discursive forms which extend the territorialization. In this way, the protocols and formats of data exchanges insist upon and enforce the territory of the SAGE assemblage by insisting on the structures and formats of codes. Similarly, deterritorialization entails a process of destabilization, disintegration and dissolution of relations and processes in which connections simply atrophy or morph into other relations.

V. SAGE as Information

Among the implications of Claude Shannon's insights is that the meaning of the content of the message is irrelevant -- it is simply a probability among all messages that could be transmitted. In addition, any message is likely to be affected by the introduction of noise in the transmission. Thus, the probability that any message transmitted from its source is received with the same fidelity, is a function of noise distortion. There is also a potential problem of translation between sender, channel, and receiver wherein, for example, as in the SAGE system, analog radar signals need to be converted to digital representations through sampling (incurring message loss) so that coordinates can be computed. Then the message needs to be reconverted to analog for transmission of copper telephone lines (adding information), then demodulated into digital signals (incurring loss) for the AN/FSQ-7 computer at a Direction Center. In these flows that move from microwave reception on the radar antenna horn through cables to a signal rectifier through a demodulater and on, there is a flow of perturbations that disturb the indifference of the machines through which the messages course. At each point of connection among the assemblage of things in the SAGE, there is an element of surprise and each surprise needs to be reconciled. It remains to see whether our focus should prioritize the element of surprise in the thing or the flow of the message -- a problem that will be addressed in chapter six.

VI. SAGE - Ontologically Speaking

What we find when we apply a substance ontology to a problem like SAGE is that the surface planes between SAGE and substance ontology are not conformant in any meaningfully way. Yet, in working our way from an ontology of substance to one of power for machinic assemblages, we have uncovered a number of problematic issues that need to be addressed further.

- Things and flows both seem to be important -- does one have primacy over the other?
- These things and flows are in a constant state of alteration and adaptation -- maintenance, enhancements, augmentations, integrations -- how does this affect the status of a *thing*?
- We keep encountering the difference between Being and Becoming in the status of a thing and its environment -- how does this affect how we think about ontological problems?

- Where does the intentionality of the human actor intervene in this process? This question seems to be particularly important in asking what constitutes the "practices of surveillance and technology".

These questions suggest that classical ontology leaves unresolved a number of apparently important issues. In the next chapter, I investigate just what kind of ontological framework might alternatively better explain just how and what surveillance and technology really are.

These are the questions we shall turn to in Chapter Six.

Chapter Five: Events, Flows, and Processes

In this chapter, I present an outline with supporting arguments for an alternative to substance ontology. This proposed metaphysics, which I refer to as *ontigeny*, accounts for many of the deficiencies of substance ontology outlined in the previous chapter. Ontigeny prioritizes temporality, difference, and noise over the corresponding dimensions of ontology, namely spatiality, identity, and substance. These displacements bear a number of important consequences for how we explain things like SAGE and techno-surveillance.

I. Introduction

Given the incompleteness of classical (and neo-classical) ontology to account for many things occurring in techno-surveillance, we need to examine alternatives. Here, we find that the most obvious dimension missing in our discussion of the existence of *things* is how they come to be, how they pass, and intermittent transitions between emergence and degeneration. In other words, what is absent in substance ontology is a full accounting for things *in time* and *through time*. This absence isn't surprising, as the question of time is a step-child for ontology. It is largely treated, if it is acknowledged at all, as an ineffable confusion -- and some say, illusion. As a result, if we are to consider alternatives to classical and neo-classical ontology, we must reinsert *time* back into the conversation. When we do, we find a very interesting set of other considerations arising as to how we think about things and the way they are in the world.

Secondly, the adoption of temporality as a principle dimension of existence, corresponds to a similar prioritization of difference over identity. In substance ontology, the principle of identity is crucial to the problem of universal logic, namely, each thing that exists is identical to itself, while different from all others. When spatiality is the primary dimension of difference -- there cannot be two of me standing in exactly the same space -- the identity of an object is preserved. However, when time is made the primary dimension, identity becomes illusory and the difference of an object is created. By way of illustration, consider the famous duck-rabbit cartoon in Ludwig Wittgenstein's *Philosophical Investigations* (2001: II.xi). Looking at a drawing that can be seen at one moment as a rabbit and with the blink of an eye can just as well be the image of a duck. For Wittgenstein, this is a distinction between "seeing that" and "seeing as" -- an ambiguity of perception and language. But, the juxtaposition of reference can also be read as successive moments of time-perception in which "seeing that" is not contrasted with "seeing as", but with a different "seeing that".

Third, the ultimate metaphysical ground of classical ontology is substance through we can identify both the universal and the essential. Substance grounds the fixity of what is primary. However, if time and difference are the *quid pro quo* of an alternative metaphysics, definitive substance is similarly displaced by an indefinitiveness. If we are to preserve a realist metaphysics based on materiality, then indefinitiveness must be something like chaos -- a mode similar to noise. Time, difference, and noise: with these three distinctions in mind, we can now outline the whole of the ontigenetic schema

II. Outline and Definitions

This chapter begins with an outline in twelve sections that offers an alternative interpretation of the underlying nature of things such as techno-surveillance -- an approach I refer to as ontigenesis or ontigeny. Following this outline is a more in-depth discussion of several of the important themes that impact my analysis in Chapter Six.

1. The starting point for this exposition is the question of what it means to be in *time* or move *through time* and the implications of raising the status of time to being at least, if not *more than*, equiprimordial with space and substance. The challenge for analyzing time is that, unlike the experience of space, time is among the most intangible of experiences -- only sensual for the briefest of instances, the experience of which only fades away into dimmer and dimmer recollections (past), or perhaps, to hover as an imminent anticipation of vague possibilities (future) which may or may not materialize and just as quickly disappear. As a result of these formless boundaries, time is always a set of experiential horizons resisting any comparison with spatiality where we can physically move from left to right or right to left or back to front or vice versa. At best, time offers a sense of order -- before and after. But even this sense seems transient as the "befores" recede further and further from the present and we become less and less sure about the order, where "befores" get enmeshed, or reordered, with "afters". If anything seems tangible about time, it is the seeming order of recurrence corresponding to cosmological rhythms.

Not surprisingly, ontology, seeking firmer ground, has rarely addressed time as a primary dimension of existence. But, as we shall see, once *time* takes its full place at the head of the ontological table, there are a whole host of surprising consequences -- most of which have direct applicability to understanding things like surveillance and technology, their relationships, and even the logic of their convergence. Though I think an exhaustive interpretation of these consequences necessitates an analysis more complex than what I outline below, I believe that what I do present,, is an adequate representation of an alternative metaphysical paradigm.

2. Among the surprising effects from establishing a *more than* equiprimordial status of time is the displacement of the principle of identity with the principle of ***difference***. I noted in chapter four, the principle of identity is axiomatic for classical ontology. This principle is directly linked with the common sense experience of the persistence of things and the search for what underlies this identity. For classical ontologists, the answer is primary substance. For neo-classicalists, the response is a thing's endo-relations. In either case, the emphasis is on the essential identity or unity of a thing. But when *time* is taken into consideration as the primary metaphysical dimension, we find things are never permanently stable, equilibrium is a momentary exception where things are in an endless state of transience -- identity becomes ephemeral. That is, things are always and already, from their genesis, in a state of difference, both *in time* and *through time*. If change is the norm, then identity is not the opposite of difference, it is nothing more than a passing effect of difference.

The crucial question is how do differences arise from time? If we are asserting that the relationship of space is by juxtaposition, north from south, right from left, then where are differences in time? There is order -- earlier and later -- but these are known only *a posteriori*. It is proposed that difference arises at the boundary between the virtual and the actual -- it is not *in* time, but *of* time. It is a difference of an emergent transition from the virtual to the actual.

3. Difference is another way of referring to ***Becoming*** or actualization. "Purely actual objects do not exist. Every actual surrounds itself with a cloud of virtual images." (Deleuze and Parnet 2007: 148). The virtual and the actual are two different moments of the same phenomenon, but the actual is always being replaced by the virtual; thus, the actual is always in a state of transition. Conceptually, Becoming always stands in opposition to Being. (Take away temporality and you have Being.) For this reason alone, the ontology is completely unsatisfactory for the study of existence. In the absence of a ready alternative, I will refer to that which we are engaging as *ontigenesis* (the Becoming of real things) or *ontigeny*.[35] The objective of such an analysis is to document the process of becoming (actualization), not to define a point of origin.

[35] This is a slight, but important, variation of Gilbert Simondon's advocacy of an "ontogenesis". This difference that I want to underscore is the prefix of "onti" (real things) from "onto" (the things of a appearance) -- a difference, I believe, of style rather than substance.

4. Difference also spawns another effect -- ***noise***. One the one hand, noise is a transgression which violates boundaries -- an incursion of the unexpected or the unwanted and, on the other, noise is a fecund field of potentiality. Becoming always first appears as noise, just as the edge of time is always noise. Noise in this sense is polymorphic -- it is interference, parasitic, and a progenitor of all that exists.

5. The initial instance of Becoming, *ceteris paribus*, is what Gilbert Simondon refers to as a process of ***individuation***, which may...

   > ....be thought of as a partial and relative resolution manifested in a system that contains latent potentials and harbors a certain incompatibility with itself, an incompatibility due at once to forces in tension as well as to the impossibility of interaction between terms of extremely disparate dimensions. (*Simondon 1992:*300).

   As actualization arises from prior actualization, there is, in fact, no initial point of origin -- no First Mover -- which is why we must engage in a speculative suspension of "holding all things equal". This moment is not comprised of substances or hylomorphs of form and matter, but exigencies of actualization. Underneath individuation is the principle of difference.

6. With the uncovering of difference, we also discover what a difference a difference can become -- namely an ***event***, or the manifestation of difference. By re-centering our interest around the differences among things, we recognize that on the edge of every *thing* is a penumbra of something coming into being - emerging into existence or perishing -- that is, being actualized. Studying the percolation of this phenomenon

turns out to reveal that the entirety of the universe is comprised of this mysterious behavior, some more compact than others. But rather than thinking of this activity as the result of something of substance, we turn the metaphor on its head, revealing the emergence of something that can be seen in related ways:

- *Events of difference*: an event always marks a difference and a difference exposes an event;
- Differences that mediate: the substance of a difference is a synapse -- either latent or active;
- Media events: difference is always information;
- Differences as the origin of individuation.

Simondon writes,

> The true principle of individuation is mediation, which generally presumes the existence of the original duality of the orders of magnitude and the initial absence of interactive communication between them, followed by a subsequent communication between orders of magnitude and stabilization. (Simondon 1992: 304)

These mediations constitute an alteration (transmission) of information from one state to another. Events are always in transition. Transitions are always a state of mediation. Every mediation constitutes a bit of information.

7. Individuated, adjacent events of difference constitute patterns, like the froth on the surface of a fast moving stream. I refer to these as ***flows***. Flows are comprised of non-repetitious sequences of related events which we can analogize with an ocean

wave or clouds floating overhead. They are sufficiently remarkable to perceive distinctive patterns (differences) in a field of events (or what might otherwise be thought of as striated noise). Flows are also often comparable, but never similar enough to say that they are the same.

8. Occasionally, flows accumulate an adjacency close enough to have both "togetherness" and repetitious patterns with other flows. The cumulative force of this connection is discharged into what I refer to as a ***process***. "Togetherness" corresponds to Alfred North Whitehead's concept of "prehensions" which he describes as "concrete facts of relatedness". (Whitehead 1978: 22). For Whitehead, the most fundamental existent is an "actual entity"[36] comprised of prehensions which, in turn, he defines as constituting "three factors: a.) the 'subject' which is prehending, namely, the actual entity in which that prehension is a concrete element; b.) the 'datum' which is prehended; c.) the 'subjective form' which is *how* that subject prehends that 'datum'." (*ibid*, 23). In other words, a prehension is a process -- which I represent as the inherent desire of an actual entity to connect. By way analogy, one can think of a rapidly moving river accumulating debris like twigs, leaves, and grains of decomposed minerals. The river does not objectively consider this flotsam, it simply gathers it into its process. Togetherness, like a prehension, is internal to a process.

[36] I do not adopt Whitehead's atomism of an actual entity, which, as he acknowledges, has a number of parallels to Leibniz' monads. My conceptualization of a basic element is a process state transductively transitioning from difference, event, and Becoming. Even an existent is a process of Becoming, which is to say it is always in a transient state of difference.

Repetition, by contrast, arises from the impact of external forces and constraints. Employing the same analogy of a river, the flow of water enacts a togetherness, not only with what is contained within it, but by irritating its boundaries at the river bank and river bed. Repetition arises from the river channel itself which surrounds and is adjacent to the river itself. The channel creates the possibility of repetition as habitual motion which is instantiated in the flow itself. Here my concept of repetition intersects with Deleuze who refers to this form of repetition as passive synthesis. (Deleuze 1994: 71). For Deleuze, this is a characteristic of living things where repetition can also be more active when it draws upon its own desires and recollections to generate a pattern of circularity. I do not make a distinction between passive and active synthesis as I assume that memories in the form of desire (as an attraction towards or a drawing near) or resistance (as a withdrawal from) is possible for living and non-living things. However, I agree with Deleuze that a repetition is never a copy of itself, but rather approximates its patterns in similitude. Processes, as such, are predictable, but they are not stable.

9. The essential characteristic of a process is its togetherness (or connectedness) exhibited in the flow of data. Whether this flow is internal or external to the processes, I will leave for later. The essential point here is that what characterizes the actualization of flows and processes, and all that ensues from these formations, is ***information***. The contents are inaccessible, that is, they are internal to the process, but the connection is public, which we refer to as ***communication,n*** and has

a meaning similar to that defined by Claude Shannon (1948) as a process constituted by an originating source, a method of transmission, a transmitted signal, a received signal, a method of receiving, and a destination (with noise intercepting and distorting the transmission). In effect, I am claiming that for ontigeny, information is what passes through and among events, differences, flows, and processes and is the basis for the seeming vitality of what exists. However, information is always in a steady state of continuous flow.

10. Whitehead's theory is distinguishable from my interpretation of processes in a second way. From John Locke, Whitehead incorporates the concept of "concrescence", which, in his analysis, is "the real internal constitution of a particular existent." (*ibid*, 210). By this, Whitehead is referring to how the many become the one -- a mechanism he describes as a process of growth and creation.[37] This does not, however, establish the kind of *thing* in which I am particularly interested. For Whitehead, a concrescence within an actual entity is a necessary condition for the creation of a *thing*, the sufficient condition is realized when a "nexus" is established among a collection of actual entities. While I have no methodological objection to Whitehead's distinction, I think it discursively detracts from what is really going on in the underlying process. Therefore, I refer to the intersection of processes and the emergence of a *thing* collectively as a <u>***presence***</u>.

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[37] If one sees parallels between Whitehead and Henri Bergson's concept of creativity as an expression of novelty as a contests between the disruptive multiplicity of life (complexification) and the underlying vitality of life (one).

The difference being that I don't posit a formal unity. Rather, I conceptualize it as a bundle of processes connected by flows of information. A presence corresponds to the things we encounter in the world -- water (which may is experientially encountered also as a flow or a process), an ear of corn, or a computer. Simondon describes this as a process of Becoming, which he says...

> corresponds to the appearance of stages in the being, which are the stages of the being. It is not a mere isolated consequence arising as a by-product of becoming, but this very process itself as it unfolds; it can be understood only by taking into account this initial supersaturation of the being, at first homogeneous and static, then soon after adopting a certain structure and becoming–and in so doing, bringing about the emergence of both individual and milieu–following a course in which preliminary tensions are resolved but also preserved in the shape of the ensuing structure; in a certain sense, it could be said that the sole principle by which we can be guided is that of the conservation of being through becoming. (Simondon 1992: 301).

What makes this objectification possible is described by two other concepts Simondon introduces: metastability and transduction. The first accounts for how things undergoing individuation can arrive at anything resembling a stable object. The second accounts for how a process of individuation does not mean that a thing is simply a sequence of individual things over a period of time. Both of these concepts account for the ways in which information is both at rest and in motion within and among presences. I will reserve discussion of these concepts for the specific section below in which I expand on what constitutes a presence.

11. Presences are at the intersection (or nexus) of processes and processes manipulate, transmit and receive information (processes are, in fact, simply conduits or formal channels of information), therefore presences can be said to be media machines for information. When the number of intermediated connections among presences is greater than some arbitrary, but small value greater than two, then we have what I refer to as a conversation. When the connections grow to an arbitrarily larger value, we have a ***network***. Unlike processes and conversations where interactions are largely the consequence of arbitrary interactions, the indeterminate connections in networks generate what seem to be their own complex behavior. Early formations of networks are often simple cybernetic regulators where thresholds are established and adjusted by an external agent. As networks become more complex, the ability of residual values in the network to inhibit or excite communicative connections that can be repeated and reinforced result in pathways that we associate with "learning". This adaptive behavior routinize the behavior of media machines. Over time, these adaptations become self-regulatory mechanisms adjusting their responses to stimuli and modifying their thresholds. Ever larger networks can transform their internal structures, functions, and relations to environmental conditions, anticipate prospective trajectories of future activities, and increasingly, under specific circumstances, extend or reproduce their capabilities into other localities.

12. What is clearly missing from this unfolding process is any mention of human beings. This is not unintentional. Nearly everything I am describing here is ontologically

independent of any human existence or experience. But human beings do exist (for now) and I would argue that what makes them different from any of these evental-driven stages is self-conscious intentionality -- the ability of an external agent to repetitiously shape and create processes, things, and to a lesser extent, networks. This ability I refer to as ***practices***. The Greek sense of *techne* incorporates the notion of practices as I construe it, as does Heidegger's phenomenological mode of ready-at-hand. However, I do not limit the notion of practices to human beings, as I think any living thing capable of even the most limited form of metabolism is capable of initiating practices. Moreover, as I will observe in chapter six, the definition of "living", "self-conscious", and "intentional" are increasingly not limited to organic things or presences, and that non-living things appear to be acquiring the functionality of intentionality and self-awareness, at least in a sufficient sense to pass a Turing-test.

13. Each of these stages is what I refer to as a ***mode of existence***, each and all of which originate out of the primary dimension of time. The sum of these modes constitutes existence itself and existence is what is real.

In the balance of this chapter, I will go into greater detail in explaining a few of crucial topics I introduced in the outline (time, difference, events, presence, and networks). In Chapter Six, I turn to applying this ontigenic paradigm to surveillance and technology, using the data from SAGE to illustrate the entanglement and convergence of surveillance and technology, and the disappearance of the human.

III. Time

It is asserted that time is the most primordial metaphysical dimension, though not to the exclusion of space. Given that in classical ontology, temporality is largely ignored, we need to re-establish what we know, don't know, and can't know about time.

What is Time?

Early Greek philosophers recognize that understanding the status of time is a fundamental challenge to comprehending our experience of the world. We do not seem to have gone much beyond Augustine's contemplative bewilderment,

> For what is time? Who can easily and briefly explain it? Who can even comprehend it in thought or put the answer into words? Yet is it not true that in conversation we refer to nothing more familiarly or knowingly than time? And surely we understand it when we speak of it; we understand it also when we hear another speak of it. What, then, is time?... I say with confidence that I know that if nothing passed away, there would be no past time; and if nothing were still coming, there would be no future time; and if there were nothing at all, there would be no present time.... [H]ow is it that there are the two times, past and future, when even the past is now no longer and the future is now not yet? But if the present were always present, and did not pass into past time, it obviously would not be time but eternity. (Augustine 1991: 230-231)

Parmenides, anticipating this contradiction, asserts the *passage* of time is an illusion, wherein "one way only is left to be spoken of, that it *is*; and on this way are many signs that what *is* is uncreated and imperishable, for it is entire, immovable, and without end.

It *was* not in the past, nor *shall* it be, since it is now, all at once, one, continuous." (Parmenides 1957: 273). For Parmenides, what we experience as time is all of one present moment with no past or future.

By contrast, Plato argues that time is not a self-created illusion, but the simulacra which represents Absolute time,

> ...the nature of the ideal being was everlasting...Wherefore he resolved to have a moving image of eternity, and when he set in order the heaven, he made this image eternal but moving according to number, while eternity itself rests in unity, and this image we call time. For there were no days and nights and months and years before the heaven was created, but when he constructed the heaven he created them also. They are all parts of time, and the past and future are created species of time, which we unconsciously but wrongly transfer to eternal being, for we say that it 'was,' or 'is,' or 'will be,' but the truth is that 'is' alone is properly attributed to it, and that 'was' and 'will be' are only to be spoken of becoming in time, for they are motions, but that which is immovably the same forever cannot become older or younger by time, nor can it be said that it came into being in the past, or has come into being now, or will come into being in the future, nor is it subject at all to any of those states which affect moving and sensible things and of which generation is the cause. (*Timaeus* 37c-38b).

Plato's division of time into an absolute idea (Eternity) and an empirical category (numbers) is not far from the modernist interpretation set out by Isaac Newton in the seventeenth century. In Newton's theory, we impose arbitrary conventions to "measure" time, while reserving a sense there is somehow an Absolute time outside or independent of us -- *ergo*, time will go on without us. As Newton puts it,

> Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration: relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion,

> which is commonly used instead of true time; such as an hour, a day, a month, a year. (Newton 1966: 6).

Because real time lies outside of our experience, it is impossible for us to metaphysically account for it, other than to acknowledge it in passing. Common time, even when we assume it is arbitrary, works just good enough for our practical needs to accept it as a "common sense" of temporality.

Coming to an entirely different conclusion from Plato (and Newton), Aristotle rejects any dualism by proposing that time is a consequence of change in temporal relations:

> ...it is evident that every change and everything that moves is in time...But what is before is in time; for we say 'before' and 'after' with reference to the distance from the 'now', and the 'now' is the boundary of the past and the future; so that since 'nows' are in time, the before and the after will be in time too; for in that in which the 'now' is, the distance from the 'now' will also be. (222b30-223a9)

It is this contest between time having two forms of existence -- one the one hand, a transcendent and eternal present parallelling an empirical time that is an arbitrary simulacra with past, present, and future (Plato) -- and on the other, a time (and space) as something we are "in" (Aristotle) -- which define the principal poles for modern disputes over the question of thinking about time.

Things in Time; or How Ontologists Try to Come to Terms with Time

The contemporary analytic school assumes that the dimensions of space and time may be thought of as either discrete or continuous, for example, space is discrete and time is continuous, etc.. Eddy Zemach has used these characteristics to define a four-way typology of things in space and time that considers how everyday language confuses the ontological status of what we encounter in the world. His categories look something like this:

- *Events* are ontological objects located discretely in both space and time. "An event is an entity that exists, in its entirety, in the area defined by its spatiotemporal boundaries, and each part of this area contains a *part* of the whole event." (Zemach 1970: 233). Events, in Zemach's model are discontinuously (which is to say discretely) distributed across space and time. I will refer to these events as occurants in both space and time.
- *Things* are ontological objects discretely located in space, but continuants in time. In this scenario, there may be multiple instances of individual pencils that persist in time (that is, each exists today and continues to exist tomorrow). This "is the concept of something that is defined (bound) with respect to its location, but is not defined with respect to its location in time." (Zemach 1970: 235). I refer to these as continuants or endurants in time.
- *Process*, an ontological entity, is something that is continuous with respect to space (i.e., not bound to a location), but discrete to time. A process, like the Vietnam War, was conducted simultaneously in multiple locations, but executed in different ways from day-to-day. Zemach observes that while he does not claim that a process-based ontology is the only ontology, or even the right ontology, it is the case that "if the world can be seen as the totality of things, it can also be

seen as the totality of the processes." (Zemach 1970: 239). I refer to these as perdurants.

- Zemach's fourth ontology is what he refers to as pure continuants -- continuous in space and time. In other words, universals or what he calls "types".

The most telling outcome of Zemach's typology is that by examining just two dimensions, space and time, he derives four constituent types of time. He argues that these distinct types are independent of each other because none of the dimensions are the same across all four types. As a result, we wind up not with a dualism, but with a quadruplism. Thus, as interesting as Zemach's ontological typology is, it reflects precisely the problem western philosophy has with time, because the determinant characteristic of his model is the trope of divisibility. The obsession with divisibility arises from the fact that space, and not time, is tangible, graspable, and divisible. The immediate sensuousness of time -- its existential presence -- only becomes something more -- that is, with a past and a future -- from the imposition of a conceptual scheme. Is time even real?

Is Time an Illusion?

In 1908, John McTaggart published a paper entitled "The Unreality of Time". His analysis remains the standard by which analytic philosophy measures its success in evaluating propositions on time.[38] He begins his analysis by acknowledging the experiential basis for assuming that time is real.

[38] Cf. Nathan Oaklander (2004) *The Ontology of Time*, Amherst NY: Prometheus Books

> It doubtless seems highly paradoxical to assert that Time is unreal, and that all statements which involve its reality are erroneous. Such an assertion involves a far greater departure from the natural position of mankind than is involved in the assertion of the unreality of Space or of the unreality of Matter. (McTaggert 1908: 456)

McTaggart's argument is that the position of time appears to us in two ways. First, in what he calls the A-Series, is a categorical concept of time, albeit continuous, which runs from a distant past to a near past to a present to a near future and on to a distant future. In this model there is a dynamic flow of time. Second, there is a B-series which he describes as an accounting of time as sequential events which occur earlier and later. Here there is only a static order of relationship -- earlier and later. Conceptually, our sense of time is that both of these positions are simultaneously valid, though we only experience the present directly, and the past through memory and the future by inference.

McTaggart then goes on to reject the A-Series because any event would have the status of future, present, and past -- a position which entails a contradiction since an event with the property of past could not also have the property of future. If one then argued that such an event had different properties at different slices of time (i.e., in the future, in the presents, or in the past), one would need to then simultaneously also have to have a description of those properties as future, present, or past, ad nauseum -- an argument from circular reasoning.

With respect to the B-Series, an event that is later than another event is always later and never changes its status. Therefore, the status of a later event tells us nothing about the timing of an event, only about its order. In the B-Series there is no quantity of change. The B-Series needs the A-Series in order to define relative time, but the A-Series is either contradictory or circular and therefore the B-Series has to stand on its own and is insufficient to tell us about time. Therefore, McTaggart concludes, time does not exist.

Is Time Real?

McTaggart's idealism still generates an enormous amount of correspondence and controversy, particularly for a paper that is more than a hundred years old, indicative of just how unsettled the problem of time is for philosophy. The origins for seeking an alternative are found in the irony that, given the quotidian experience of time, the question of the existence of time is even plausible. It turns out that part of the problem arises from an indeterminacy about what we mean when we speak of time. For time to be real, it must have some status independent of mind, that it is structured by universal physical laws, and that is supervenient on the *experience* of time.

Currently, philosophers (and physicists) are working with four models of a mind-independent theory of time: presentism, eternalism, blockism, and possibilism (or growing block theory). Each of these theories offer a different way of addressing the existence or non-existence of the tenses of time: present, past, and future.

- Presentism is an interpretation of time in which the only ontological sense of time is with respect to the immediate present. It is a theory that presumes that the *reality of now* corresponds to what has *presence now*. Anything else -- meaning the past and the future -- is not real. At the same time, this is a temporal world in which the now is always in the process of being imminently intruded upon -- there is no future that is real as it is unknown. Yet, events are always emerging at the horizon of the present. Similarly, what is now, will, in a second, be gone -- there is no past that is real. What *is* present did not exist in the future and does not exist in the past. This implies that time only exists as a difference of events in the immediate present. Arthur Prior asserts that only through tenses in language can we construct a temporality that has a past and a future -- the reality of which do not exist. (Prior 1959).

- Prior was particularly concerned with Eternalism and its related variant, Block Theory. Here the past and future are all part of an imminent now, which extends in all directions eternally. The past and the future are real but only in the sense that they are extensions of, or have relations with, the now, not as separate categories. The past and the future do not scroll off or into the present. There is a continuing reality that neither increases nor diminishes. The relationship of past, present, and future are not distinct places, nor do they have a special ontological status, but are relative to where we are standing in the present.
- The Block view of time arose after the implications of Albert Einstein's discovery of general relativity became more generally well-known. This model has many features in common with Eternalism. However, in the Block model, all events exist in four dimensions. As a result, all the dimensions of space and time are simultaneously concurrent in one unimaginably large block of four dimensions. (Whether these dimensions are correspondingly infinite and eternal is not relevant to this discussion.) But, as a result, events simultaneously exist ontologically in the past, present, and the future and are concurrent with each

other. The existence of time depends on whether one is standing outside of the block -- in which case, time is static or non-existent, or whether, one is inside the block, in which case, the observation of simultaneity is replaced with sequences of time. We will encounter the Block theory again when we consider time as an emergent property.

- Finally, there is a school of thought that posits that the present and past are real, but not the future. The future remains unknown until it is disclosed in the present. This is referred to as the possibilist or growing block of time in which the present is always imminently disclosing itself at the edge of what is unknown. Following from Tristan Garcia (2014), what is present always remains present, but is a different kind of present -- a presence with less intensity. This places the emphasis on the time of the present without losing the sense of the past. Garcia puts it this way, "the past is what is less present than the present. It follows that the present is always *the maximum of presence*....what cannot be more present. Presence is the being and comprehension of things in each other, when one thing is in another." (Garcia 2014: 183). Like the Eternalist, the status of the past is a question of relationships rather of absolute position such that the present and the past are always accessible. However, unlike the Eternalist perspective, the past is less intense than the experience of the now.

The key to this approach is the role the *horizon* of what we call the future plays in our expectations of how we experience things. Events emerge in a froth at this

> edge, often not distinguishable until they seemingly begin to form coherent relationships with other events -- relationships that are both subjective and objective. The subjective relationships are formed in a mind-dependent concept of time, while the objective relationships arise from flows, processes, and practices -- topics that I address later in this chapter.

We have now two sets of arguments. One says time is not real and the concept is a complete contradiction. Another set of arguments asserts that time itself is real, but there is wide disagreement about what aspect of it is real and whether some of those aspects exist.

Is Time in the Mind?

In the end, time cannot be grasped or manipulated as something in space. Yet, it persists as a fundamental human experience. It cannot be seen directly, while we nevertheless impute its effects in nearly every aspect of our lives.[39] It is not tangible such that I cannot "see" the future, yet I often anticipate it with excitement or anxiety and I can remember the past, but only through my private memory or with the aid of technical prostheses like video recordings. Despite its immateriality, the phenomenological experience of time *seems* real and universal.

The introduction of presence, like the status of an observer, begs the question of how and in what way does the interpretation of time depend on the mind. Since Maurice Merleau-Ponty, most phenomenologists would concur that the perception of

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[39] According to Kucera and Francis (1967), the word "time" is the most frequently used noun in the English language.

space and time is created by the observer. So is time a creation of our being in the world? How does our physicality and our mechanics of cognition affect our concept of time?

At the end of the nineteenth century, Henri Bergson started speculating that time was, if anything, more real than space. In *Time and Free Will* (1960), Bergson introduced three concepts that would prove to inspire an entirely new way of conceptualizing time: multiplicities, intensive and extensive magnitudes, and duration. Multiplicities are the collection of experiences we acquire from perceiving the world. Unlike Kant or phenomenologists who interpret this perception as a unification of experience in cognition, Bergson argues that this multiplicity is retained in our experiential cognition. Analytic philosophers and scientists, he argues, reduce everything to a series of successive relations. (Bergson 1960: 99). They mistake our experience of heterogeneity in multiplicities to be countable, as if they were situated in space. But our unfettered experiences of the world, he concludes, run quite contrary to this conclusion. Rather, what we sense is a qualitative continuity of experience that is undifferentiated by discrete divisions of time. In the process we encounter external (extensive) interruptions and internal (intensive) sensations that flow through our experiences. He writes,

> We can thus conceive succession without distinction, and think of it as a natural penetration, an interconnection and organization of elements, each one of which represents the whole, and cannot be distinguished or isolated from it except by abstract thought. Such is the account of duration which would be given by a being who was ever the same and ever changing, and who has no idea of space. (*ibid* 101).

To illustrate just how to conceptualize this, he offers three analogies. The first is a spool of wire that is progressively unwound only to be wound again a couple of feet away. As the first spool is unwound, it gets smaller, while the latter spool gets bigger over time -- not unlike our expectation of life. (Bergson 1970:163). But that analogy, by itself is insufficient. He suggests that one take a rubber band and stretch it apart. One cannot find a point, divisible from all others that is anywhere distinct from the rest of the rubber band. Duration is like this rubber band. (*ibid*: 164-165). The third analogy can be thought of as a spectrum of colors. One can see how they pass from one intensity of a color to another. But nowhere can one find a discrete difference such that there is no shade of one color in another. (*ibid*: 165). These examples analogize time as phenomenological, but leave us no closer to time than the concept of an event horizon of future becoming present.

Time as an Emergent Property

An alternative perspective is arising from theoretical physics, where scientists are working with a model that proposes that time is an "effect" (i.e., a property) of change -- albeit, at the quantum level. The starting point for this line of investigation was framed in a speech in 1908 given by Hermann Minkowski, one of Albert Einstein's teachers, and whose own work significantly contributed to our understanding of the geometry of relativity. In his words, "Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality." (Minkowski 1952: 75). The challenge for Minkowski and his enthusiasm for a unified theorem of quantum mechanics and general relativity was that any attempt to join these two basic principles always resulted in infinite solutions -- a sure indicator that either scientists had the wrong theory or were pursuing it in an unfruitful way. There was also a second, seemingly unrelated problem when two or more sub-atomic particles interact, there are occasions when the quantum state of one particle is measured, all of the other particles instantaneously alter their behavior to be consistent with the measured particle despite the fact that there is no way that one particle can communicate with another particle. Quantum entanglement ties the correlation of quantum states together such that they cannot be measured independently.

In 1967, Bryce DeWitt proposed a solution to the first challenge that seem to resolve this insurmountable hurdle. But his theorem had another consequence -- it said the world was essentially static -- an account of the universe without any theory or need for the dimension of time. In this world, the past, present, and future are all of the same difference -- that is, the block view of the universe as noted above. The problem is that in making time disappear, and with it, change, physicists were confronted with a theory that was not commensurate with experience, and if physicists are uncomfortable with anything, it is with a theory that is contrary to an otherwise seemingly "universal" experience.

In 1983, Don Page and William Wooters published a paper demonstrating that the relationship between two time events was entirely different if an observer with a clock was outside the universe of the time events, in which case the world was static and consistent with DeWitt's model. However, if the observer was inside the universe of the two time events, then, against the background of the universe, a change in time would be detected. The conundrum of the quantum entanglement turned out to be a way to measure this difference. In other words, if an event occurred in one and an event would occur in the other, it turns out that time is an effect of this entanglement and consequently, time is an emergent property of the difference of that entanglement. The question about such a complex set of relations is whether it can be empirically demonstrated. In 2013, an international group of scientists offered evidentiary proof that the Page-Wooters theory was correct. (Moreva et. al. 2013). By measuring the difference in the quantum state of two photons that were entangled with each other, the polarized state of the photons generated a temporal difference demonstrating that time, for an internal observer, was a product of the difference in events. However, the same research demonstrated that an external observer did not "see" this difference and time effectively did not change.

What this theoretical research suggests is that time is unobservable from without, and thus theoretically is an eternal present, while simultaneously, establishes that time is, for internal observers, a multiplicity of realities for as many observers as there are within the closed systems.

IV. Difference

Which is more important? A thing, in its identity and unity? Or the difference it has with another thing? If there is nothing by which to compare a thing to another, how do we know what it is? It is only by difference that we can say that something is this or that. Difference makes it possible to have an identity.

As much as the investigation of time is quiescent in western philosophy, it can equally be said that the anxiety over ontological "difference" plagues it: difference in kind, degree, relations, or time. The resolute presence of the problem of difference is found everywhere in the philosophic corpus from pre-Socratics to contemporary philosophers. For example, Heraclitus writes about the ontological *archê* of fire which burns, consumes air and earth, waxes and wanes, and is always in a state of transition. Fire is among the most visible of differences and the most transformative of agents. But it is not fire alone, for Heraclitus, "everything flows", "on those who step into the same rivers, different and different waters flow", and "cold things grow warm; warm things grow cold; wet grows dry; parched grows moist". (Barnes 1982: 65, 66, 67). Thus, what underlies everything for the Milesian philosopher is the flux and flow of difference and change.

In our own generation, Gilles Deleuze and Jacques Derrida promote a philosophy founded on the primacy of difference though each do so from distinctly separate traditions (Nietzsche and Bergson for Deleuze and Husserl and Heidegger for Derrida). Between these two points are a scattering of a few philosophers who treat difference as a crucial problem (e.g., Spinoza, Nietzsche, Heidegger, Canguihelm, and Simondon), it is the case that for a majority of philosophers the issue of difference is a residual by-product of defining the question of identity (e.g., Leibniz’ Identity of Indiscernibles or Kant's difference by number for identicals). Only because of the questions raised by

Deleuze and Derrida has the literature on difference started to resemble a legitimate philosophic topic on its own.

In this section, my goal is not to summarize this debate, but rather to establish a clear understanding of what I mean by difference and how I situate difference as a crucial element of ontigenesis. I begin by summarizing the two most important views of differences in the ancient world as a baseline for defining a profile of difference.

The Language of Difference

Much of the Western philosophic tradition has struggled with the problems of identity, sameness, otherness, and difference. When are two things the same? If they are the same, are they identical or are they coextensive? When is something that is the same also different? If something is other than something does that imply that it is different? For example, take two cats: one is Persian and one is Siamese. They are both cats, yet they are different kinds of cats. Compare both of them to a cougar. They are, all three, cats, but they are different, and in some important ways, the two domestic cats are more different from the cougar. Compare all three cats to an elephant. It is true that all of these are quadrupeds, but do we say the elephant is simply different from the cats, or she is other-than a cat? This represents the problem of kinds of difference.

Returning to the Siamese cat, if this cat, which we will call Thelma has an identical twin, which we call Louise, that is, they have identical DNA, can we say these cats are the same or are they different. If see Thelma in the kitchen and again in the living room (time has stopped), is it the same cat we saw in both rooms or should we refer to Thelma_1 and Thelma_2? This is a difference of relations. If we restore time, and we do not see Thelma move from room to room, but simply glimpse at Thelma at two different times (maybe a week later) such Thelma is a little bit older, is it the same or a different Thelma? These are differences of time. We encounter the same problem when we represent something in language. When someone uses the word "red", it does not convey information about hue or saturation -- and even if those magnitudes are provided, I may still not know what how to phenomenally experience that specific "red". There remain differences of degree. In contemporary Western culture, the whole problem of gender identification is taken up with conflicts over what constitutes, not the binary of male or female, but the differences in kind, degree, relation, and time -- often concurrently in the same instance -- of whole new emergent genders.

Contradictions

Plato poses a similar set of issues. There is the One and the not-One, but because identity is so crucial to his ontology, the not-One is wholly distinct from the One, that is, the One is ontologically independent of the not-One. For the One, the status of not being itself (not-One) is never an issue -- identity always preempts difference. It is always difference which is in a subordinate status. In the *Parmenides* dialog, Plato seems to suggest that difference might have a more important role, but then drops the discussion: "if something is different from something else, that something else must be different. Now all things which are 'not one' must be different from the one, and the one must also be different from them." (164c). This suggests that difference can be a Form in which things can participate. That would raise difference to being equiprimordial to all other Forms. Indeed, this theme reappears in the *Theaetetus*

(186a) and *Sophist* (257b). Even then, difference arises simultaneously as not-One (as its essential quality) from being a part of One (as a thing). In other words, not only does a large cat participate in the Form of largeness, while a small cat participates in the Form of smallness, they both participate in the Form of difference. While it is contestable, I think the appropriate reading of Plato is that for something to be the same as something else it must share in common *more* of what it partakes in than if it is simply "like" something else. The problem with this reasoning is pointed out by Lloyd Gerson who notes that "If, however, Forms are postulated to explain sameness in difference, then Forms are not universals. For universals as such explain nothing." (Gerson 2004: 308).

Differences and the Four-fold

It is this contradictory state that accounts for our inheritance of an idea of difference through Aristotle's rejection of Plato's dilemma. While many philosophers look to Aristotle's *Metaphysics* as the primary source for his philosophy of difference, and indeed, it is a more complete accounting, I find his earlier *Categories* to be much clearer on this topic. Recalling the discussion of beings from chapter four (*supra*), Aristotle distinguishes between what is said-of and what is present-in, and most importantly, what is not-said-of and not-present-in as the culmination of difference defining what constitutes a primary substance. Anything that is said-of others is defined as a universal ("cat" is said of Thelma) while something that is present-in another is an accidental or contingent feature. Conversely, qualities (to be read as 'beings') that are not-said of others are considered as particulars, while those that are not-present-in are said to be non-accidental. From these categories we get a four-fold set of differential relations from which we derive the two most important categories: essential universals (something said-of another that is non-contingent) and primary substance (which is not-said-of another and is non-contingent). That which is present-in entails accidental features such as qualities, relations, etc.

It is from this four-fold division that Aristotle derives kinds which are presented as genus and species -- e.g., the genus "animal" is said of the species "cat". Moreover, even within these connected differences, Aristotle defines another set of differences including contraries ("the most distant in the same genus" (6a15-18)), correlatives (a slave is always the slave of a master), and dichotomies (potentiality and actuality). All of these differences fit within the four-fold, the types of beings that are derived from these four basic categorical definitions, and the genera-species taxonomy and the success of this ontological structure is not to define difference, but how to include difference within his ontology without committing himself to difference as being ontologically primary. Difference is a consequence of what the identity of something (i.e., its representation) is not.

Difference as Ontologically Primary

It is with this headwind in mind that Gilles Deleuze observes, "difference is not and cannot be thought in itself, so long as it is subject to the requirements of representation." (Deleuze 1994: 262). In the introduction of *Difference and Repetition* he writes that the representation of difference is entangled in four ways: first, difference is subsumed into the thought of unity and identity i.e., multiplicity is unconceptualizable); second, by analogy, difference is sublimated through judgment;

third, from opposition, difference is absorbed in sensory appearance; and fourth, through resemblance, difference is sublated into the conceptual object itself. (*ibid*: 29) Deleuze proposes that "difference is the state in which one can speak of determination *as such*." (*ibid* 28). That is, difference cannot be treated as something that is simply the residual of what is made primary, but needs to be thought as *at least* primary in and of itself.

The objective of this project is to think through difference, not to define difference, *per se*, and to account for how difference interpenetrates the processes and practices of the evolution of surveillance and technology. In this way the concept of difference is apophatic. In doing so, difference challenges our thinking of either of these practices as static and not in time, while supporting the notion that these kinds of things are dynamic, emergent, and, perhaps most importantly, always in a state of transitive mediation.

Rather than interpreting the development of a single thing, what we must account for is the way in which difference mediates and sustains the continuity of transitions. Difference is not the mediation itself, but that which makes mediating events possible. Contrast this to Aristotle's assertion that "everything that changes is something that is changed by something into something." 1069b38). He is not referring to things coming into existence or completely taking on new forms, but to the changes in already existing things. As such, he never has to come to terms with original difference.

Difference as a Project

The crucial role, initially for difference in this project, arises in the mediation between the emergence of time and its effects on the horizon of the present which I propose to call events. Difference erupts out of the continuum of flows and relations throughout this project, even in the textual discourse itself. Difference is the means by which events and flows interrupt the present, emerging as something new, on the one hand, and recollected, like anamnesis, from the past, on the other. As illustrated by Proust's discovery of a past intervening in the present, we find difference constantly appearing and reappearing in our technics, our ways of watching over, and as information. It is where we can locate the difference that arises in irony, ambiguity, and the comedic -- not between two states, for that would put difference back as the boundary of identity -- but as the disrupter of its own difference -- the best indication of its ontological nihilism. Difference stands on its own as its own, signifying nothing but itself.

V. Noise

Noise is a manifestation of continuous difference. Gaussian noise is pure difference. Put another way, if what underlies existence is time, and time is the juxtaposition of difference, then what marks difference is the continuous transition of one phase of difference to another -- a parasitical relation of successive moments.

Michel Serres (1982), working with the French word *parasite*, plays on its multi-valence meanings of biological (the rat), social (Lord and master), and informatic (noise). Our vocabulary references noise as interference, background, and aural. It is wholly a negative interpretation as something which is not wanted, not present, and affecting our sensations. Given the primacy of sight over sound, we tend to disregard noise as a nuisance.

That is unfortunate, because noise is much more than transgression, or milieu, or acoustic. Greg Hainge, an Australian literary theorist, affirms that noise "makes us attend to how things come to *exist*, how they come to stand, or be outside of themselves." (Hainge 2013: 23). In his reading, noise is an ontological problem that exists in time. Taking this further is Frances Dyson's reading of composer Michel Chion's consideration of sound in general, and noise in particular, which,

> was to think of sound as event, rather than an object, and in doing so to incorporate a sense of organic process, of movement, change, and complexity, while maintaining a sense of identity and individuality. This shift is important, since it introduces a different, perhaps paradoxical, notion of materiality: the materiality of process, of a multiple, mutating form found in a figure closely tied to sound -- the figure of vibration. Vibration, figuratively and literally, fluctuates between particle and wave, object and event, being and becoming....it also gestures towards the immersive, undifferentiated, multiplicitous associations...(Dyson 2009: 11-12).

Noise spreads itself out, interpenetrating the fabric of what can be perceived. Amidst this field, noise also becomes the source of what is possible. Noise is embedded in the stream of signs and becomes a part of what is signified. Gregory Bateson puts it this way, "all that is not information, not redundancy, not form and not restraints—is noise, the only possible source of *new patterns*." (Bateson 1972: 405).

To be clear, the kind of noise to which I am referring is metaphysical noise -- that which transgresses, fails to assemble, incurs, or resists that which seeks order. Difference is initially disorder and thus is synonymous with noise. This kind of noise ebbs and flows through interstitial pathways forming flows and processes in the course of its encounters with other differences. Hainge iterates five different types of ontological processes that may emerge:

1. Noise *resists* -- not necessarily politically but materially because it reconfigures matter in expression, conduction and conjugation.
2. Noise *subsists* -- insofar as it relates the event to the field from which expression is drawn and thus subtends all being.
3. Noise *coexists* -- as its ontology is only relational and does not come into being by itself but only as the by-product of expression.
4. Noise *persists* -- because it cannot be reconfigured or reconstrained, cannot become thetic as it passes into expression, but remains indelibly noise.
5. Noise *obsists* -- since it is fundamentally anathema to stasis and thus opposes all illusions or fixity, pulling form beyond itself through expression and bring about the collapse of meaning. (Hainge 2013: 23).

Noise is a crucial component of time (as moments of difference); it continues to be effective as the materiality of difference; and it is the source for the formation of material presence, both as the thing itself and what the thing is not. Finally, it is the relationality of difference and events-in-becoming that make materiality possible. Paul Hegarty writes,

> Noise is negative: it is unwanted, other, not something ordered. It is negatively defined...but it is also negativity. In other words, it does not exist independently, as it exists only in relation to what it is not...Noise is something like a process... (Hegarty 2007: 5).

Though I disagree with Hegarty's definition of "what it is not" as a regression to substance, I completely agree that the status of noise to its neighbors is one of relationship and process. This status is fully ontological.

VI. Events

In a field of pure noise, events mark a difference between one random event and another and make it possible to distinguish foreground from background. Events are the first sign that there is a liminal boundary between the virtual and the actual.

Events are omnipresent, as much or more so than things: a chilly breeze, a smile, a basketball bouncing off the backboard, or an offensive odor. Events affect our choices: the buttoning of a coat, a smile returned with a smile, a leap to grab the basketball, or taking the garbage out to be collected. In each of these examples, events mark differences or transitions -- from warm to cold, from indifference to recognition, from anxiety to relief, or from nausea to stability. Events are movements in process. And as Aristotle puts it in the *Metaphysics*, "the word 'actuality', which we connect with 'complete reality', has, in the main, been extended from movements to other things; for actuality in the strict sense is thought to be identical with movement". (1047a30). Events are the actuality of difference and events, whatever they are, are real.

What are Events?

Many philosophers deny that events exist in the same way things exist. As Eddy Zemach speculates, things are continuants across units of time, occupy units of space, and can move from place to place, while events are discrete entities divisible across units of time and space, but cannot move. For other philosophers, things can precipitate events (e.g., a car can go through a red light causing an accident), while events that are not associated with things do not seem to exist (e.g., there is no nuclear explosion without the fissionable material to set it off). At the same time, events seem to surround things and intersperse among the differences of things. In this way, there are no such things as things absent events. Given these connections, should we consider events as properties of things? Or is it that events represent cumulative differences that perturb, irritate, and penetrate things? If the latter is the case, then perhaps, going back to Aristotle, events are simply actualizations of differences?

Ambiguity of Events

Nelson Goodman (1951) and Willard Quine (1970), seeking to preserve the identity of substance, individually posit that the distinction between objects and events has more to do with the relative duration of time, than with any meaningful ontological distinction. Goodman, for example, considers an object to be a monotonous event, while an event is a temporally unstable object. Quine refers to objects as firm, while events are objects that alter quickly. This doesn't really solve anything except to suggest that even in an analytic sense the boundaries between objects and events are at best, ambiguous, and perhaps, even indeterminate.

Events and Time

Leibniz anticipated the ways time, difference, and events intersect in his eclectic proposal that the universe was primarily comprised of something he referred to as monads. Leibniz deemed monads to constitute the most basic substance in the universe -- a kind of atomism. But unlike atoms, his monads were non-extensive in space. Moreover, Leibniz consider time to be an illusion, adopting an argument similar to McTaggart's A-series. But, he conjectured that things occurred in a succession (before and after) and it is this sense of order that gives us a minimal temporality. (Cf. Leibniz' *Metaphysics* 1991).

What makes Leibniz' monads more like events is that he considered monads as complete within themselves -- the subject of a monad contained all of its predicates and is extensive through these predicates to explain everything there is to know about the concept of a monad. However, within the monad is all of the potentiality of difference, because every monad, in its completeness, also contained its own history -- past, present, and future. This history is coiled up inside a monad waiting to be unsprung, unfolded as a sequence of events. Yet this history, even as it is manifested in events, is indivisible with no moment discretely separate from another. In this way, like the emergent theory of time, a monad must participate in time within its world, but from the outside an observer would never see a monad passing in time. But internally, the monad "is a natural consequence of its preceding state, so is its present pregnant with the future ". (Leibniz 1991: 96, §22). For Leibniz, events fill time.

Events as Process

However, it would be another two hundred years before something like Leibniz' theory of evental existence would be taken up again in the work of Alfred North Whitehead. But the inspiration for Whitehead was less about events in themselves than about events in a process. In 1927-1928, Whitehead delivered the Gifford Lectures at the University of Edinburgh which was subsequently published as *Process and Reality*. In the text, he sets out to critique the inheritance of substance ontology and empirical epistemology and its ties to a mechanistic (i.e., Newtonian) view of the operations of the universe. His alternative refers to a "process philosophy" or "organic philosophy".

Actual Entities

For Whitehead, the most basic element of reality is what he calls an "actual entity" or "actual occasion". With one exception which applies to God, the two terms can be assumed to be synonymous. "[T]he actual world", he writes, "is built up of actual occasions and by the ontological principle that whatever things there are in any sense of 'existence', are derived by abstraction from actual occasions." (Whitehead 1978: 73). Thus, much like Leibniz' monads and Democritus' atoms, Whitehead's world is an aggregation of "actual occasions", which, are not extensible in space. But, unlike the monads, Whitehead does not distinguish between internal and external time, an interpretation that draws Whitehead closer to Bergson's theory of time.

Events in Duration

The property of temporal extensibility is evaluated in terms of "duration" -- a concept accounting for the way in which an actual occasion is temporalized. In this way, Whitehead distinguishes between Leibniz' monads and his own conception of basic reality, by acknowledging that his "is a theory of monads, but it differs from Leibniz in that his monads change. In the organic theory, they merely 'become'". (*ibid* 80). In other words, an actual occasion has, as part of it basic constitution, the state of duration and becoming. Concomitantly, if there is no actual occasion, then there is nothing to seek regarding the determination of ontological principles such as causality or the reason that something is as it is. This is the foundation of Whitehead's ontological principle.

Towards Becoming

Actual occasions are "analysible in an indefinite number of ways" -- some more abstract than others. For example, there are different gradations of importance among actual occasions and there is a multiplicity of functions that they play in the world. Whitehead defines two methodological approaches for understanding an actual occasion: one which analyzes the potentiality for an actual occasion being objectified in the becoming of other actual occasions, and two, an analysis of the processes underlying the actual occasions own becoming. (*ibid* 23). Irrespective of these differences, though, all actual occasions (or entities) are on the same level of being -- in other words, a flat ontology. At the same time, it is an ontology of becoming making it less an ontology, than an ontigeny (the being of things in time).

Events in Time

How does Whitehead's philosophy correspond to my interpretation? I indicated in the section on time, that I was sympathetic to a view of temporality that considered the present and the past as real, and the future as consisting of speculative potentialities. Because of their nascent status, the emergence of events tend to arise from the temporal periphery, or what we commonly refer to as the future. At that edge of present and future-possible lies a horizon of evental froth constantly streaming into the present. At this liminal boundary, the emergence or becoming of evental potentiality, in which, what is virtual is the process of becoming actual -- and discoverable.

At that edge, there is no consistency, certainty, or clarity. What comes forth from that difference are what I refer to as events which actualize the inchoate differences at the horizon. The event is a momentary difference, but it signals the arrival of an interloper, a transgressor, into the unfolding of the present. It is a difference that makes a difference. Events are pure potentiality and as such are pure information -- albeit it has no structure, no applicable rules of syntax or semantics, and passes only information through itself as a media event. What we need to understand is what its capability are. What information does it contain? What is it willing to share? And most importantly what does it want? Given its chaotic state, we will not find answers in events. But just as we find neutrinos nearly undetectable until they eventually cause detectable collisions with larger masses, we kind locate the reality of events through their role in the formations of flows and processes -- each of which are co-constitutive with information.

VII. Information (Flows and Processes)

Events are non-extensive (i.e., don't take up space), are conductors of potentiality generated by differences, and are purely transitive. In this path, there is nothing that suggests any materiality or the possibility of materiality exists in events. If this were the end point, that conclusion would be a consistent reading. However, events are by their very definition, in motion, and motion is energy, even if it is potential energy realized from something at rest. Energy is a type of information.

Matter as Information

The physicist, John Wheeler, at a conference at the Santa Fe Institute in 1988, suggested that we are thinking about the world in the wrong way. Instead of looking at the world as made of "its", we need to analyze the world as "bits". That is, the material world is informatic. He states,

> It from bit symbolizes the idea that every item of the physical world has at bottom — at a very deep bottom, in most instances — an immaterial source and explanation; that what we call reality arises in the last analysis from the posing of yes-no questions and the registering of equipment-evoked responses; in short, that all things physical are information-theoretic in origin and this is a participatory universe. (Wheeler 1990: 311).

That is a rather strong assertion, but it is consistent with philosophers of information like Luciano Floridi (2009), wherein a strictly binary interpretation of the real as material/non-material is illusory. There is now a substantial and growing volume of literature defining the characteristics of the ontological fungibility between physical matter and information.(von Baeyer 2004; Vlatko 2010; Davies and Gregersen 2010).

Energy|Matter as Information

After Einstein, it should not be controversial to state that matter and energy are directly related to each other. And if matter can be thought of as information, then so should energy. As Gordana Crnkovic puts it,

> Matter and energy are higher order concepts derived from interactions of an observer, or a network of observers, with the universe, including mutual interactions among agents. This does not mean that the reality is just an agreed upon imagination. A world exists on its own with human agents in it and we discover its structures and processes, patterns and laws, by interactions and via self-structuring of information obtained through the interaction. (Crnkovic 2012: 751).

Matter, Energy, Information, and Entropy

In the late nineteenth century, Josiah Gibbs mathematically described the uncertainty one could ascribe to the distribution of energy in a system, given what was known about the volume, temperature, and pressure of the system. This description calculated the probability of any one microstate in the system having that energy. This state and its change is called entropy and in the absence of any external changes, the second law of thermodynamics says that energy will dissipate at what is referred to as the rate of entropy which is expressed mathematically as

$$S = -k_B \Sigma_i \, p_i \ln p_i$$

which states that entropy (S) is inversely related to the amount of energy in a system, i.e., the more entropy the less energy in a system, meaning that the distribution of particles (p_i) is more random and stable. Conversely, the more energy (the more ordered), the less entropy there is.

In 1948, Claude Shannon published an article mathematically describing the structure of communication in which he described the amount of information in any system as a probabilistic state of information choices, the equal probability of any of those choices, and that probability is continuous over the entire set of choices. (Shannon 1948). Shannon's equation, which describes these relationships, is,

$$H = -K \Sigma_i \, p_i \log p_i$$

which describes the state of information as inversely proportional to the amount of random data and signs in the information set. The lower the value of H the less information is available. Consider a message that has no disorder -- "AAAAA". The message is nothing but a string of single letters, but it offers almost no information. Now substitute one instance of the letters "OBM" for three of the A's and one *could* get "OBAMA". The replacement string does not offer a lot more information, but by adding three different symbols, we have a universally recognized message. The greater the number and distribution of symbols (e.g., twenty-six letters) and the longer the message, the greater the entropy and the greater the amount of information that is available. Of course, we can go too far in the other direction with such a large number of randomly distributed symbols and very long strings, that we get noise (or as cryptographers would put it "as close to noise without being able to recover meaning").

Flows

There is then an ordered relationship between information and matter, information and energy, and both of these relationships with entropy. From this we can interpret entropy from an entirely different perspective. Entropy is not a static condition, but rather a consecutive flow of difference. Entropy describes the flow of the state of information through time. Thus, flow is not something that is constructed, assembled, or caused. It is the inherent characteristic of events of difference by which events can continue to emerge on the horizon of the present. Flows of events are different kinds of entities. The energy fields operate in a way I would analogize as similar to the way electrical fields effect work by conducting an electrical charge. Flows are a kind of energy field only the flow is comprised of a consecutive sequence of events of difference that mediate a charge between one flow event to the one following. A flow then becomes a field of events of difference. But flows are not recurrent just as lightning is not recurrent for the same path and in the same way.

Towards Materiality

I am moving this conversation along a path towards greater materiality, but it is important that my notion of flows is distinguished from that described in Deleuze and Guattari's *A Thousand Plateaus* wherein they write, "it is matter in movement, in flux, in variation, matter as a conveyor of singularities and traits of expression." (Deleuse and Guattari 1987: 409). These flows are often expressed as being comrpised of the most mundane matter. But for Deleuze and Guattari flows can constitute the passage of milk or it can be escalated to more abstract planes such as complex financial derivative trades on commodities. My notion of flow is much more primitive in that what is distributed in flows is neither recurrent nor predictable. These are transitional initiatives which may or may not accumulate sufficient critical mass to become recurrent. Though flows demonstrate some capacity to move across space, it is intermittent and inconsistent. In any case, flows that are capable of retaining predictability and consistency -- the first requirements for a condition of materiality -- are what I refer to as processes.

Having made that distinction, there are a number of parallels between Deleuze and Guattari and my informatic model. In their paradigm, as in mine, there is no determination for subject-object. And as we shall see shortly, their cartography of relations emanating from assemblages is congruent with my theory of presences and their relations with processes (pre-presence) and networks (post-presence). In both cases, (i.e., of assemblages and presences) there is a common set of processes that are constantly territorializing (coding) and deterriorializing (decoding) these relations. The difference is that in my interpretation, one can interpret the process of coding as imposing greater and greater structure to information such that what begins to emerge from this process is formative matter. The relations are simply extended assemblages or machines integrating relations and code flows which pass from one assemblage to another. Even in its emergent materiality, it is still incorporated (structured) as information.

Processes

With processes, my ontigenetic model again intersects that of Whitehead's philosophy, though my terminology is different. What makes Whitehead's actual occasions so interesting is the way in which they interact with the world. Unlike Leibniz's monads which have a windowless perspective on the world -- in some ways, operating blind -- Whitehead's actual occasions are fully engaged in the world which surrounds them. This interaction works on several levels called "prehensions", "concresence", and "nexus".

- Prehensions are defined at the highest level as "concrete facts of relatedness". (*ibid* 22). Prehensions are the process by which an actual occasion establishes the possibility of a relationship with another actual occasion. Whitehead describes this possibility as containing three aspects: the actual occasion itself in which the prehension is a constituent part, what he calls the "datum" of what is to be prehended, and the subjective condition (the affect) of how the datum is understood to be prehended. (*ibid* 23).
- Concresence is the accumulation of prehensions in an actual occasion and make the actual occasion what it has become. In other words, concresence is the process of an actual occasion in its becoming. It is crucial, in approaching Whitehead's process ontology, to understand that "how an actual entity becomes, constitutes what that actual entity is..." (*ibid* 23). It is important to note that two descriptions of actual occasion/entity alluded to above "are not

independent. Its' being is constituted by its becoming. This is the principle of process."

- In the unfolding of the conscresence of an actual occasion through its prehensions (concrete facts/acts of relatedness), actual occasions have cause to encounter and align with other actual occasions. Whitehead refers to these as a nexus and it is these concrete aggregations that we experience as "real" objects in the world. A "nexus of actual occasions, interrelated in some determinate fashion in one extensive quantum" constitutes what Whitehead refers to as an event. (*ibid* 73). Just as actual occasions are basic engines of process, the intersecting interest (or intentionality) of a nexus of actual occasions is a process extended over duration.

Processes are the means by which events and flows become something more than transient phenomena and directly leads to the assembling of presences or things. Prehensions or concrete relations are the ways events and processes have encounters (either intentionally or inadvertently) and acknowledge these encounters. There are exchanges (one might call them flirtations), but usually nothing more. There are alternative outcomes, of course, where an exchange becomes immediately beneficial leading to a union (the nascent stage of presence) or ongoing exchange without the benefit of union in the form of a network (both of which are discussed below). Both of these latter conditions correspond to what Whitehead refers to as a concrescence and nexus.

Time as Information

If time is as crucial to ontigeny, as I proposed in the earlier part of this section, in what way is it related to processes? The chain unfolds like this:

- Time is manifested as differences;
- Differences are the basis of events;
- Events are raw sources of information; and
- Processes are the means by which flows of information are assembled, processed, transformed, and distributed.

In other words, processes are media machines by which time and events are encoded in and through information. This kind of machine is precisely what the name infers. It is a mechanism, a set of repeatable flows or processes that sit in between other processes and facilitate the transmission of information. In a similar way, Deleuze and Guattari refer to "abstract machines". At the end of *A Thousand Plateaus* they describe this environment,

> Every abstract machine is linked to other abstract machines, not only because they are inseparably political, economic, scientific, artistic, ecological, cosmic -- perceptive, affective, active, thinking, physical, and semiotic -- but because their various types are as intertwined as their operations are convergent. (Deleuze and Guattari 1987: 514).

A media-machine is crucial to the virtual connections of neighborhoods of such machines, as well as to amplifying the perturbations that ripple through adjacent neighborhoods. What is this abstract machine? Deleuze and Guattari define them in Anti-Oedipus,

> A machine may be defined as a system of interruptions or breaks. These breaks should in no way be considered a separation from reality; rather they operate along lines according to whatever aspect of them we are considering. Every machine, in the first place, is related to a continuous flow that it cuts into. (Deleuze and Guattari 1983: 36).

I extend their notion of an abstract-machine to that of a media-machine, because (with apologies to McLuhan) the media is the machine -- a view that is entirely consistent with Deleuze and Guattari and even more so with Levi Bryant (2014). The media-machine processes a continuous flow, causing, in its course, differences, distinctions, and disruptions. But the disturbances are not breaks or losses, they are simply more flows. In the context of information theory, the discontinuities are markers and noise from which all sorts of new possibilities emerge.

Media Time

Over the millennia, we have invented and innovated upon technics that Andy Clark and David Chalmers (1998) refer to as the "extended mind". The piece of paper on which we scribble our thoughts and the pencil we use is not simply a technics we employ to represent what we are thinking in our mind. Those notes and the media on which, and by which, they are inscribed are extensions of our mind, just as the car is an extension of our will to be somewhere else, or the television brings what is distant intimately close. The car and the television are not just extensions of our capacity to do something -- they *are* that capacity in a way that is familiar to our body. This is a reformulation of Ernst Kapp's morphological extension of the body through the machine.

For millennia, we have created these kinds of extensions of time to transform the ephemeral into the material. Most of these extensions are various kind of media such as oral epics, chronologies, diaries, or more complicated enfoldings of time, like histories. It is not something that came upon us in the past hundred years. It first appeared in the world of clocks, calendars, and time zones. It is the transfer of the experience of time into abstract dimensions in which the objective is to make human beings less obstructive to the processional flow. It is always there, being counted and re-enacted in rituals, schedules, and official records. All media is in time. I refer to this as media time -- the artificial accounting of the temporal through the application of techniques for demarcating, measuring, and counting time. Media are technics of succession and order, by which the frame of reference for time is established and overlaid upon (or incorporated within) the human observer.

In the nineteenth century as Jonathan Crary observed, we began to re-conceptualize the notion of how we could use media-machines to transform time -- first through phenakistiscopes, photographs, stereoscopes, and cinema. (Crary 1999). But it wasn't until the introduction of television that time was transformed from an experience of an interior imagination to an exterior simulation. In all its different forms, surveillance is simply an extension of this simulated exteriority. As time became a set of signposts by which we measured progression and succession, the media machine substituted the experience of temporality for a simulation of time. The temporal informatics of events by which we distinguished one form of information from another were super-imposed upon by what we thought were technical extensions such as the notes on a piece of a paper soon became indistinguishable from processes emanating from a source outside of ourselves. In fact, the materiality of the notes is more reliable than our memory and justifies our reliance on these other processes. Time, materiality, and the multiplicity of connections between them are all constituted in processes (some of which are customs, others standards) that are instantiated by media machines calibrated by a media time that lies completely outside of our frame of reference. But, this is not a simulation that stands outside and ahead of the real, as Baudrillard (1994) might suggest. It is another reality -- a media reality -- which precedes any possibility of what is materially real.

Subsumption of the Human

The German theorist, Siegfried Zielinski, recounts how Taylorism, through the efforts of Alexsei Gastev, was brought to Soviet Russia just after the revolution and how the transformation of objective and subjective time could only be managed through media time.

> The attempt to industrialize society and daily life collided violently with the traditional pace of life, which had hitherto been determined by the changing seasons and the diurnal round of agricultural production...[Gastev] became convinced that his ideas of social progress could be realized only by integrating each and every individual into the technical process. Thus, the effort was no longer to organize the machines; instead, the machines themselves would affect the transformation. (Zielinski 2006: 229).

The ideal opportunity was in the invention and development of what Zielenski calls "media machines" (*ibid* 242). In the age of computing devices, tThe cumulative effect, has only accelerated this convergence. He writes,

> This boundary between media users and media devices simultaneously divides and connects two different spheres: that of the active users of the machines and that of the active machines and programs. In the 1990's, both technological developments and dominant media concepts were oriented toward making the boundary between the two imperceptible. The vision was to use a computer and be unaware that it is a machine based on algorithms for calculating stimulating. (*ibid* 259)

Even the most ludic experiences of a machine are still algorithms. In fact, culture instantiates this play is itself an algorithmic process. (Cf. Galloway 2006). Human beings believe they measure time and make the machine so that the machine can better make human beings more than what they already are. But the machine doesn't operate in human time. Over its course, the processes transform the human into an extension of the machine working in media time. This is a theme we shall come back to in chapter six.

VIII. Presence

Presence is the evental construction that we would call things, objects, or entities -- the aggregation of events and properties that give rise to the experience of a world of stuff. The underlying construction has not changed from the evental world, it is simply a shift in the horizons of temporality. What is real still remains events, flows, processes -- all operating on a principle of difference.

Heidegger

The use of the term "presence" to speak of things or objects that are immediately present may be somewhat confusing given Martin Heidegger's use, and one might even say, ownership of the term to refer to things that are present-at-hand (*Vorhanden*). This confusion is, perhaps, unavoidable. Heidegger declares in the beginning of *Being and Time* that philosophers have completely misdirected the search for Being by turning it to "as that living thing whose Being is essentially determined by the potentiality for discourse." (Heidegger 1962: 47). He goes on to write,

> That is *why* Aristotle 'no longer has any understanding' of it, for he has put it on a more radical footing and raised it to a new level. *λέγειν* [the consideration] itself -- or rather *νοεῖν* [a perceiving understanding] , that simple awareness of something present-at-hand, which Parmenides had already taken to guide him in his own interpretation of Being -- has the Temporal structure of a pure 'making-present' of something. Those entities which show themselves in this and for it, and which are understood as entities in the most authentic sense, thus get interpreted with regard to the Present, that is they are conceived as presence as *οὐσία* (being or substance). (*ibid*: 48)

Heidegger's critique of presence, as the most ontic, and his division of beings in the world -- human being (*Dasein*), ready-at-hand (*Zuhanden*) and present-to-hand *(Vorhanden*) -- such that the ontic is the least accessible to Dasein promotes his disdain for substance ontology. My separate path, however, begins with his ontological division between Being and beings (ontos and ontic), resulting in the self-conscious Being (Dasein) having primacy in the ontological investigation. Given the irony that Heidegger's text was supposed to be about Being and its relationship to time, in the end, Heidegger does not think Being *in* time.

Ontigeny

As a result, my use of presence is about a kind of Being-in-time, but since I am setting aside ontology, for the moment, to study ontigeny, it is more proper to think of the kind of presence I have in mind as *time-with-Being-in-beings*. In other words, to take *things* seriously in their least examined dimension, time. Consequently, I am interested in things as they pass in time. If I were to say "pass through time", then I would be given time a status outside of beings. Rather, as I have suggested beings exist in time and time exists from the beings themselves.

For Heidegger, a thing, like a hammer, has only one mode of existence. If I (as an example of Dasein) know how to use a hammer, then the hammer has the mode of existence as ready-at-hand. On the other hand, if the hammer is broken or I don't know how to use, its mode of existence is present-to-hand. Though Heidegger, as far as I know, doesn't speak of a spectrum in which something exists (e.g., moving from one mode to another), a thing only has one mode of existence.

Modes of Existence

In my interpretation, there are multiple modes of existence, many of them existing simultaneously, as events, flows, processes, presences, networks, etc. Which, among reasons, is why the world does not stand still for discrete objects to persist through time. It is true that most things transition on their own time scales -- nothing says time is uniform in all dimensions for all things. Thus, presence is a mode of existence in which an intersection of processes cause a thing to become present. A presence is distinguishable from the events, flows, and processes that comprise it, while it is also distinct from the relations, bilateral or networked, in which it participates. It has a distinct mode of existence, which I call a mode-of-presence, while the things that comprise it retain their own respective modes of existence.

Presence as Connection

Tristan Garcia stresses that "presence is a relation that connects a thing to what a thing is in....Presence is a thing's being and comprehension, which in turn become *something*." (Garcia 2014: 168-169). In other words, the status of presence, which establishes the actuality of the present, is a relationship between the being of a thing and the recognition that that being is present. Not simply existing, but present. The degree of intensity determines the extension of time from the present. Thus, the intensity of presence is correlated with the intensity of its existence.

Networks

The interior and exterior spaces of a presence are vital with degrees of intensity. The more that processes are entangled in a presence, the more they can rely on corresponding processes to unburden peak loads, the more they are can be receptive to further engagements. Processes that are more intense are those that are more receptive to engagement with other processes. The greater the receptivity, the more expansive the available connections.

Connections entail portals and protocols and for a connection to be established between processes, these portals and protocols must be "compatible" -- or more properly, an ensuing connection must be coherent and viable. Networks amplify the effect of these connections. Simple connections constitute a conversation between processes be it with the interior or the exterior. A multiplicity of connections is the foundation of network. Networks create stability, improve resistance to degradation, and increase reliability and performance.

Networks add an important value to processes and presences. The connection between two processes (or presences), if it is sustainable, becomes a presence in itself bearing its own processes. Networks are multipliers, wherein edges (connections) become nodes (presences) and a multiplicity of connected nodes becomes its own edge. Information exists not only in the node, but in transit on the edge. In fact, the edge is crucial that instead of visualizing edges as connecting nodes, we should consider nodes as bridges for edges. The edge of a network is the entelechy of the whole network and networks can be thought of as their own presences. In this way, a city is the network of villages which is a network of communities which is a network of neighborhoods, etc.

If they are large and diverse enough, networks are eco-systems which give networks an ability to adapt and form new, emergent entities. Like computer networks, the fewer the connections or the more centralized those connections are, the more fragile the network and the less viable it is. The multiplicity and richness of connections, however, doesn't explain either the continuity that or the kind of equilibrium we experience of the things in our daily lives (like trees and buildings). Given this kind of existence and the earlier discussion of the modes that constitute a presence (events, flows, etc.) how does one account for the endurance of a presence in time? And how do different scales of time, i.e., stability, come about in a world that is continually transient? To explain these phenomena, I turn to two concepts introduced into philosophical literature by Gilbert Simondon: transduction and metastability.

Transduction

Transduction arises from Simondon's theory of individuation. In his analysis of the development of the individual, Simondon has the same problem as we are confronting: how does an individual who is constantly individuating herself, also maintain a connecting thread between these individuating stages. Whereas, classical ontologists would posit that there is a unity of the individual through his or her essence that maintains the identity of that individual, transduction posits that the process is itself a process. Adrian Mackenzie, in his book on transduction, translates Simondon,

> This term [transduction] denotes a process -- be it physical, biological, mental or social -- in which an activity gradually sets itself in motion, propagating within a given domain, by basing this propagation on a structuration carried out in different zones of the domain: each region of the constituted structure serves as a constituting principle for the following one, so much so that a modification progressively extends itself at the same time as the structuring operation...The transductive operation is an individuation in progress; it can physically occur in the form of progressive iteration. However, in more complex domains, such as the domains of vital metastability or psychic problematics, it can move forward with a constantly variable step, and expand into a heterogeneous field. (Mackenzie 2002: 16)

The emergence of the brain or of self-sustaining diversity in a swamp represent kinds of transduction, but so do forms of reasoning that result in higher levels of abstraction or news methods of reasoning. I theorize that transduction also retains, like Leibniz' monads, its own history coiled up inside, so that every transductive stage sustains a continuity -- a pathway in which each stage is individually unique, but retains a singular continuity in its evolution.

Metastability

Borrowed from the physical sciences, the problem of metastability arises in systems where flows and nonequilibrium dynamics are in play. Consider a ball rolling down a hill in San Francisco. Given the steep slope, the momentum of the ball is likely to propel it all the way to the Bay. Now consider that halfway down the hill there is a substantial "saddle" in which the downward slope suddenly rises upwards, before it continues its downward course. If the saddle is substantial enough, the momentum of the ball will reduced to the point that the ball does not have enough energy to continue downhill, but instead falls back into the saddle. It remains this way until a substantial rain storm washes the ball out of its equilibrium and the ball continues its downward trek. The state of the ball when it is at rest in the saddle is called metastability.

Metastability is directly related to entropy and "indeed, one can argue that metastable states are determined by *the maximum entropy* (or minimum free energy) principle...." (Olivieri 2003: 233). Metastability exists when a presence retains substantial potential energy, yet is in a prolonged state of equilibrium. Almost any number of physical and biological entities operate in the same way. An entity (or presence) may rest temporarily for a nano-second or an Eon -- the length of time doesn't matter as its individuation is reduced to a proportional crawl. Nevertheless, and this is the crucial assertion, metastability is how things come to have presence.

IX. Implications

In this chapter, I have outlined, however briefly, what an evental or process-based ontigeny would look like. A crucial question is, given a real world scenario, like SAGE as a representative of techno-surveillance, how does this paradigm compare to classical ontology in explain what techno-surveillance is and where it is going? That is the challenge for the next chapter in which I will conduct a side-by-side assessment of key themes from ontology and ontigeny and how well they explain SAGE and techno-surveillance.

Chapter Six: *Convergence*

In this chapter, I bring together the material from chapters four (*Things*) and five (*Events*) into contrast with the archaeological data on SAGE (chapter two). I compare concepts of ontology with similar ones in ontigeny to determine which of the two demonstrate a better fit with appropriate data on the SAGE surveillance system. I conclude by considering the implications of this analysis for future paths of convergence between surveillance and technology.

I. Core Issues

In chapter three, I demonstrated how most current research into techno-surveillance is based on presuppositions derived from epistemological interests, in particular, a variant of social construction in which the practices and artifacts of surveillance and technology are evaluated as bi-products of social relations, which, in turn, are formalized as frameworks of social knowledge. This approach limits our interpretation of surveillance and technology to be being little more than methods for signifying social relations. If practices and artifacts have any powers, capabilities, or momentum that lie outside of these relations, they are largely ignored. As a result, most research products about surveillance and technology are primarily focused on questions concerning political or ethical consequences.

In chapter four, I proposed that, despite a commitment to epistemological claims to the contrary, research relying on these claims retains an unconscious (or "forgotten") commitment to classical ontological principles. Some of those ontological commitments are derived from Plato (Critical Theory), while much of current academic social theory is ultimately grounded in Aristotelian ontology. In order to clarify just what these unconscious commitments entail, I presented a summary of Aristotle's ontology. I also introduced contemporary adaptations of Aristotle's metaphysics and suggested that some of these latter innovations were provocative and useful. Nevertheless, I concluded that there were just too many considerations left unaddressed to adequately account for what constitutes surveillance and technology, as well as the ways in which these practices are converging.

In chapter five, I proposed to replace this Aristotelian paradigm and its prioritization on space and substance, with an alternative metaphysics that emphasizes the role of time, events, and processes -- in other words, an approach that subordinates *Being* to *Becoming*. The question is whether this latter approach, which I refer to as ontigeny, is, in fact, a better way to account, not only for SAGE, but for contemporary phenomena in surveillance and technology. To answer this question, in this chapter I present a series of contrasts between a single aspect from ontology with a one from ontigeny. For each pair of these aspects, I proceed to demonstrate how this analysis specifically applies to the archaeological data from SAGE, and more generally, to surveillance. In the last section of this chapter, I will expose, what I believe are some of the more important implications of my analysis, including the ways I believe we can account for the increasing points of convergence between surveillance and technology.

II. Metaphysics in Action

Space | Time

The fundamental theme of ontological analysis is its concern for determining the nature of substance -- of what it is comprised and how it explains the order of nature. In Aristotle's paradigm, things are substances. In the *Categories*, those substances are defined as a set of hierarchical relations, at the bottom of which are primary substances -- or the individual things that we encounter in the world. In the *Metaphysics*, substances retain these relations, but are complicated by the fact that they are actualized when the form of a substance is combined with matter into something he calls a hylomorph. It is this combination that makes something we refer to as an existent and, more importantly, gives it a physical presence in the world. The hylomorph is the actualization of something in space. For example, the tree at which I am looking is the combination of matter (cellulose and other matter) with an arboreal form. If the cellulose disintegrates, the physical tree at which I am looking will disappear, but the form of the tree is retained. Thus, forms are persistent through time and actualized when conjoined with matter to constitute a *spatialized* thing.

In our own sensuous world, this persistent thing might be a table, a thing that takes up space. Its form is predicated of furniture, that is, as something to be used. It also might be predicated of fine craftsmanship, as something to behold as beautiful. Its matter is wood, but it could just as easily be stone or plastic. At the intersection of form (table) and matter (wood) is the potentiality for actualization which arises through the transformative power of causality. In this way, Aristotle associates the *concept* of the table with a formal cause. If a formal cause drawn upon by an efficient cause (a table-maker) who, in turn, exploits a material cause (wood), he or she can affect a final cause -- to wit, a table that exists in space. Through the principles of causality, everything is either actually or potentially a thing in space, and while it may be intangible at the moment, it is always already potentially tangible. To preserve the unity of just such a thing through the modes of causality, Aristotle relies on the underlying essence of a thing -- an essence that never changes and persists across time, effectively neutralizing any temporal distinction of a thing.

By contrast, the evental paradigm looks to time as the fundamental dimension along which things should be evaluated. This dimension, unlike space or essence, does not offer a unity to a thing or a substance. This kind of temporality is expressed in moments of differences that are transducted. These differences are dynamic, generating fluxes and flows. To become conscious of this temporality requires reimagining the experience of time not unlike Bergson's three tropes on duration raised in chapter five. There is a cognitive dissonance, for most of us, between the idea, on the one hand, that what is real is simultaneously fleeting in time, broken up by infinitesimal differences, and, on the other, our common experience that the world which we inhabit is fundamentally spatial, continuous, and persistent. The challenge to prioritizing temporality over spatiality is the construction of an alternative philosophical architecture of what it means for something to exist. It is the difficulty of undertaking such a transformation in our worldview that makes epistemology seem like a much easier and simpler approach to grasping what is real. A starting point for reconsidering the ontological problem is to see what the world looks like when we focus on a particular domain of experience. For that reason, I now turn to SAGE.

[Application]

Everything about surveillance, including SAGE, is in time. Nothing in surveillance, or even the application of technology, is about a single act or a single moment. It is always about a sequence of moments, an ordering in time -- though not necessarily an ordered time. There are sequences of acts, progressions of intentionality, as well as iterative re-assessments of risk. There is, in fact, no point in the lifespan of surveillance where time is not the pre-eminent dimension. While, it is true that surveillance takes place against a background of space, place, and borders, it is only the differences of space *in* time, in which time reveals space that the process of surveillance unfolds. Spatiality is derivative of temporality -- not just subordinate, as if it was an *almost* equal dimension, but is, in fact, no more than supplementary to time.

Time drives everything in SAGE: the pulse of the radar transmission, the rotation of the sweep, the sampling conversion from analog to digital, cyclic transmission of messages, computer clock cycles, refresh rates on the Direction Center displays, synchronization of data by date and time, clock cycle coordination between dual AN/FSQ-7 computers, and hundreds of other time division and multiplexing operations. Any failure to synchronize the movement of data or instructions from one component to another is equivalent to bits of data simply crashing into and cancelling each other. Perhaps most important is the requirement for a master control program to coordinate the timing of program operations and computational events.

This kind of time, however, is not Absolute time or human time. It is *media time*, driven by the clock cycles of the disparate technical components, each operating by their own rhythm. These components connect only at the portals, guided by the protocols, and artificially synchronized by buffers. While it may seemingly only be a single system, it is, in fact, a multiplicity of thousands of heterogeneous systems connected together. It is not through coordinating space by which these components can work together, but by orchestrating their multiple temporalities through the synchronization of common clock cycles that establishes an illusion of a single harmonious entity. It is, indeed, a simulation of time, not unlike the ways in which we coordinate the common time of clocks.

Consider a target of surveillance, be it a Soviet bomber or a suspicious person walking down the street. There is no absolute or even common time associated with the images. As a result, it is an image that is context-free occurring in the temporal frame of media time. The images may even be simulations, wholly manufactured for the sole purpose of stimulating a response. But all these frames are examples of the insistence and interjection of time into nearly every aspect of the SAGE environment: a sweep of the radar, the time slices of sampling data for transmission to a central monitoring station, the synchronization of signals into machine readable format, the time-coordination of signals with contextual data, the clock cycles for reading/writing data in proper sequential order at random locations on external storage, or the cathode ray tube that refreshes its raster display at a steady frequency.

Being | Noise

Aristotle is relentless in his search to interrogate what constitutes substance. Besides the qualities of essence, hierarchical predication, the sensuous hylomorph, he considers, as well, that substance has a more regulatory or existential aspect, namely that it serves as a "principle and a cause" (1041a9-10). Aristotle's starting point in his investigation of what constitutes the world is the identification of an *archē* (fundamental principle) and *aitia* (cause). While essence is what gives a substance a persistent identity over time, he is no closer to understanding what gives a substance continuity over space. He concludes that it is something that underlies essence itself, and which he identifies as Being.

His project, then, is to understand Being-qua-being. Being is an existential state and is not the same as a being an existent (i.e., a thing). Being exists, as it were, independent of any specific manifestation. Nevertheless every existent possesses Being. To understand Being, we have to work our way back up through the conceptual chain from essence to substrate to form to substance. In other words, substance is what gives Being its presence. Therefore, what constitutes the world ontologically is Being. Being is existence. It is universal and omnipresent. There is no such thing as existence without Being. If Being is in the world, does it express itself in a single way? Is there only a single way of experiencing Being?

Martin Heidegger, in seeking to recover ontology from the epistemic graveyard, discerns that Being, in fact, has modes -- ways of being-in-the-world. These modes are foreground (an existence that is immediately accessible) and background (a general existence in which we are immersed, but with which we have no intimate familiarity).[40] These modes explain how we come to manipulate things we encounter in the world, which, through our own introspective analysis, we can choose to take up authentically (i.e., to seriously approach and investigate Being-qua-being). Thus, Heidegger's response is that there is indeed one kind of Being in the world, but that the human experience of Being is relationally dependent. Two consequences follow from this reasoning: first, Being precedes beings and existence precedes existents -- therefore, Being is transcendental; second, Being can only really be understood by those who are capable of authentically investigating it. In other words, Heidegger's notion of Being is only something of unique interest to human beings.

In the evental model, what is fundamental is the existence of a uniform field of difference which is *in time* and is *apatial* (that is, without tangible dimensions). The best illustration for this field of difference is Gaussian white noise, in which every moment, every point, every state is randomly different from any adjacent state or moment. There is a spectrum between pure noise and no noise -- a spectrum that we refer to as entropy. In ancient mythopoeisis, this domain is referred to as the "formless" or "the void". Here it is simply conceptualized as noise. It is a virtual world, in that it has the power to become (something), but it is not yet (anything). This virtual world

[40] Heidegger proposes a third mode, not insignificantly, of Dasein, i.e., our own mode of being-in-the-world.

interpenetrates and is co-constitutive with the real world. It simultaneously produces a multiplicity of frequencies that simply cancel each other out. What is fundamental in the evental paradigm is purely stochastic.

Like duration, it is hard to account for noise. It is a distraction, an interruption, a source of entertainment, or something to which we are consciously oblivious. Nevertheless, it is something with which we are all familiar and to which we all accommodate. Noise is omnipresent, but, unlike Being, is not transcendental -- it is not a given condition. Noise inheres itself to this environment and is immanent. At the same time, noise is not passive. It is a form of information. Noise constitutes its own modulation, in which the properties of noise (that which is a moment of difference) vary the relations among these differences, which are, in turn, a type of information.

Noise also is mimetic wherein adjacencies of difference affect the modulation of a moment. This is not an abstraction for human beings. Noise is affective, oftentimes in the form of anxiety which replicates through mimesis across a field/fabric/plasma of neighborhoods. Anxiety is parasitic, like noise, which interrupts daily lives and calmer patterns of discourse. In this way, the ultimate expression of noise as anxiety is a difference that irritates.

[Application]

> When we consider SAGE, or any surveillance operation, we find the world into which it is placed filled with all sorts of noise. Long before a surveillance operation takes place, there is a background field of noise that generates the need for surveillance. Recall that the operation of surveillance is to "watch over",

often, because there is something to be seen that cannot otherwise be detected. The very fact that there is a need to "watch over" and to do so to see what cannot be seen means that surveillance is often motivated by suspicion -- mistrust and anxiety -- which generate additional levels of noise.[41] Once surveillance begins, if the "observer", be it a human being or a machine, has never "seen" this environment before, he/she/it will probably encounter nothing but undifferentiated noise and will have to "learn" how to see and interpret what is sensed and detected.

SAGE was created in a field of noise. As a result, consider the following:

- Stalin mistrusted the West, in general, and the American monopoly of the atomic bomb specifically. His anxiety over the absence of a Soviet atomic weapon generated waves of anxiety among his scientists, planners, and intelligence organization.
- On the other side, the Allies ratcheted up the noise level by declaring that the Soviet Union was imposing an "iron curtain" (Churchill) and warning "we have to get tough with the Russians. They don't know how to behave. They are like bulls in a china shop. They are only 25 years old. We are over 100 and the British are centuries older. We have got to teach them how to behave." (Truman recounted by MacDougall 1965: 22-23).

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[41] It is ironic, in this context, that the Latin roots of suspicion and suspect go back to *suspectus and suspicere, which alternately mean "to mistrust" and "look up to or admire (secretly)".*

- U.S. military planners, specifically the newly formed Strategic Air Command, were increasingly anxious and belligerent, creating a noisy political environment.
- Even the formation of the SAGE project was noisy with competing interests between academic, military, and commercial -- all seeking their own best position with respect to a growing fear of Soviet threats.
- Noise was (and is) a multimedia affair. Newspaper headlines screamed warnings of communist expansion and UFO's. Hollywood produced movies about communist subversion such as *I Was a Communist for the FBI* (1951), alien invasions like *It Came From Outer Space* (1953), and the consequences of atomic mutations in *Them* (1954). (Ken Hollins 2014).

Noise also constituted the field of invention out of which SAGE arose. It is worth recalling Gregory Bateson's comment that which is not already given as structured information is noise. Noises are glitches that make it possible for new patterns to emerge. Redmond and Smith retold one aspect of this emergent form of innovation (2000) in their history of the Whirlwind computer design. In the spring of 1947, project leader Jay Forrester confronted the problem of how to construct an internal memory for Whirlwind. At the time, only massive arrays of vacuum tubes could solve this problem, but they were slow, hot, unreliable, requiring substantial refresh cycles. In the meantime, London University professor, Andrew Booth, proposed something called a magnetic core memory.

What was proposed was only a conceptual rendering and no one was sure how to actually build something quite like this new design.

It was Jay Forrester's reading of an advertisement in an electrical magazine that provided the crucial spark. What Forrester came upon was a company that produced a thin metal ribbon that could be shaped into small toroids which, in turn, could be woven with very small wires. The properties of this ribbon would allow electrical charges to be reversed and stored so that the toroid could represent a binary value of 0 or 1 --depending on the direction of the electrical charge. Placed in an array, these torus-like objects could represent an entire field of binary information -- either program instructions or data.

The noise, in this example, was constituted by a coincidence of concrescence -- hundreds of "half-baked" ideas floating about, competing for attention which lacked either the ability to fulfill minimum requirements or a way to actualize their designs with physical materials. It was the further noise of advertisements, which could easily have never been recognized, which, in Forrester's mind at that particular moment, represented a connection among noisy dots which created a realization (which was wholly virtual at this point) -- which led to a real solution. (Redmond and Smith 2000: 51-56).

Noise also plagued the daily operation of SAGE Direction Centers. An early operator recalls, "we had two main problems: (1) multiple radar blips on each target caused by imprecise radar site locations in the computer, and (2) lots of glitches in the 'smoothing and predicting' program which associated computer symbology to a particular radar track."[42] Over time, other, more obvious examples of noises such as unexpected weather patterns would cause unanticipated detections for observers. These glitches, which caused great anxiety among watch commanders, turned out to have great value in anticipating enemy electronic jamming of signals and the eventual development of counter-measures.

Potentiality | Events

Much of Aristotle's analysis of substance is synchronic -- that is, concerned with the structure of substance at a particular point in time. Nevertheless, Aristotle was quite aware that things change over time, so in Book Nine (Theta) of *Metaphysics*, he addresses how change affects substance. He posits that underlying all substances is something called *duanamis* (*δύναμις*), or what has been translated as potentiality. Potentiality inheres to substance and has two aspects to it. The first is power -- an internal capability to move or change itself -- which he refers to as *kinesis* (*κίνησις*). The second, and more significant form of potentiality, is something he refers to as *energeia* (*ἐνέργεια*), or actuality. For Aristotle, actuality is what is most real. The lump of clay has within it the potentiality to be a sculpture of a young man or a bowl to be used in the kitchen, but its potentiality is not unleashed until it is actualized as one or the other.

An alternative to Aristotle is proposed by Deleuze and Guattari who trace these same steps but invert the significance of the operands. They argue that, indeed, what

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[42] Reported by Chris McWilliams who worked as a SAGE operator at Stewart Air Force Base in Kingston NY from November 1957 to October 1958. Downloaded from http://www.radomes.org/museum/parsehtml.php?html=StewartAFBNYnewsite.html&type=doc_html

underlies everything is change, but there is not a duality -- a potential which becomes manifested in its actuality -- but a reality that exists *as* change. That is, the reality of anything and everything is not in the actualization of the thing-in-itself, but in its becoming. What is most real is its emergence from its own potentiality, which is just another set of potentialities. This emergence is an event. Aristotle's concept of difference is between two substantive states -- a lump of clay (potentiality) and a sculpture (actuality). The difference of the event is that there is nothing of importance from which it came and nothing that can be known about where it will go. The event is a difference that makes a difference. But unlike Aristotle, there is no telos, no final form in which the real is actualized. Aristotle still seeks to preserve the synchronicity of substance and does so by prioritizing the actual over the potential, while still acknowledging that latent potentiality lies beneath whatever is stable. For Deleuze (and Guattari as well), what is conceptually substantive is the underlying power of becoming, the reserve out of which something is actualized.

[Application]

> Just as SAGE is immersed in and emerges out of noise, it does so in a field of events -- in an immense field of differences. In fact, the starting point for everything in surveillance, as well as its cognate forms of practice, is the remarkability of events. Surveillance nearly always takes place against a stream of undifferentiated events, or noise. To watch a radar scope without anything being displayed except the illumination of the sweeping signal is the equivalent of watching a television screen filled with snow. In both cases, there is nothing

remarkable that breaks the monotony of these visual fields. What does signify an interruption is an event -- for example, a blip in the case of the radar. A single blip may be nothing -- more noise such as static or the passing of a bird. But, there is a significance of a minor sort in that the blip may indicate a bounced transmission. On first inspection, we have only the existence of an event different from the context of its neighborhood.

What we learn from events is that there is a set of characteristics by which we can classify them. The first is the intensity of the event -- how intense the shock, how loud, how bright, etc. This characteristic is independent of space or time. Then there are spatial characteristics: distance, azimuth, and height; and, there are those that are temporal: time of event and time since last event. From time, there is a second degree of characteristics such as speed, acceleration, and pattern. Finally, for most types of surveillance, there is an analytic characteristic of forecasting opportunity or risk.

As presented in chapter two, radar detection is only the beginning of a long process of events in the SAGE system. Radar data is analog information -- sinusoidal waves of peaks and valleys over a variable length of time. To be useful to computers, analog data needs to be in a binary of digital format. To obtain that format, continuous waves of information need to be converted into digital events. Analog data waves are sequentially sampled at a regular frequency. The amplitude of the analog signal is converted into a numeric digital value and a sequence of such samples track the changing amplitude of the wave. However, if the frequencies of an analog signal change too quickly, then the sampling produces insufficient data, creating a sampling error. Each discrete sampling conversion constitutes an event, while a sampling error is a "missed event" that is lost to the data stream.

When event data streams are produced, they are uploaded to an input/output device that divides the data streams into a thirty-two bit parallel path (the width of an AN/SQL-7 data word). Each of these parallel streams move together as a collective event in a computer-driven clock cycle with each cycle moving the data closer to its next target -- perhaps an external storage device where it is written serially unto the disk surface, or to the central processing unit, where they are loaded for computation.

The point is that nearly everything in the SAGE system operates on a temporal field against which millions of events pass through the system. The events leave traces, what we now call detritus, some of which form parts of sequences and flows and come to represent some higher levels of information. But at the heart of SAGE are these millions of events or what Katherine Hayles refers to as "flickering signifiers". (Hayles 1999).

Matter & Form | Information

Matter, for Aristotle, has an interesting role in the study of Being. Matter, like a form, doesn't disappear, but, at the same time, in the context of a substance, doesn't always maintain the same participation. Consider a substance that is a hylomorph (a combination of matter and form) -- which are the kinds of things we encounter in the everyday world. When a thing degenerates, matter loses its form, but matter remains matter. Form retains a thing's essence, but, in the absence of matter, the materiality of the thing is gone.

The form is less an abstraction than a morphology (a structure) and I posit that the morphological entity to which this gives rise is that of information. Etymologically, information is derived from the Latin *informare* or "to give form to something" and the common root is *morphe* (*μορφή*) or form. I am not claiming that things are composed of information. I am asserting that things *are* information, existentially and ontologically. Events are small chunks of information -- marks against a field of noise. Events (or flickerings) constitute a form of proto-matter -- or matter that is so infinitesimally small as to be nearly non-extensive. When patterns emerge in flows of events they indicate the presence of a structure. We may not be familiar with or able to interpret the pattern, but we recognize a distinction and a repetition in the events from which we can distinguish a pattern, and most likely a pattern we already recognize. As Gregory Bateson observes,

> What we mean by information — the elementary unit of information — is a difference which makes a difference, and it is able to make a difference because the neural pathways along which it travels and is continually transformed are themselves provided with energy. The pathways are ready to be triggered. We may even say that the question is already implicit in them. (Bateson 1975: 459)

This is the one point where an evental paradigm maintains a strong parallel with the Aristotelian model. In the equations of difference as energy and energy as information, information is a material element. But, information without structure is simply noise where structure plays a role similar to form. That is, what gives information the possibility of materiality is the structure it affords itself, of what I loosely call *in-formation*. Linguistically, this structure can be detected in lexical, grammatical, and semantic rules that are layered upon utterances (phonemes) or marks (glyphs) to create information. However, this information is only meaningful when both the transmitter and receiver employ the same set of rules. This is the basic principle behind cryptography, which necessitates depriving all receivers of the structure, except the intended target. In the absence of rules, the information is indistinguishable from noise. In fact, the closer a message is to noise, the more obscure the structure, the stronger the encryption.

There are, in fact, parallel, though not equivalent, structures between linguistic, ontologic, informatic, and evental processes.

Progression	**Linguistic**	**Ontologic**	**Informatic**	**Ontigenetic**
Entropy	Emptiness	Being	Noise	Noise
Difference	Mark	Identity	Glyph	Event
Sequence	Lexical	Matter	Data	Flow
Repetition	Grammar	Form	Information	Process
Nexus	Semantics	Hylomorph	Knowledge	Presence
Application	Semiotic	Causality	Usability	Practice

The second and third columns correspond to an emphasis on stability, replication, and durability and work primarily in a spatial dimension. The last two columns are indicative of disequilibrium, disruption, and fragility and primarily align in the temporal dimension. The first column represents the progression of what is real in the temporal domain, but also bears a striking resemblance to categories of more stable ontologic structures. This suggests that the realm of Being and Becoming may not be a questions of opposites, but more similar to the interpretation of Page-Wooters for differences of time. Namely, that the difference of Being and Becoming is attributable to whether one is observing within or without the domain of what is real.

[Application]

The objective of SAGE is not to exist in the moment of an event, but to assemble a sequence of such events, to discriminate among these events, and to identify patterns. Blips are events; intermittent sequences are flows; patterns reflect processes -- repeatable sequences that are predictable. The integration of other data such as weather, commercial airline flight paths, altitude data, vector of approach, and speed with the azimuth radar data contributes to the aggregation of information about a pattern of events. These processes all come together when sufficient information suggests a reliable pattern upon which one can produce a decision. A decision represents only a probable state of knowledge, which can only iteratively improved or degraded. To the extent that it is a sequence of differences among things, it is accountable as a problem of Becoming. For a SAGE operator, determining the status of a blip as "friend or foe" is useful, but not actionable. Dispositive knowledge is derived from the pattern of blips over time indicating path, source, distance, evasive behavior, putative destination, and time to target. The cumulative sequence results in a risk factor that is always in the state of reassessment.

The structure of SAGE information (which in the linguistic domain, we would refer to as the lexical, grammatical, and semantic rules) was an early problem in the conceptualization of SAGE as a system. Claude Baum summarizes these challenges as comprised of eleven tasks that had to be built into every software system and sub-system:

- Centralized system data structures and control
- Modular, top-down system organization
- Discrete structured program modules
- Overlapped input/output and data processing
- Simultaneous real-time and computational processing
- Time-sequenced synchronous scheduling and interrupt for ninety subprograms
- Centralized data processing with remote input/output and display devices
- Comprehensive communication pool defining all global data in the program
- Table driven software for ease of modification
- Built-in test, recording, and data reduction; computer-supported system development and checkout. (Baum 1981: 24-25).

That these specifications were developed before there were software programmers or even a programming language is quite remarkable. It is enlightening to overlay these requirements onto Norbert Weiner's argument that cybernetic systems were equally true of human beings, social systems, and all other sentient beings. One can begin to grasp how engineers were trying to articulate the practical requirements of semi-mechanical processes through automated and dynamic systems that were constantly evolving. Harold Sackman, a principal of the team developing the SAGE application environment observes,

> The type of evolution espoused for man-machine digital systems is not that of inevitable social progress nor that of biological evolution. It is provisional, experimental, and adaptive, not blind or passive. It is a directed scientific and technological evolution, not the totality of human evolution. (Sackman 1967: 512)

The machine, as Canguihelm observed, is an organism and the organism, as Weiner proposed, is an information *system*. What was being undertaken in SAGE was the construction of an electronic nervous system for a gigantic information machine. Recalling that nearly ten years before these software specifications were drafted, McCulloch and Pitts described a living nervous system as a logical calculus of immanent activity, only hinting at the ways in which technology was already being analogized as an organic conduit for information.

To be sure, this is not a unified theory of nature and information, but a theory of parallelisms. In 1955, Ludwig von Bertalanffy proposed,

> a consequence of the existence of general system properties is the appearance of structural similarities or isomorphisms in different fields. There are correspondences in the principles that govern the behavior of entities that are, intrinsically widely different. (von Bertalanffy 1968: 33).

SAGE and the AN/FSQ-7 computer can simultaneously be considered systems; they can be considered stable entities; and both can be considered as bodies of information in constant transition. For example, we can focus on the constraints of capacity and the ways these constraints enforce stability and resist change. Alternatively, we can consider these same constraints as anticipating a solution and an opportunity to evolve into something more capable. Put another way, we need to ask whether these systems resist change or seek opportunities to expand. This is not to say that these are self-conscious entities directing their intentionality towards a goal. Instead, I am pointing the conversation to a more dynamic model that interprets complex systems as capable of resisting or adapting to internal and external demands -- a model such as that proposed by developmental system theorists like Susan Oyama (2000) where she writes, "since the genome represents only a part of the entire developmental ensemble, it cannot by itself contain or cause the form the results. But neither can its surroundings". (Oyama 2000: 23). In a parallel fashion, this entails a consideration of the trajectory of technology and surveillance, its hereditary momentum and the boundaries of its environment, as well as the implications of difference and order in which the border is transgressed.

Identity | Difference

I have discussed the schism between identity and difference as a philosophical issue. I now want to introduce the same set of issues with respect to the development of information systems. For a system to evolve it must simultaneously be stable and accommodating -- not so stable that it is rigid, and not so accommodating that it immediately disintegrates. A sustainable system must, over some arbitrary period of time, maintain some kind of stability -- a state we have already referred to as metastability. To achieve this stability, it must have the ability to affix its own local control over its neighborhood. Oyama enumerates three kinds of controls that are emergent in local conditions. First, are controls that arise from mutual interaction, or what I referred to before as a shared interest in portals and protocols? Second, controls develop from hierarchical relationships in which interactions at one level "give rise to the entities or processes at the next, while upper level processes can in turn be reflected in lower level ones." Third, control or stability follows through time from process to process. She observes, "these phenomena are not independent; in fact, they are three ways of looking at constructivist interaction." (Oyama 2000: 130).

She is concerned with describing the functional-structure of the development of order -- how do entities engage their environment to produce stability. For Oyama, that engagement is an exchange of information in patterns meaningful to both the entity and its environment. For biologist Stuart Kauffman, that translates to describing the evolutionary fitness of an entity to its environment. In a moment I will posit that both of these approaches are describing the same problem from different perspectives. But first, let me quote Kauffman at some length to illustrate just how information complexity maps to its environment. He begins by describing a Random Boolean network which he describes as "vast family of disordered networks." In this network,

> ...we shall find that they exhibit three broad regimes of behavior: ordered, complex, and chaotic. In the *ordered* regime, many elements in the system freeze in fixed states of activities. Those frozen elements form a large connected cluster, or *frozen component*, which spans, or *percolates*, across the system and leaves behind isolated islands of unfrozen elements whose activities fluctuate in complex ways. In the *chaotic* regime, there is no frozen component. Instead a connected cluster of unfrozen elements, free to fluctuate in activities, percolates across the system, leaving behind isolated frozen islands. In this chaotic regime, small changes in initial conditions unleash avalanches of changes which propagate to many other unfrozen elements....The transition from the ordered regime to the chaotic regime constitutes a phase transition, which occurs as a variety of parameters are changed. The transition region, on the edge between order and chaos, is the *complex* regime. Here the frozen component is just percolating and the unfrozen component just ceasing to percolate, hence breaking up into isolated islands. In this transition region, altering the activity of single unfrozen elements unleashes avalanches of change with a characteristic size distribution having many small and few large avalanches. (*Italics in original*, Kauffman 1993: 174)

For Kauffman, ordered states are associated with smooth landscapes among entity and environment. The more rugged the fit between the two, the more the relationship tends towards the chaotic. As the resilience of a system benefits from increasing diversity, Kauffman's research points towards the importance of a regime in which the landscape is rugged, but not so rugged as to destabilize the relationship. This environment he refers to as a complex and provides the greatest amount of diversity without risking the absence of fit at all of a chaotic environment.

As Claude Shannon noted, information systems with the least amount of entropy have the least amount of information to offer; those with the most amount of entropy may have too much information. The optimization of information exchange is also the point where systems in transition can produce the most amount of diversity without a complete loss of order. This, in short, is the argument for an information model that emphasizes a difference that makes a difference -- where the difference is significant enough to be sustainable, but not so radical as to destabilize the neighborhood.

[Application]

SAGE was designed to detect, isolate, and identify differences. Indeed, all surveillance systems share the same objective to identify a difference. Even a *facebook* page is made to stimulate, or in some cases, provoke a difference which can be identified. In a SAGE radar, a transmission that encounters nothing produces a 0, while a bounced signal corresponds to a 1. (Obviously the analog signals themselves are in frequency and amplitude.) Length of difference in time corresponds to distance. Difference in affirmative responses represents a path and an estimate of speed.

Ironically, most surveillance systems don't work this way. For example, an important form of security for a digital network segment works on the basis of anomaly detection. Here one establishes a baseline of what is considered "normal" behavior for a given a set of parameters (time of day, day of the week, etc.). Anomaly detection systems then seek to identify aberrations or conditions that are out-of-bounds. For example, if a network begins to indicate that large amounts of data is suddenly moving across the segment, it is an anomaly event that needs attention. But, if the pattern that is hidden among "normal" traffic, then no anomaly is found and no alarm is raised.

> SAGE, on the other hand, detected events directly. Events were uncommon enough that almost anything that appeared was worthy of inspection. The normal condition was an empty screen. If an abnormality was detected, it could quickly be negated by confirmation as an expected pattern.[43]

Causality | Flow

For Aristotle, causation or causality is a process of transformation.[44] The clay is transformed by the sculptor, who transforms it into the form of a sculpture, which, when it is done, is transformed into something beautiful. Each of these phases of transformation constitutes a mode of causality. The matter (clay) remains essentially the same throughout this cycle, though clearly the form is altered as it moves from being a lump to its final transformed representation of, for example, a person. This final cause, the *telos* of these transformations, is more important for Aristotle because of its finality. The fundamental transformation is the way that which is in space is manipulated.

By contrast, the evental paradigm begins with the froth of events that emerge on the horizon of the present. There is no essence. It is only random information -- which is to say, if there are patterns in the froth, they are neither interpretable nor fully formed. The forthcoming events, however, cascade into the present and are capable of forming non-repetitious sequences called flows. These sequences do not yet have the self-

[43] Even today, with all the clutter in space and the enormous amount of commercial, private, and military traffic, the Ballistic Missile Early Warning System (BMEWS) uses anomaly detection as part of a discrimination process. BMEWS uses an array of thousands of small transmitters that rely on altering the phases (troughs and peaks) of transmitted signals to create a directed array at a target at ultra high frequencies. The thousands of signals produce extremely fine grained pictures of a targeted field that is capable detecting a target. Of course, the appropriate response to this kind of technology is to create an aircraft that is "invisible" or stealthy.

[44] Though is more ambiguous for the neo-classical ontologists who have widely different views on causality.

organization to manifest any kind of stability, but do exhibit sufficient adjacency to appear to be able to reach a stage of self-organization. This is an edge event -- between spurious autonomy and self-sufficiency. At best, they cause perturbations among clusters of surrounding events -- what Graham Harman referred to as "vicarious causality".

There are two related analogies that are applicable. First is a proposal by John von Neumann made in a series of lectures presented in the late 1940's and into the next decade on various ways of understanding "self-reproducing automata".[45] Von Neumann's work in this area began with a simple project of understanding how a programmer working in a formal language (one naturally understood by human beings) could produce a set of logical requirements that could be "understood" by a computer interface, translated into machine language, and then executed by the computer. All of this was to be accomplished within the computer itself, including the entry of the programmer's logic, the translation, and the machine execution. Today, we would recognize this as a run-time interpreter. In working through this problem, von Neumann envisioned a universal Turing machine that could construct its own automatic software, or automata -- machines that run themselves. In the 1960's, John Conway sought to validate von Neumann's theory by building a simple two-dimensional world he called *Life* and a software application that ran itself in this world which he calls *The Game of Life*. (Gardner 1970). In this world, an initial condition is established in which a small number of pixels are illuminated and a small number of rules are applied to those pixels.

[45] These lectures were assembled by his colleague Arthur Burks and published in 1966 as *Theory of Self-Reproducing Automata* Champaign-Urbana: University of Illinois Press

For example, if three of the adjacent pixels are also illuminated, then the first pixel will die (be turned off). The *Life* machine continues to run the rules until the world dies or becomes so stable that nothing changes. However, in some cases, emergent forms appear and new life structures assemble. Many will die, but some will survive and continue to reproduce new forms and patterns. The point of the game is to show that with a limited set of rules, binary material, and a *Deus ex machina,* things simulating life-like structures can form. What von Neumann's theory and Conway's software illustrate are the ways in which simple pattern generation and rules most often lead to death or sterility , but often enough lead to new forms, reproduction, and sustained viability. The justification for isolating flows as a special form of progression in the evental paradigm is, admittedly, by analogy, but, to which, the increasing evidence suggests it is more than worth paying attention.

[Application]

SAGE started to come on-line in the summer of 1958. Between 1950 and that summer, the Soviet Air Force and U.S. air forces (including the Navy) had been engaging in a hot war: eight U.S. aircraft had been shot down, while two Soviet planes and one commercial airliner were destroyed in this time period. All of these incidents were near Soviet airspace or related to the war on the Korean Peninsula -- none were anywhere near U.S. air space. Just as SAGE was being lit up, a U.S. Navy reconnaissance plane was shot down near the Alaskan island of St. Lawrence, but following the full operationalization of SAGE, the only planes (excluding engagements in Korea or Vietnam) shot down were American aircraft largely engaged in testing Soviet air defenses. (Polmar 2001; Kotlobovsky and Seyidov 1995).

Apart from Soviet aircraft probing air defenses in European airspace, there are no known recorded incidents of Soviet incursions into SAGE air defense sectors.[46] Most incursions were conducted over Soviet airspace by the United States using redeployed B-29 bombers and the U-2 spy plane. The Cold War for SAGE was, at best, tepid and during the twenty-five years of SAGE, few, if any, significant flows ever developed. Yet, SAGE was pre-occupied with flows, of which two types are important.

- First, were the indistinguishable, non-repetitive flows of the monitored airspace? Every sweep of a radar represented a flow -- perhaps best designated as a null flow, but a flow nevertheless. The analogy might be a CCTV operator watching crowds of pedestrians walking on Oxford Street in London or Fifth Avenue in New York -- densely packed and indistinguishable. These are flows like a stream where the water does not repeat itself -- as Heraclitus might say, "you cannot look at the same passing pedestrians twice". But the stream continues onward. At best, it is a curiosity and at worst, has the effect of a dulling of the brain. In SAGE, in the continuous sweep of the radar are weather patterns, designated commercial airliners, and friendly military aircraft. What does not occur is a remarkable event.

[46] There were Soviet efforts at probing U.S. airspace around Florida during the Cuban missile crisis but these were detected by the Eglin Air Force Base air defense sector, which was not part of SAGE proper.

- Second, intermittent patterns were constantly erupting from the SAGE project and its Whirlwind predecessor in the form of ideas, inventions, innovations, development, manufacturing, organization, and emergent processes and institutions. The flows of SAGE in this regard were more like Kauffman's avalanches. As Redmond and Smith write,

  > Without the computer there would have been no SAGE air defense system, and without the magnetic core memory there would have been no computer capable (as soon) of performing the required task", and they continue, "in retrospect it is difficult to separate the R&D program that produced Whirlwind from the one that led to the SAGE air defense computer...as the one became integral to the other." (Redmond and Smith 2000: 441).

  And quickly cascading from these accomplishments were the developments of ergonomic visual displays, software languages, systems analysis, external storage, and networking. These were bursts of creativity out of the cacophonous relationships between MIT, IBM, Lincoln Labs, Western Electric, Burroughs, RAND, SDC, and the U.S. Air Force. These outcomes may have been desired, but hardly predictable. These virtual flows of events -- perhaps Kauffman's "avalanche" is a better trope -- are just as real in their manifestations as the hardware of the AN/FSQ-7 computer.

Actual | Simulation

As already indicated, Aristotle acknowledged a difference between the potentiality of a thing and its actuality, of which he considered what is actual to be more real. The declaration that what is most real derives from Aristotle's theory of the modes of causality that which has reached its greatest potentiality is its final development, its fullest stage of reality. Of course, the fact that the sculptor has transformed the lump of clay into a beautiful portraiture does not mean that we cannot imagine that the outcome could not be something much more beautiful or different. For Aristotle, formal cause only intimates what is potentially real. It has not been actualized.

How different a world we live in today. That which is most real (as in realizable) is that which *could be* -- it only requires our consent to participate in its realizability (whatever *it* is). It is only a question of determining what that *whatever* is, of finding its origins and potentiality and locating its reality in space and time. That turns out to be more problematic than one might at first surmise. Consider Jean Baudillard's recounting of Borges' tale of cartographers who set out to create a map of the Empire in which every detail in the map is accurate to the same scale of the object in the Empire. In other words, the map is as large as the Empire itself. Baudrillard writes,

> Today abstraction is no longer that of the map, the double, the mirror, or the concept. Simulation is no longer that of a territory, a referential being, or a substance. It is the generation by models of a real without origin or reality: a hyperreal. The territory no longer precedes the map, nor does it survive it. It is nevertheless the map that precedes the territory -- precision of simulacra -- that engenders the territory...Only the allegory of the Empire, perhaps, remains. Because it is with this same imperialism that present-day simulators attempt to make the real, all of the real, coincide with their models of simulation...Something has disappeared: the sovereign difference, between one and the other, that constituted the charm of the other. (Baudillard 1994: 1-2).

In the domain of information, everything is real and everything is simultaneously simulacra. The digital is capable of making everything real, because everything is information. The real only retains its reality, when one can sensuously know and remember it. When access to that reality is cut off and memory is no longer sensuously reliable, what is real is the simulacra. Consider the following scenario: there is a pilot sitting at Creech Air Force Base in southern Nevada; enclosed in a trailer; watching grainy video monitors; overseeing the flight of a Predator drone; dispatching a Hellfire missile at an adobe structure in South Waziristan; then goes home to his wife and family and an outdoor barbeque in North Las Vegas. What is real in that scenario? And what difference would it make if the video was simply looping through flight patterns from a year earlier?

[Application]

> SAGE was born from experiments of the Whirlwind computer at MIT's Servomechanism Lab which, at the time, was under contract to develop Whirlwind as a simulator for training combat air pilots. Throughout its operational history, SAGE was designed to simulate the real world. The chain of real events in the SAGE universe was short-circuited shortly after the initial event in the magnetic cavitron. There electrons, ejected from an anode were quickly cascaded around a pitted environment that accelerated their speed and reduced their frequency until it was captured and, in a discrete pulse, was directed out into the atmosphere. Anything after that initial physical act is an abstraction. The electron may, or may not, encounter a firm surface. If it does, it bounces back towards the emitting station. The fact that it bounces back, the time it takes between transmission and reception, is a translation of what an engineer presumed the receipt indicated. The radar is blind to a similar event until its

rotation brings it back to the same azimuth. Only with a second and third reception can we say we have a detection. But a detection of what? All we can see is a blip on an oscilloscope.

The analog signals are transmitted to a SAGE Direction Center, which, depending on conditions, might take 10-15 seconds. The signals are converted to digital data, merged with corresponding time-lapsed data on weather and other registered flights. The merged data is then calculated into coordinates that can be used to display a "blip" on an observer's screen. What the observer sees is a set of events overlaid on an electronic map of the territory an observer station is pre-assigned responsibility. Nothing that the observer "sees" is real. Everything is an electronic simulacra of electronic events that have been constructed by the software on the AN/FSQ-7 that, in turn, has been normalized and cleaned by other software. Despite labeling this process as real-time, in fact, the temporality is nothing more than media time.

The imposition of a simulated environment becomes very explicit with the attention that was given to the problem of training and qualification for SAGE operators. Before an operator was ever assigned to a SAGE Direction Center, trainees were run through extensive simulations. Once they were assigned to a Center, operators were continually run through simulations, some of which were recorded "live" working sessions. An entire section of the fourth floor of every SAGE Direction Center was reserved for just such simulation training and testing.

Despite the fact that the Soviet military shifted its strategic planning to Inter-continental ballistic missiles (ICBM) to compensate for its lack of bomber capabilities and SAGE had no capacity to detect such missile launches or flight patterns above 45-60,000 feet, SAGE continued to be employed until the late sixties when the U.S. began to deploy an upgraded SAGE-like system called Ballistic Missile Early Warning System (BMEWS). What is curious (or ironic, depending on your pre-disposition), is that the orientation of all these systems (SAGE, BMEWS, and its successor, the Solid State Phased Array Radar (SSPAR) system) were aimed towards the north or northeast where it was presumed Soviet/Russian attacks would originate.[47] This focus has been maintained for fifty years, despite the fact that the Russians long ago deployed a large portion of its strategic ICBM force to submarines which could attack from completely different directions. It could be argued that air defense began as a simulation and continues as one today. When it comes to amend the strategy, our imagination is defined by the language of the tactics which circumscribes our vision of a strategy -- the institution becomes the limits of our imagination.

Things | Presences

Trees, cockroaches, light bulbs, music -- these are things of the world. Heidegger, in his *Introduction to Metaphysics*, says that the sum of beings in the world is meant to include things like the Japanese, Bach's fugues, Hölderlin's hymns, criminals, and madmen. (Heidegger 2000: 80-81). This is to say, 'beings' refers to all the things in the

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[47] The five stations of the SSPAR at Beale AFB (CA), Clear AFB (AK), Cape Cod (MA), Thule (Greenland), and RAF Fylingdales (UK) continue this orientation.

world which exist and which we can identify as such. Nevertheless, there remains a confusion about how we think about things reflected in the language that we use to refer to things: beyond things and beings, there are substances, entities, objects, stuff, units, possessions, items, articles, accumulations, aggregations, machines, and systems. Though each of these terms have their own unique nuances, what they share in common is a specific intersection (collocation) of matter and/or concepts in such a way that we can indexically refer to this nexus as a type of thing. There is a synonymy that is established and preserved by a stability we believe allows us to reliably perceive and speak of the same thing in a continuous fashion. In Aristotle's model, this certainty arises from the predicate relationship between genera and species and through the persistent continuity of a thing's essence. In the neo-classical model, it is the fixity of the endo-relations that assures a thing's tenure.

By contrast, in the evental paradigm, presences imply a more tentative temporality and evade any definitive expectations of permanence or continuity. Presences arise from the nexus of repetitious flows (processes) . What gives it it's *thingness* are the entanglements of these processes with each other affording a metastability. This quality evinces an illusion of stability which only masks the underlying turbulence of flux and its continuous flows that comprises every presence. It is in this context that surveillance stands in such sharp relief to presence, for surveillance is about perceiving the fleeting, the unseen, and the unknown. Only through observation accompanied by archival documentation does surveillance establish a persistence of presence.

[Application]

It is this connection between presence, observation, and the archive, that gives SAGE its durability. On the one hand, SAGE is a massive undertaking. Each Direction Center blockhouse is estimated to have contained nearly 400,000 cubic feet of reinforced concrete with each wall and floor two feet thick. Of the twenty-two SAGE Direction Centers that were built, nineteen are still standing in various states of use (in some cases) and abandonment (in others). Many of the radar stations, including some of the inoperative radar antennas are still in existence.[48] Many stations were simply abandoned, while others were converted to commercial airline tracking systems. In one sense, SAGE has completely disappeared from American popular memory.

Nevertheless, the "culture" of SAGE persists in ways most contemporary observers do not even recognize. While few have ever heard of SAGE, its image recurrently appears as the archetype of technological control. More than fifty movies and television productions have used portions of the display or control panels from the AN/FSQ-7. Even as SAGE was continuing to operate in the U.S. air defense system, the AN/FSQ-7 made its first cameo appearance in *Zontar: The Thing from Venus* (1966), followed by two Woody Allen movies, *Every Thing You Always Wanted to Know About Sex * But Were Afraid to Ask* (1972) and *Sleeper* (1973), while O.J. Simpson starred as the computer operator of an

[48] The Montauk NY site is preserved nearly in the condition it was last used, because it was so prominent at the end of Long Island that sailors use it today as a landmark.

AN/FSQ-7 control panel in *Towering Inferno* (1974) and the computer had a major role in *War Games* (1983).[49]

SAGE persisted in many other ways as well. Today, the SSPAR system that rings the North American and European continents is connected with a massive network of computers and networks, airborne early warning radars (AWACS), submarine detection, all connected to the same central control (NORAD) that was originally designed for SAGE. The physical location of NORAD is still in Colorado Springs CO and its mission remains essentially the same -- though since 2002 also has responsibility for monitoring the interior of U.S. airspace.

In less detectable ways, SAGE was constantly going through upgrades, alterations, and modifications during its operational lifetime. Some are obvious like the transition from the AN/FPS-3 to the AN/FPS-20. The older radar had a height limitation of 45,000 feet, lower than the maximum altitude of new Soviet bombers. An extended range unit called the AN/GPA-27 was added to boost signal range to 60,000 feet (using a klystron instead of a cavity magnetron). There was no outwardly apparent difference between the two types of radars. When it came time to mass produce a radar with the capabilities of the AN/GPA-27, the AN/FPS-20 came on-line, but it looked just like the AN/FPS-3. The AN/FPS-20 became the staple radar unit for most of the lifespan of SAGE.

[49] While the list of films in which the AN/FSQ-7 stars also includes a large share of grade-B movies, it also includes a number of commercial success stories such as *Battle for Planet of the Apes* (1973), the television series *Battlestar Galactica* (1979), *Airplane* (1980), *Independence Day* (1996), and inane comedies like *Austin Powers: The Spy Who Shagged Me* (1999).

> However, the AN/FPS-20 had a severe limitation in that it operated on a single pulse sideband, which was easy to jam electronically. In 1959, without changing anything about the AN/FPS-20 basic architecture, a new module was added that produced multiple, random frequency pulses that made jamming much more difficult. This one addition turned the AN/FPS-20 into what became known as the AN/FPS-64. Over time, upgrades in antennas, in modulators, and in rectifiers added significant new capabilities to the AN/FPS-20. And with each new alteration, the Air Force assigned a new product code. (Winkler 1997). But, despite the name changes, barely anything externally recognizable about the AN/FPS-3 was different in the AN/FPS-64.

SAGE was in unending flux. On the one hand, SAGE was a thing. On the other hand, what we call SAGE at any one moment was simply the presence of a sequences of flows of events. The overall SAGE system can be said to have been in a greater state of stability than the AN/FSQ-7 software or the radars, but SAGE is the nexus of all of these things, and these things are the cumulative nexus of many other things, all of which are in a continuous state of alteration. The irony is that military organizations are always in search of stability, and the very nature of maintaining strategic advantage in military conflict always assures that there is no such things as stability. SAGE was designed to be a thing it could never be. Indeed even when it was deployed, it was already incapable of responding to the most current of threats.

Hierarchies | Networks

As Aristotle described in the *Categories*, the relationship among substances is hierarchical --fixed in place by the properties that are inherited from genus to species. This structure and metaphor has survived for thousands of years and certainly corresponds to the formal organization of military, government, and corporate bureaucracies. Deleuze referred to these as inverted arboreal forms in which the trunk is at the top and it branches out into limbs as it descends. The end point is a leaf if the trunk is an oak tree or a needle if the trunk is a pine tree. The branches inherit the properties of the root.

The projection of force during World War II is the epitome of such an organization: field armies organized into corps comprised of divisions that branch into regiments containing battalions each of which have multiple companies organized by platoons manned by squads made up of troops (an individual soldier). This organization corresponds to a command structure, a set of missions, and logistics. In military parlance, the totality of this structure is known as the order of battle.

By contrast, early transportation and communication systems were usually built on a completely different principle -- a point-to-point network -- that connects dots (or nodes) by the most feasible direct route from one point to another. The relations among points are horizontal. Deleuze referred to this kind of network as rhizomic. As this kind of network matures, stronger connections are established with nodes that are more centrally located creating direct pathways to points that have reached a critical mass (efficient markets, advanced switches, etc.). This distribution is known as a hub-and-spoke and has the advantage of improving the connection speeds between outlying and central points. However, these kinds of networks are neither resilient (a breakdown in the hub disrupts the entire local network) nor efficient, if a single spoke is congested. This is when individual points begin to make their own independent connections. These leads to multi-path, multi-interest, multi-value connections that are referred to as web or mesh networks. The ability to take any number of routes avoids specific connection failures or congestion, significantly improves resiliency, and most importantly, eliminates gatekeepers. In the world of communication, it moves from an inefficient broadcast model to targeted narrowcasting.

The question is, how do these networks work and what enables them? The answer to these two questions, ironically, can be found in the work of two early sociologists, Georg Simmel and Gabriel Tarde. In the case of Simmel, it was his interest in the problem of social relations as a web of influences. He portrays it,

> For societal connection immediately occurs in the "things", that is the individuals....It has no parallels with spatial things and their interaction. Societal unification needs no factors outside of its component elements, the individuals...This does not mean, of course, that each member of a society is conscious of such an abstract notion of unity. It means that he is absorbed in innumerable, specific relations and in the feeling and the knowledge of determining others and of being determined by them. (Simmel 1971: 7).

He goes on to observe that there are limits to these connections,

> It seems...that every individual has in himself a core of individuality which cannot be recreated by anybody else whose core differs qualitatively from his own...All relations among men are determined by the varying degrees of this incompleteness. (*ibid* 9-10)

In acknowledging these limitations, Simmel disregarded macro relations and connections by focusing on the multiple ways that small exchanges contributed to larger circulations of relations in money, fashion, secrecy, nobility, or the disruptive role of the stranger among those who are intimately familiar with each other. Ultimately, Simmel's interest turned towards what might be described as a phenomenological investigation, but his questions are an invaluable awakening to the importance of microscopic relations.

Gabriel Tarde pursued a similar interest in the mechanisms of networked relations, but with a different set of tools. Tarde's analysis emphasized three dynamic forces behind social relations: repetitious imitation, opposition, and adaptation. He begins with a critique of Durkheim's analysis of social relations, wherein social relations are nothing more than a replication of social affect. In this interpretation, relations simply reproduce what has been received. In this model, there is an explanation for the functionality of relations, but no accounting for how that functionality might change.

For Tarde, what is really going is not replication, but imitation. Imitation constitutes a likeness, but not a duplication. We cannot replicate that about which we have incomplete knowledge. The communicative chain that Durkheim was reporting is simply repetitious imitation. This is consistent with Simmel's view that we never know the totality of the other. But Tarde extends this further by hypothesizing that repetitious imitation facilitates adaptation, on the one hand, by taking from the imitated source what is useful, and enabling opposition when resistance is useful. (Tarde 1969: cf. 113-

119). It is from the contentious boundaries of these three forces that Tarde argues that creativity and invention emerge.[50]

It is in the work of Bruno Latour that this sociology is extended, if not quite to a metaphysics, than at least to an empirical level that is useful to metaphysics. In the context of this study, Latour is a frustrating subject to analyze. His theoretical work begins with social construction and traditional epistemological concerns. But, over the last ten years, he has demonstrated a decided turn towards metaphysical questions, particularly questions that embrace things other than human beings. This later work include two important texts. In *Reassembling the Social* (2005), he describes a world that is comprised of just two primary elements: actants and their connections -- the combination of which constitute a flat network of relations. Actants may be human beings, other living things, natural things, or artifacts. The connections may be material or conceptual (some might say, semiotic). Moreover, the scale of actors (institutions or individuals) doesn't matter in this construction. The only thing that counts are the connections and the connections he has in mind are those constituting information. He writes,

> As soon as we concentrate on what circulates from site to site, the first type of entities to snap into focus are *forms*. Few words are more ambiguous, and yet this is just the sort of topic that the shift in social theory allows us to see in a new light. Usually form is taken not in a material, but in a formal sense.....But as soon as you notice that each site has to pay the connection with another site through some displacement, then the notion of form takes a very concrete and practical sense: a form is simply something which allows something else to be transported from one site to another. Form then becomes one of the most important types

[50] Although it adds a level of complexity to the present paper, I believe it is nevertheless important to draw attention to the way in which Rene Girard observes the connections between imitation and deception, on the one hand, and mimesis and mimicry on the other. (Girard 1966).

> of translations...a displacement...that can be extended to information. To provide a piece of information is the action of putting something into a form. (Latour 2005: 222-223)

Latour's interest in relations takes an interesting turn in his latest text which he describes as a work in progress. Here he is interested in the problem of what I call portals and protocols. Not all relations, Latour observes, are equally possible. He gives the example of a climatologist who is use to speaking to other scientists, but is in the uncomfortable position of having to relate his reliance on the institution of scientific truth to a group of people whose frame of reference is aligned with economic self-interest. It turns out while the climatologist can speak to a group of fellow English-speaking compatriots, he is not at all speaking in the same frame of reference. The protocols between the two parties is completely misaligned. (Latour 2013)

Networks are primitive mechanisms for exchange and as Simmel observes, the exchange is completely separate from the sender/receiver or buy/seller. The exchange or the network relation has a completely different value and, in fact, as McCulloch and Pitts observed about nervous networks, the intermediation of networks store their own protocols and memories that affect the information that is transmitted. Looking at just the actors alone completely ignores what is the most viable and vital component of the network -- the relations themselves.

[Application]

> The SAGE network, whether one is speaking of the telephony system, the microwave towers, the processes in place for technical exchange, or the recruitment and training of operators was primitive by any standard.

Nevertheless, what is remarkable is how quickly the complexity of any of those networks became as relations were utilized, refined, and confirmed. The telephony network -- really a hierarchical tree -- was extraordinarily fragile and susceptible to failure. For that reason, not long after SAGE became operational, strategic planners began to consider creating standalone SAGE Direction Centers. It quickly became obvious that this alternative was too expensive. The investment in telecommunications equipment and protocols demonstrated that distributed systems were possible. The question quickly became, are such networks feasible? As we know in retrospect with the development of MILNET, ARPANET, and the Internet, the answer to that question is yes. But it took multiple layers of technology -- Ethernet, TCP, IP, routers, switches, firewalls -- and standardization to make these layers work together before this network would be both robust and resilient.

Predicates| Autonomy

From his earliest expositions on the nature of substance, Aristotle's model was committed to a hierarchical taxonomy. What made these branches rigid and firm was his commitment to the relationship of predication in which a secondary substance was predicated of a more primary substance. This predication is an attractive model in that attributes (such as order, properties, etc.) are inherited as one works down the arborial structure. This model is particularly attractive to military and capitalist organizations, in which hierarchy and command and control structures are optimized for this kind of model. For two thousand years, the taxonomy model introduced by Aristotle's metaphysics was useful and practical.

However, as wars and economic competition have become less hierarchical and symmetric and as information moves from vertical integration to a distributed peer-to-peer model, traditional organizations have increasingly confronted challenges from more flexible, less predictable, asymmetric threats. In fact, many scenarios suggest that a strategy employing distributed collaboration among human and non-human agents (including robots) will be the only way to re-establish a competitive threshold in these new environments. These scenarios optimize resiliency (using highly flexible swarming agents), cooperation (emphasizing shared goal seeking and the value of collective knowledge), autonomy (equipping agents with the perceptive and cognitive capabilities to navigate and reason about conditions in real-time), and adaptability (the ability to significantly change course or behavior and seek alternative paths to goal achievement or independently resetting goals). For example, a 2014 report to the U.S. Secretary of Defense on future warfare strategies underscores these points. The author, Paul Schaare, highlights several major points,

- Swarms of robotic agents re-introduce mass-scale at significantly lower unit cost:
- Future military forces will fight as a swarm, with greater coordination, intelligence and speed. Uninhabited systems can help bring mass back to the fight by augmenting human-inhabited combat systems with large numbers of lower cost uninhabited systems to expand the number of sensors and shooters

in the fight. Advances in information technology achieved in the twentieth century allow modern military forces to fight as a network:

> The power of swarming lies in more than just greater numbers, however. Today's modern military forces fight as a network, with interconnected human-inhabited platforms passing surveillance and targeting data across great distances.

- Battles are won on the best information:
- Autonomous and uninhabited systems will be networked and cooperative with the ability to autonomously coordinate their actions in response to events on the ground. Swarms of collaborative and informed agents can make faster decisions:

> Increased automation also has the potential to speed up the pace of warfare by helping to shorten decision cycles and, in some cases, remove humans from them entirely. Increased automation can allow humans to process large amounts of data quickly, allowing warfighters to react to changing events on the ground faster than the enemy. In some cases, the fastest reactions might come by removing humans from some tasks entirely.

- Automated surveillance extend the eyes of the warfighter (on both sides):

> Sensors can detect enemy forces and pass targeting data through communications links to shooters, who engage enemy targets with precision-guided weapons. The U.S. military was the first to harness the advantages of the information revolution to build a networked force, but

> other nations are following suit. Adversaries are building reconnaissance strike networks that can detect U.S. forces at long range and strike them with precision-guided weapons. (Schaare 2014: 6, 10, 12)

What this report highlights is that the transition to the next revolution in military affairs is going to necessitate the employment of non-human actors that are highly inter-connected through resilient information networks capable of acting autonomously, while carrying out and executing their own surveillance and intelligence assessment missions.

[Application]

Though SAGE had no self-generated mobility, there were a substantial number of autonomy-based objectives included with the SAGE environment. First, SAGE utilized the first fault-tolerant architecture in which two AN/FSQ-7s were running simultaneously, one in hot mode and one in ready backup mode. Second, the AN/FSQ-7 had its own methods for predicting failure, which entailed dropping the voltage a few degrees. Filaments that were about to fail wouldn't tolerate this drop in voltage and would begin giving off erratic voltages. The failing unit would produce an identification code so that a maintenance officer could be quickly dispatched to replace the module. Third, the software system was designed to handle regular upgrades by running the new software through a quality assurance routine to validate whether the desired output was produced. These techniques are standard procedures in software deployment today, but in the 1950's, this design was a radical invention. Fourth, in the event of a major communications failure, the telecom network had the ability to switch communication nodes and re-route around a failure. Fifth, the entire SAGE system was capable of running in simulation mode to validate response criteria, to test existing competencies, or to train new staff. The system was capable of switching back and forth between so-called "live" and simulation sessions. Sixth, one of the most important lessons from the SAGE networking experience was the importance of resiliency. To achieve this objective there were two sub objectives: build more bomb-resistant structures or build more redundancy in the communication networks. As the increases in the destructive capabilities of nuclear bombs seem to be outpacing building designs, the only reasonable alternative seem to be designing high redundancy. A researcher at RAND Corporation, observing these risks, designed a packet switching network that would allow multi-point connections to route data either around a failed or backlogged router. This lightweight redundant design soon became the preferred architecture for a future Internet. (Baran 1960)

Techne | *Processes and Practices*

Aristotle, in the *Nichomachean Ethics*, proposed that there five sources of truth, of which two (*epistemē* and *technē*) are the most important for our purposes. Epistemē is that form of knowledge that employs reason and analysis to achieve. Technē is the form of knowledge that also employs reason, but in this case, in furtherance of doing something. Though Aristotle often mixes the applications of these two forms of knowledge in a way that it is not always clear which is which -- a physician, for example, uses scientific knowledge to understand an illness, but a physician also uses his knowledge as an art to help a patient live a more healthy life. The acquisition and use of scientific knowledge is a process -- of observation, analysis, reasoning, and application.

Processes are predictable and repeatable sequences of events,. A scientist uses repeated experiments to validate a hypothesis. The methodology for scientific verification and discourse is well understood and every scientist (usually) intends to follow this protocol. At the same time, most artists apply repetition in their techniques to achieve an intentional outcome. Even an artist like Jackson Pollock, in breaking with the tradition of painting forms with lines to distinguish the boundaries of these forms, used repetitive applications of paint to create lines that did not define a form -- in fact, his lines can be said to be anti-form. Thus, Pollock, in rejecting one process, simply invented another one which he applied repeatedly.

Processes and repetition, practices and intentionality -- there is a rapidly blurring distinction today between science, technology, and art. As the story of Jay Forrester's discovery of a ribbon for use as a critical material in magnetic core memories indicates, the creative and the rational act turn out to be different side of the same performance, which we call a process. When that process is applied repetitively to a common set of problems, it becomes a practice -- be it science, medicine, or art. These are performances that engage both the material and conceptual realms and make the distinction between *epistemē* and *technē* almost irrelevant.

Andrew Pickering, in his study of practices writes, "The world...is continually doing things, things that bear upon us not as observation statements upon disembodied intellects, but as forces upon material beings....Much of everyday life...has this character of coping with material agency, agency that comes at us from outside the human realm and that cannot be reduced to anything within that realm." (Pickering 1995: 6). This response, Pickering adds, is a performative act which "is regarded [as] a field of powers, capacities, and performances, situated in machinic captures of material agency." (*ibid* 7). As Judith Butler puts it, "...performativity must be understood not as a singular or deliberate 'act', but, rather, as the reiterative and citational practice by which discourse produces the effects that it names." (Butler 1993: 2).

Processes and practices were an excluded domain in ontology -- shunted to the world of *technē*. In ontigeny, processes and practices are the common carriers of becoming. Processes for events that irrupt from within and practices for events that impinge from without. In either case, like a riverbank that channels the flow of a stream, it is difficult to distinguish the boundaries of the two.

[Application]

> As the SAGE project was about to go operational, nearly all of the software that was used in the AN/FSQ-7 was developed by the System Development Corporation (SDC) -- a startup originally housed at RAND Corporation in Santa Monica CA and subsequently incorporated as an independent firm. SDC's mission was to write, test, and maintain software. What made this project so unusual was that in 1955 when SDC was first established, there was no software industry, no notion of a professional programmer, no programming languages, and no established methods for designing, writing, or

testing software. The word "software" had yet to be invented and the usual term for programmer was "coder" -- a job predominantly performed by women. Programming, if it can be called that by today's standards, was described as "black art", "a private arcane matter", and "depended primarily on the programmer's private techniques and inventions". (Backus 1980: 126). Starting from a base of virtually no programmers, SDC, only a year later, employed 700 programmers, which some estimate accounted for sixty percent of all the people in U.S. capable of working on computers. (Ensmenger 2010: 60).

Over the next three years, SDC programmers produced over one million lines of code. As they developed the code, SDC invented standardized design, specification, development, and testing methodologies. By 1960, they had accumulated enough internal data on employee success and failure that all new applicants were screened by standardized tests. Documentation emerged as a separate task, as did system analysis, training, installation, and support tasks, all of which required different skill sets. SDC had to manage working relationships with IBM manufacturing in Kingston NY, MIT's Lincoln Laboratories in Cambridge where technical design was managed, project managers at Western Electric in New York, Burroughs Corporation engineers working on the radar-to-computer communications systems, as well as Air Force project executives at various sites is a perfect example of Pickering's "mangle of practices" in which processes were performances invented on the fly. In effect, SDC extracted data from the very processes they had themselves created and the recursively injected the quantification of those processes back into the production of those processes themselves.

Sixty years after the founding of SDC, software programming remains an art and as much as many software managers would like to represent it to the contrary, we are not much closer to a science of software development.

Boundaries | Ambiguity

To understand the complexities of a boundary, we need to return to the Greek distinction between space and place. For Plato space was the universal, non-physical expanse in which the Forms existed. Space, or *khora*, as Plato defined it in the *Timaeus* comprises the intervals between the Forms. In this way, space is an infinite, universal abstraction that is neither being nor non-being. By contrast, Aristotle argued one of the fundamental properties of the world was the quality of what is meant by the word *where*. In the *Physics*, this is defined as a place, or *topos*, which "surrounds whose place it is; a place is not what it surrounds; a thing's primary place is neither smaller nor greater than it." (211a). Plato's space receives that which is imposed upon it. Aristotle's space is that which is contained. For Plato the boundaries are established by the outside of the Form. For Aristotle, the boundaries are established by what is within.

This raises the question of the role of boundaries with respect to space/place and whether the nature of the border itself helps us differentiate between a space or a place? In this case, I turn to Heidegger from a 1954 essay: "A space is something that has been made room for, something that is cleared and freed, namely within a boundary....A boundary is not that at which something stops but,…the boundary is that from which something begins its presencing…Accordingly, spaces receive their being from locations, and not from 'space'". (Heidegger 1954:154). In this ontological interpretation, borders create a place; they do not define the relations of a space.

How do borders, of whatever source, function with respect to place? What is their role? The anthropologist Mary Douglas suggests that boundaries naturally arise from the inherent need to define the integrity of what belongs and what does not. The belonging constitutes an ordering which "implies restriction: from all possible materials a limited selection has been made and from all possible relations a limited set has been used. So disorder by implication is unlimited… [and] destructive to existing patterns." (Douglas 2002: 128). Borders, in Douglas' interpretation, arise from the social construction of meanings of order. Rituals symbolically acknowledge the "potency of disorder". (*ibid* 117). The rules for maintaining that order and preventing the e/irruption of disorder constitutes the rituals of what is contained within the borders.

Douglas postulates there are four distinctive conditions of importance to the border: a danger pressing from outside; the risks of internally-motivated violations of the boundary; the impermeability and resilience of the boundary itself; and the stability and coherence of the internal relations among the members inside the border. (*ibid* 151-152) On each of these cases, the preservation of the boundary is paramount to the internal interests of the community. What makes the boundary so complex is the indefinable, inarticulate status of those who populate the margins? The more inarticulate the edges of the community become, the greater the risk of confusion and disorder to the entire community. In the early days of the Cold War, the anxieties of

Soviet aggression, internal communist subversion, and the frightening magnitude of human destruction in the atomic bomb and World War II instilled a need for order and certainty, and nothing did that more than "securing our borders". The Aristotelian heritage gives us an ontological framework that stabilizes the present and assures us that the uncertainty of uncertainty of the future is only an actualization of what is already present.

That certainty is only as good as the integrity (or purity) of those residing inside the boundary. The role of surveillance, either internally or externally, is to assure the integrity of the border. Douglas writes, "It seems that if a person has no place in the social system and is therefore a marginal being, all precautions against dangers must come from others." (*ibid* 121). As a result, "all margins are dangerous". (*ibid* 150). The sociologist, Georg Simmel noted that the ambiguous status of the stranger gives rise to this same problem. One who is a visitor is detached from the community in obverse status from those who belong in this place. But, the resident stranger is neither a visitor, nor one who belongs: "the distance within this relation indicates that one who is close by is remote; but his strangeness indicates that one is remote is near". (Simmel 1971: 143)

What role do borders play in surveillance? Often they are crucial. The boundaries of a country, a nuclear power plant, or a military base represent demarcations between who may or may not cross the limit. Internal surveillance system use borders to measure the expectations of integrity of those *inside* the border. This is as true of the responsibilities of Britain's MI5 or the U.S. FBI. But it is also true of a looser definition of a community found in *facebook* friends who often watch each other to circumscribe or encourage certain behavior. But borders are sometimes the limit beyond which one intentionally transgresses -- such as voyeurs who surveil those that perhaps do not expect to be watched. And there are borders that exist to indicate the perpetration of a seduction -- as in exhibitionists who invite the voyeur. Thus, I theorize that borders are a nebulous creation that may not, in fact, exist in any essential sense. Which is perhaps why social media is as successful as it is by conveniently encouraging transgressive border crossings.

[Application]

SAGE was justified by two considerations. First, the United States considered that it had a dangerous and treacherous enemy in the Soviet Union. Second, the boundaries of the United States, once protected by vast oceans from potential enemies were no longer sufficient to protect the North American continent. SAGE was designed to create the "eyes" to see and track any potentially enemy attack. To accomplish this task, SAGE was given a boundary -- actually a set of boundaries -- that extended a couple of hundred miles beyond the Arctic Circle and along the North Atlantic perimeter. As long as a potential intruder crossed that boundary at an altitude between 10,000 and 45,000 feet, SAGE was likely to detect it.

But as mentioned earlier, that boundary was extremely porous -- different altitudes (higher or lower), different directions (west, south, or east), evasion (electronic jamming), gaps in the radar detection space, or radars down for maintenance -- could all fail to detect an intruder -- what is known as false negative. On 9/11, it became quite clear that boundaries were increasingly meaningless.

III. Implications

From these contrasts and comparisons we can draw a set of implications for how we think and conduct research about the kinds of things we encounter in the world.

- From chapter three (epistemology), we saw that evaluating things simply as processes as things in themselves, such as power or legitimacy, devolves into a multiplicity of unrelated or conflicting explanations. From chapter four (ontology), we began to construct all alternative view of things as coherent, independent objects which encapsulate their own set of private processes, while at the same time communicating among each other in the form of interruptions or irritabilities. The conceptualization of these objects were seen to range from material elements to abstract entities that incorporate elements, but with an effect, the sum of which, is not reducible to the elements themselves.
- This ontologicalization of the world is an effective, but very incomplete way of modeling the real world. In chapter five (ontigeny), we revealed how objects are in various modes of existence, usually simultaneously, ranging among differences, noise, events, flows, processes, presences, and networks. In this way, objects are not the substances or entities of identity as we find in variants

of ontology, but are evaluated as transitive modalities that can be seen in different ways at the same time.

- This simultaneity, as discussed in chapter five, is founded on the inversion of space with time, in which, things are not only interpreted as being in different modalities, but as always transitioning among multiple temporalities. In this way, objects are not singular, persistent, and divisible in space, but are always in states of transition including mutation, adaptation, convergence, and emergence. Objects are not just things, but are things becoming objects.

This analysis suggests that further research should be focused on questions around the ways in which processes of individuation and transduction take place, which drive technological migration. In the same vein, we should begin to rethink what it means for technology, or more properly, what Kevin Kelly (2010) calls "techniums", to acquire properties of autonomy, complexity, self-organization, and emergence. Finally, can we seriously talk about machines becoming autonomous and autopoietic without asking in what ways machines are ethical or have ethics.

IV. Conclusions

The Technium

I began this project by observing that techno-surveillance has established a pervasive presence in the world today. In chapter two, I argued that in the history of surveillance the origins of this contemporary phenomenon can be traced back to a set of events and decisions in the late 1940's and early 1950's that resulted in the investment in and development of the SAGE system. The intellectual and engineering prowess behind SAGE and all of its subsidiary projects represents a precipitous inflection point in enabling the convergence of symbolic manipulation, information theory, cybernetics, decision systems, analog signaling and digital computation, knowledge representation, machine-to-machine/signal-to-signal networking, application programming, and man-machine ergonomics into a single, integrated, complex surveillant technology. It is, in every sense of the word for which Kevin Kelly invented the word, a "technium":

> The technium extends beyond shiny hardware to include culture, art, social institutions, and intellectual creations of all types. It includes intangibles like software, law, and philosophical concepts. And most important, it includes the generative impulses of our inventions to encourage more tool making, more technology invention, and more self-enhancing connections. (Kelly 2010: 11)

Scope in Dollars

Determining the scope of the SAGE technium is difficult. Indeed, the scale of SAGE is so enormous that no single descriptive characterization captures the essence and the nuances of its accomplishments. Perhaps only the magnitude of the dollar investment in SAGE summarizes the relative importance of SAGE both to defense programs as well as to engineering employment.

In 1954 dollars, the Federal government budgeted $48 billion in defense expenditures for FY 1954 (representing sixty-nine percent of the total Federal budget). As noted in chapter two, the total expenditures for SAGE over its initial development and installation were $8-12 billion (1954 dollars). Although this investment was made over five to six years, it is remarkable that legislators, military planners, and engineers would envision an expenditure corresponding to twenty-five percent of a single year's defense budget for the research, development, and implementation of a single mission project.

Scope in Labor

In terms of employment, SAGE employed tens of thousands of individuals including eight thousand programmers at the RAND spinoff devoted to SAGE, Software Development Corporation, at the peak of the project in 1957. Though there is no definitive accounting for SAGE employment, a study by the National Science Foundation noted there were only 69,800 engineers working in electric and electronics in the entire United States in 1957.[51]

Scope of Risk

It was an investment of money, manpower, and resources in a technology that, in retrospect, would seem highly improbable for success. Today, technology risk is measured by the degree of uncertainty about the success of achieving a technical objective. Uncertainty is, in turn, measured by how well the problem to be tackled is well understood. By nearly all accounts, the lack of a digital computing machine or any of its primary components, such as core memory, were not only not well understood, but an engineering vision of a solution was quite opaque, at best.

Why the Inflection?

Evaluating SAGE from the perspective of ontigeny points to *noise* as a primary driver for the urgency by which engineering, political, and military decisions were

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[51] Cf. Table A-16 from NSF Industrial Research and Development Information System (IRIS). Downloaded from http://www.nsf.gov/statistics/iris/tables.cfm?pub_year=nsf_59-50.

applied. The noise was expressed as anxiety mimetically amplified through multiple media -- radio, newspapers, cinema, and the new technology of television. Nor was this noise one-sided as the Soviet government and military were equally propagating and amplifying their own forms of noise.

The transition from this *noise* into the consecutive coincidences of *concrescences* is more surprising. Yet what we discover in the history of SAGE are a multiplicity of concurrent flows that are sufficiently persistent to becomes processes that, in turn, accumulate sufficient critical mass to become *presences*.

The irony, in many ways, is that the chaotic turmoil of the noise (in both the United States and the Soviet Union) was at one and the same bilaterally focused in its respective opposition. The noise became more concentrated because the object of the anxiety was so singular. At one and the same time, the enemy was everywhere (for the United States the confrontation was with the Soviet Union, China, North Korea, the Warsaw Pact, Vietnam, Congo, etc.; for the Soviet Union it was surrounded by NATO on the west, the United States to the north, SEATO to the east, and U.S. allies Turkey, Iran, and Pakistan to the south) but it was the same enemy -- the "main enemy", on the one hand (Beardon and Risen 2003); and the "main adversary" (*главный противник*) on the other. (Andrew and Gordievsky 1990: 367).

Containing the threat meant keeping track of it. Given its geographic distribution and the accelerating shortfall in the time to discover an oncoming threat, keeping track of a threat meant automating it. Surveillance became a logistical challenge, spatially, but even more importantly, temporally. Repetitious processes could be automated in calculating machines. Threats could be converted into electronic flickerings which could be collected into symbolic representations. Responses could be distributed through networks of machines and pushed out to kinetic forces. The concrescence of machines could logically manipulate symbols connected to and generated by perception-machines and could do so simultaneously over large expanses of space connecting observations, decisions, and actions into a real-time cybernetic machine. As Levi Bryant puts it, "machines all the way up and all the way down".

Dissonance and Reality

From our contemporary perspective, there is less and less we find remarkable about machines with cognition, perception, mobility, and connections. We increasingly encounter robots that talk to us, anticipate our requirements, carry out burdensome work on our behalf, and makes connections with other machines to communicate or complete tasks. What is striking is the degree to which the populace of 1954 found such encounters, albeit fictive or hallucinatory, equally credible. As previously noted, popular media in the early 1950's was pre-occupied with stories of machines and aliens with many of these capabilities. Even visions of mutant organisms (such as *Them!*) or biotical spores capable of absorbing, embodying, and replicating human beings without their emotions (*Invasion of the Body Snatchers* (1955)) are visions of machines that think, see, move, and act without moral qualms or emotive qualia. What many citizens of the 1950's transposed from the power of the aliens was an anxious anticipation of what they hoped they could do for themselves.

Persistence of Noise

I would suggest that a residual effect of Cold War anxieties modulates through our society today, keeping our envisioning of surveillance, information, machines, cognition, and automatons as distinct categories that are too dangerous to confuse together. But, in fact, the distinction between surveillance and technology is increasingly murky, as information systems become perception-machines. The boundaries between machines and human beings are increasingly difficult to discern as machines become more life-like (android), and human beings are acquiring more technical prostheses to extend their abilities or compensate for the disabilities (cyborg).

Transgressive Boundaries

In her 1985 essay on cyborgs, Donna Haraway noted three different boundaries that were in the process of dissolving. First was the difference between human beings and animals as nearly all the claims for human exceptionalism are disputed. As materiality claimed territory once lost to the incorporeal and insensate, the human-animal difference simply didn't matter anymore. Haraway calls "the second leaky distinction" as that between organisms and machines. The barrier of Turing's intelligence test has long since been breached and any observation of remote pilot operations of Predator drones reveals just how far the machine is defining what a human being can and cannot do. Third, and this is critically germane to this project, "the boundary between physical and non-physical is becoming very imprecise..." (Haraway 1991: 151-153). All three of these boundaries are not only disappearing, but the materialities that gave these domains their claim to difference are flowing into each other at an accelerating rate. The technologicalization of perception and the transformation of information into materiality are two important examples, not only of what Haraway is critiquing, but what Stacy Alaimo refers to as trans-corporeality.

Accelerating Transgressions

And the speed at which this is happening is the most important clue as to why social researchers are missing the ontological importance of the transformation of nature -- material and conceptual -- that we are undergoing. The ancient and medieval theory of Being was predicated on an ideal of human dimensions which permitted the perspective of time to be held in abeyance, while the experience of space was immediately accessible. But since the nineteenth century, the speed at which we pass the world is accelerating. First it was steam-powered paddleboats, then trains, telegraphy, gramophones, telephony, radio, cinema, and television. For the first time in modern history, the issue of Becoming is arising as a challenge to our existence. What Aristotle and two thousand years of western philosophy have presumed -- namely that time is simply something that we live within and that our transcendence of time is only achieved through begetting (rather than Becoming) is rapidly emerging as a questionable presumption. We are propelling ourselves in such a way that only technology can maintain the integrity of our journey.

Enframement?

That we are willing to sublate ourselves into the rigorous demands of advanced technical systems is not a late twentieth century development. Martin Heidegger, in a post-war essay pondered just this question. (Heidegger 1977). The ontological challenge, for human beings through most of our existence, has been to face our own Being and to uncover its properties. Tools were one of the principal means by which this discovery could unfold itself in the world. But, modern technology, Heidegger opined, was no longer revealing nature, it was challenging and seeking to overcome it. This challenging he termed a "setting upon" in order to create a "standing reserve" of nature's forces and capabilities. In order to accomplish this, technology not only has to make order of nature, it needs to make an ordering of the order itself. As a result, human beings and Being, become ensnared in this ordering and standing reserve. The pilot is no longer the commander of the plane because he is encapsulated within technics of the plane, the order of the airline for whom he works, the air traffic control, and a whole host of organizations and structures lying completely outside his purview. The pilot is, in Heidegger's word, "enframed". However, this may turn out to be a more apt description for the implications of systemic technology.

The Simulacra of Envelopment

I concede that Foucault was right about the ways in which the human product is shaped by organization and discipline. At the same time, I agree with Deleuze that the objective today is control -- at least in a cybernetic sense. But there is something else going on that our traditional epistemological and ontological paradigms haven't revealed, largely because the dimensions at which this is occurring are outside of human scales -- not just speed, but the production of simulacra at rates beyond our imagination. (William Bogard was early to discern this pattern and its implications for techno-surveillance.) What Heidegger imagined as the implications of nature being held in reserve within the bounds of a system are hard to imagine when that system has been enveloped by an imagination that is controlled by simulation.

In 2007, when Israel attacked a Syrian nuclear power plant under construction (Operation Orchard), one of the key tactical objectives was the blinding of the Syrian air defense system. This objective was achieved (most likely) by inserting a "normal" data stream into the input channel of the Syrian air defense information system which simulated a normal airspace.[52] A similar technology was employed in the Stuxnet attack on Iranian centrifuges by making control monitors appear normal while the centrifuges self-destructed. In this world, the boundary between real and simulacra disappears. (cf. Falliere, Murchu, and Chien 2011). These tactics reflect a military objective of using flows and processes to deceive (make something not appear), to seduce (to draw something or someone closer), or to subvert (to undermine the facility, ability, or legitimacy of something or someone).

Technical Sensoriums

There are six primary characteristics of this "next generation" of techno-surveillance systems that enable them to have capabilities far in excess of "watching over".

- Machines that have cognition, multiple forms of sensory perception (much of which extends beyond human sensibilities), mobility, and the ability to connect to other machines (as well as human beings and other animals) acquire an equilateral status with human beings and their social networks. These machines

[52] Described by John Markoff as a "kill switch". Cf John Markoff "A Silent Attack, but not a Subtle One" in *New York Times* (March 26, 2010)

"want" something more than robotic enslavement. They are, as Heidegger put it, equally enframed with the logic of autonomy. While this is a contentious assertion, I want to argue that the kind of autonomy, of which I am speaking, is a self-referential autonomy in which the identity and integrity of the machine is derived from its own independent standard. Most machines are pre-coded (as was the AN/FSQ-7) or are soft-coded so that the bounds of outcomes are constrained by the structure of the program. But machines that learn *ab initio* from algorithms that recursively redefine themselves, not only polymorphically, but procedurally, can define their own diegesis and their own identity. The constant individuation of these conceptual constructs means that the processes and the morality of the machine are never the same. To the extent that the constructs are analogized to other pre-existing objects to which the machine may be exposed, but to which it is not constrained. This substantially opens up the degrees of freedom for a machine's interpretation of things in this world. The momentum of iterative development necessitates greater and greater independence of human control and connections. Operator control at a distance may have slow data links and operators may not be sufficiently attentive to effect a decision and an action in a necessary time. On the one hand, the effectiveness of a machine that is encumbered by slow human reaction may be deemed insufficient. On the other hand, the obvious response is to give the machine greater autonomy to respond in a more timely fashion. That is the instrumentalist response. The alternative perspective is to acknowledge that the logic of these systems, or rather then Techniums in which they are enveloped, is to "want" greater autonomy. In 2012, the Department of Defense observed that the whole concept of autonomy being interpreted as a spectrum was obstructive to granting greater capabilities to remote machines. (US Department of Defense 2012). The word "want" is used in the sense that it is just simply "logical" to make these machine/organisms autonomous. The capability of these systems to observe a greater bandwidth of data (infrared, ultraviolent, nuclear, biologic, etc.), to analyze more quickly (particularly in a distributed swarm), to maximize options and minimize risk, and to act with greater force than most human organizations are capable makes it "logical" to extend to machines the capacity to evaluate objects in ways different from the ways human beings might do so.

- In this same way of using the word "want", machines want mobility, not in terms of place or location, but in terms of information and ability to act. And they want the ability to employ whatever resources are accessible to them -- via networks and protocols. I refer to this as a *monodromy* -- multiple entanglements capable of moving together as a single unit, while retaining their individual processes and flows. Finally, I posit that these systems want a purview into their environment and their neighborhoods (logical or physical) in order to gain, what military tacticians refer to as situational awareness. This means that systems are evolving not just an entanglement, but a convergence between the perceptual systems and information systems.

My principle conclusion from the "logic" of SAGE and successor system is that the internal logic (following from Ellul) of the technics drives the technical product, that this product compensates (following from Kittler) for the limitations of human capabilities, and while this product could have been considered to have co-evolved with human beings (following from Stiegler), its internal logic has accelerated in development faster than the ability of human beings to master or even accommodate it.

The primary objective of this project has been to explore in what ways SAGE is a prototype for this convergence. But there are many examples of how this paradigm is playing itself out today. For example, in an increasing number of urban transit systems (San Francisco, Atlanta, London), a new technology is being deployed that exemplifies all of these capabilities. *AISight* is a "next generation" surveillance system.[53] It is a set of digital cameras that "watch over" station platforms and stairwell. But unlike most other security systems, there is no operator look at a screen to detect suspected malevolent behavior. Instead, every pixel as it changes in the charged-couple device is transferred to a computer. The data is continuously analyzes the changing pixel patterns to identify behavior patterns – it still largely relies on identifying anomalies. But unlike other systems that are "taught" what to look for in these patterns, *AISight* uses a neural network software program (and other software resources) to "learn" about patterns and behavior. It is an adaptive system that learns from its false positives and false negatives how to better discriminate among pixelated patterns to find things of interest. In this sense, it gains situational awareness from experience. At this time, *AISight* is

[53] Made By Behavior Research System Laboratories, Houston Texas.

being integrated with more traditional cameras that are linked with operators and recording systems that can be used to photograph and track suspected offenders. In this sense, it gains mobility -- not physically, but informatically.

At the beginning of this project, I theorized that examining the convergence of surveillance and technology through epistemological eyes only produced a multiplicity of confused interpretations. Alternatively, a similar evaluation employing some variant of ontology was similarly deficient. I have laid out in this chapter the justification for applying ontigeny to the phenomenon of techno-surveillent convergence. Decades ago, Marshall McLuhan interpreted technology as an extension of human beings. What I have proposed in this project is a framework for examining whether this phenomenon has become inverted wherein human beings are becoming at best, extensions of machines, or at worse, irrelevant.

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