Care of the Machine Self: Physiology, Cybernetics, Humanistic Systems in Ergonomics

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Dedication

This Dissertation and my graduate career I dedicate to the life and spirit of my Mother…

Table of Contents:

List of Figures:

Chapter 1: Introduction

"We start with atomic parts, but these atomic parts have transitions, passages, 'tendencies,' which circulate from one to another. These tendencies give rise to habits. Isn't this the answer to the question 'what are we?' We are habits, nothing but habits-the habit of saying 'I.' Perhaps, there is no more striking answer to the problem of the Self" (Gilles Deleuze).

The above passage from Gilles Deleuze encapsulates the major ideas of my dissertation. He begins the problem of a "self" not with identity or body, but with its compositional nature. However, he also does not focus on these "atomic parts" as merely reductive identities constituting a self, but rather their relationships with one another. He wants to know first and foremost about the communicative aspects that work below the scale of the self. It is thus crucial that he selected the words, tendencies, and habits, both aspects of behavior that could be construed as non-conscious because they occur primarily at the level of affection, or a body's capacity to produce and be productive of change.

My project is primarily concerned with how we affect and are affected by machines. Like the above passage, I am interested in the compositional parts that make up both human and machine identities, as well as how those parts connect the two across the divide of being a living human being vs. being a machine devoid of the qualities of life and humanity. The dissertation will discuss this human/machine binary as resting on a fundamental problematic of communication—namely an ability or inability to self-express or communicate an identity that puts a body on one side or the other of the binary. The dissertation expands on Deleuze's tendencies and habits by exploring the posthuman

thought within physiology, cybernetics, and ergonomics over a span of several hundred years. In the process I will sketch out the precursors and influences that resulted in concepts such as environment, system, autopoiesis, and emergence. All of these concepts work to redefine already constituted and engrained images and ideas of what life, subjectivity, and ethics are. These concepts also work to gain their epistemological and ethical significance, I argue, through the figure of the machine.

My project takes ergonomics, or the scientific study of how humans behave in technological environments, as its research object. Since its academic inception in 1949, ergonomics has developed as a field that continues to research all aspects of human-machine interaction, all of our habitual uses of machines, so to speak. The Human Factors and Ergonomics Society, founded in 1957, uses the two terms synonymously. The editors' mission statement from its inaugural journal issue illustrates a discipline that has historically integrated radically non-anthropocentric theories together with humanistic principles:

> In this study [of human factors] in which cross-fertilization between life sciences and engineering is encouraged, the human factor is considered in relation to the machines and environments in which man works and plays…the ultimate aim…is toward the optimal utilization of human and machine capabilities to archive the highest degree of effectiveness of the total system.[1]

As the concept of a "human factor" present within all technological environments has spread, the defined goals of ergonomics become more philosophical and ethical in character. For example, in its definition the National Research Council

[1] Morehouse, Inaugural Journal Introduction, *Human Factors: the journal of human factors society of America*, 1958, vol. 1, 1.

states that the, “goals of ergonomics range from the basic aim of making work safe through increasing human efficiency to the purpose of creating human well-being.”[2] According to the Health and Safety Executive in Britain (where Hywel Murrell founded Ergonomics as an academic discipline), a human factor is thought beyond the individual and every human factor must include the job/task, the individual, and the organization. As my dissertation will argue, ergonomics has taken this non-individual, non-anthropocentric view of a human factor into account.

This dissertation seeks to understand the intensifying relationship between what Manuel DeLanda calls organic and nonorganic life forms. Of human life he writes:

> We are all inhabited by processes of nonorganic life. We carry in our bodies a multiplicity of self-organizing processes of a definite physical and mathematical nature…Yet is there any way to experience this nonorganic life traversing us…there is a “wisdom of the rocks” from which we can derive an ethics involving the notion that, ultimately, we too are flows of matter and energy (sunlight, oxygen, water, protein and so on).[3]

The claim that nonorganic materials should be considered under the umbrella of life is to follow from a basic supposition that drove the works of Michel Foucault and Gilles Deleuze, works that very much inform the theory and method of my dissertation. That supposition is that subjectivity or identity is produced from external forces. This is certainly the most radical element in each of these thinkers philosophy; between Foucault’s technologies of self and Deleuze’s

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[2] Human Factors and Ergonomics Society web site, accessed on August 9th 2014, http://www.hfes.org/web/educationalresources/hfedefinitionsmain.html#Website

[3] DeLanda, Manuel, "Nonorganic life," *Incorporations* (New York: Zone Books, 1992) 29.

machines without organs, we can see the evacuation of any "inside" to identity. An identity that, as Foucault notes becomes both an object of knowledge and an image to be projected onto the other for comparison. It is the rationalist cogito as inner mind intervening on outer body, and self on other.[4] But what happens theoretically and ethically when that which Foucault knew as technologies of production or apparatuses, and what Deleuze called machinic-assemblages, get pulled into our biological/scientific theories of life? What changes about scientific, political, and ethical valences of technological machines when we treat their actions as part of their subjectivization or becoming?

Saving the Technical Object

My dissertation is compelled similarly by the work of Gilbert Simondon, who has influenced the technical aspects in the thought of both Gilles Deleuze as well as Bernard Stiegler, who claims that techne, or the craft of producing technological objects, is the immemorially repressed of Western Thought.[5] In an interview given with the French magazine "Esprit" in 1983, Simondon not only confirmed that his work posited that human alienation results from "non knowledge" of the technical object, but stated that the purpose of his work was precisely to "save the technical object."[6] He continues,

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[4] Michel Foucault, *History of Madness*, ed. Jean Kalfa, trans. Jonathan Murphy and Jean Khalfa (Routledge, 2004).
[5] Bernard Stiegler, *Technics and Time: the fault of Epimetheus*. *Vol. 1* (Stanford University Press, 1998).
[6] A. Kechkian, and G. Simondon, "Saving the Technical Object: interview with Gilbert Simondon" *Espirit* (1983): 147-152.

> I think there is a risk in technics. It is certain that the inflation of technical objects currently is one, if only the arms of overconsumption. That is why I said earlier, it's a question of saving the technical object, just as it is the question of human salvation in the Scriptures. I believe there are humans in the technical objects, and that the alienated human can be saved on the condition that man is caring for them. It must in particular never condemn them.[7]

Beginning his research and plea for a reconsideration of technology back in 1958, Simondon expressed a very different perspective on the social aspects of technology that, while highly influential on Gilles Deleuze, has been little explored in contemporary media studies. His is a philosophy of technology that deserves further consideration in media studies, particularly those threads working with new materialisms and affect studies because of its starting premise to consider technology beyond its use value to humans. As indicated by the above passage, Simondon did not begin from the assertion that modern machines and technological infrastructures, instrumentally designed and deployed to comply in a capitalist regime, are a prime engine for human alienation in labor and social contexts—although he agrees that this is in part a reality of our current "inflated" status to technology. Neither did he begin from the perspective of the technologist who has increasingly, with the support of the market and with government resources, articulated the advancement of

[7] Ibid.

knowledge, health and culture with the continual development of new scientific technologies.[8]

I am suggesting instead that Simondon called for a turning to the technological object that is a caring for it. Ultimately, the guiding problematic for Simondon was how to be generous to a "technical mentality" that he saw developing and that in turn thought through technologies in non-instrumental, ethical ways. His work began always with the technical object and its own reality in order to discover the

> common modes of functioning--or of regime of operation--in otherwise different orders of reality that are chosen just as well from the living or the inert as from the human or the non-human.[9]

Simondon's call to save the technical object thusly is of crucial importance as an alternative way to study the most contemporary systems of technologies that through machines have simultaneously molecularized and digitalized the human life processes that modern politics takes as its referent.[10] It is my argument that much can be accomplished epistemologically and ethically by turning attention to these machines not as what Rosi Braidotti refers to as the "four horsemen of the posthuman apocalypse: nanotechnology, biotechnology, information technology and cognitive science,"[11] but as being caught up in the same biopolitical regimes of regulation and production as the human life forms they are in relation to. In the following chapters I build a historical case for how particular threads of scientific

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[8] Chunglin Kwa, Styles of Knowing (University of Pittsburgh Press, 2011).
[9] Gilbert Simondon, "Technical Mentality," Arne DeBoever trans. *Parrhesia,* no. 7 (2009): 17.
[10] Michael Dillon, and Luis Lobo-Guerrero, "The Biopolitical Imaginary of Species-Being," *Theory, Culture & Society* 26, no. 1 (2009).
[11] Rosi Braidotti, *The Posthuman* (New York, Polity, 2013) 59.

knowledge beginning in the 18th century have culminated in Ergonomics to produce a scientific practice that does much work to save the technical object in human-machine interaction.

In its most general argument, the dissertation claims that there is a much longer and richer posthuman history that should be of interest to Media Scholars. From the critical communication and media studies perspective this protracted history has a few consequences that render the posthuman less recognizable. The first and perhaps most provocative consequence is that the posthuman is not directly tied to or contingent upon the digital. Instead, I argue that it owes as much of its epistemological and ethical foundations to strands within the Life sciences. I begin by describing an epistemology that is found in the history of physiology and that borrows from thinkers committed to naturalism and vitalism. This results in a profound reinterpretation of Cybernetics and Systems theories that are seen as integral to the development of a digital, virtual, and posthuman present. As I demonstrate, Cybernetics in particular can be read as a machine theory of human beings, organisms, inorganic life, and their ecologies. Cybernetics, like the posthuman, is not tied to the digital computer as the standard for the modern machine.

The second general claim I make, albeit as a subtler undertone, is that the posthuman derives strongly from the rejection of humanism, or that the posthuman is tantamount to anti-humanism. No doubt the theories and thinkers I discuss all radically decenter the figure of the human being as the locus of

knowledge as well as the center of an ethical system. In fact, ethically I believe that ergonomics ends up a powerful tool to move beyond anthropocentrism and androcentrism that sees people, animals, objects, and the Earth as expendable resources. This dissertation holds that thought, life, and agency occur at levels beyond human understanding. However, whenever humans communicate with the nonhuman that process of communication involves what Andrew Pickering calls a mangle of human/nonhuman agencies. Whether humans anthropomorphize in order to bring what is alien into recognizable human scale, or they modify the image of the human, keeping what is useful for communication and discarding what is not, they engage with the nonhuman the only way they can, through human affect and perception.

The dissertation will contribute a new object for critical media studies—the field of scientific experiment and theory called Ergonomics. The term ergonomics may have the most saliency as related to Carpal Tunnels Syndrome and other work related stress injuries. Orthopedic surgeon George S. Phalen contributed a major principle to Ergonomics in his "Phalen's Maneuver" which was a test of the wrist for the syndrome leading to changes in design of office equipment.[12] Similarly, ergonomics has recently been given publicity for contributing to a new health-centric trend: the "just stand" phenomena claims multiple health benefits to standing instead of sitting while computing or doing other office jobs.[13] This

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[12] Pamela McCauley-Bush, *Ergonomics: Foundational Principles, Applications, and Technologies*, (CRC Press, 2011), 221.

[13] Just Stand web site, accessed April 01 2014, http://www.juststand.org/OnlineTools/tabid/637/language/en-US/Default.aspx

has led to the design and marketing of a standing desk that has fed into the buzz that ergonomics has informed us that, "sitting all day is generally a bad idea."[14]

Ergonomics has a much longer history of development as a science, and is far reaching in its epistemological and material influence in all areas of life with technologies and technological spaces. It is, I will argue, important for a new understanding of Posthumanism, one that is less articulated to the communicative and representational characteristics of digital technologies, and more situated in the histories of human and animal physiology, as well as 19th century conceptions of machines. The 20th century trajectory of ergonomics will see the significant influences of systems theory and particularly of cybernetics on its theories of human machine interaction. But to first parse the definitions and descriptions of its function will illustrate that it developed based on strong Humanist ideals. Two of these ideals included a most basic equality in the workplace and of being physically and mentally able to perform the tasks of the job. Technology's role within ergonomics held these principles implicitly even as the industrial economy foregrounded optimization, efficiency, and round the clock productivity within work practices and machines. For founding ergonomist Hywel Murrell, in order to maximize efficiency in man-machine systems, ergonomics had to,

> enable the cost to the individual to be minimized…[i]t should create an awareness in industry of the importance of considering human factors

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[14] Alan Henry, "Five Best Standing Desks," Lifehacker web site, accessed April 1st 2014, http://lifehacker.com/five-best-standing-desks-1528244287

> when planning work, thereby making a contribution not only to human welfare but to the national economy as a whole.[15]

In Human Engineering, the "engineering for human use" or the adapting of technology design to the various attributes of people, was the U.S. design practice that preceded Ergonomics in Great Britain. Its 1957 definition implied a latent humanism thusly:

> In Broad terms the goals of human engineering are those of human economy, or efficiency, in work activities…implies two more specific goals, namely the improvement of work and of human welfare."[16]

The intimate connection above of human welfare, well-being, and happiness with labor would be a recurring theme in ergonomics. In addition, as its theory takes on a more philosophical character, human labor would be conceived of as a good in and of itself.

From 1957 when Murrell founded the Human Factors and Ergonomics Society, Ergonomics was adopted in Europe and the U.S. as an umbrella term for a field composed of many interrelated disciplines concerned with studying human technology interactions. Ergonomists who wished to design human-centered technologies included researchers in engineering psychology, biomechanics, and anthropometry—or "the systematic collection and correlation of measurements of the human body."[17] The list of engineering and social science fields falling under the domain of ergonomic research continually

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[15] Hywel Murrell, *Ergonomics, or Man and his Working Environment* (Great Britain: Chapman Hall, 1965).
[16] Murrell, Ergonomics, xiv.
[17] "Anthropometry," Britannica Online Dictionary, accessed April 1st 2014, http://www.britannica.com/EBchecked/topic/27531/anthropometry

increased and diversified immediately following WWII and to that research was added a significant new area of design in the 1960's with the emergence of the digital computer. After the explosion of computer engineering and the "micro-electronic revolution" that enabled visions of a national computerized work force, the study of human-computer interaction would also begin to concern itself with designing computer technologies to "fit" the human user. The ongoing development of the computer introduced an important development in ergonomics as well with the growing perception that machines had evolved in complexity by an order of magnitude such that machines could be described as "partners" to humans or as in "symbioses" with them.[18] The moment in which researchers began programmed theorizations and material experiments with machines that had previously been conceived of only in science fiction (and philosophy)—the artificial intelligence, the human modeled robot or android, and the cybernetic organism, or cyborg—brought ergonomic theory of machines to the foreground but also brought about significant change within it.

This twofold change is what informs the underlying argument of this dissertation, at least as an argument that attempts to enrich a history of posthumanism. First, as the field of ergonomics expanded to include many sub disciplines that either dealt with specialized objects (computers vs. simple tool-machines vs. vehicles) or began from different theoretical orientations (biological, psychological, physics and material sciences) its proponents sought to unify

[18] Joseph Licklider and Carl Robnett, "Man-computer symbiosis," *IRE Transactions on Human Factors in Electronics* 1 (1960): 4-11.

interdisciplinary and fragmentation through the most basic of principles. The more ergonomics began to take account of its own history, it retroactively expanded its domain based on an "ancient" desire human beings had to design tools for their own purposes. The story of ergonomics then included the observation that since the age of early hominids there had been, "specific, intelligent reactions to the interactions between man and his environment" and that this drive was essentially human, and its quality was essentially ergonomic.[19] This era of complex machines in science and engineering that made liberal use of the burgeoning system, information, and cybernetic theories of mid 20th century, had the effect of a re-intensification or rearticulation of an essential human subject, one that was essentially not only creative but also reflective of her creations. From the 1960's on there would be continual refinement of the definition of Ergonomics including a gesture towards its appreciation of human agency in relation to machines.

After researching the many attempts to systematically define the field, I believe that there is no strong contradiction or differing opinion on a basic guiding principle: ergonomics aim has been, in contrast to other forms of technological design, to fit technologies to human beings. My chapter on Ergonomics will provide the historical setting in which the humanist and progressive impulses arose from moments in the 19th and twentieth century based on the systematic efficiency and design processes of the science of labor.

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[19] Julien M Christensen, "Ergonomics: Where have we been and where are we going: II," *Ergonomics* 19 no. 3 (1976): 287.

The disciplinary positions that emerged—ergonomist, engineering psychologist, human engineer, human factors researcher—were all variations on a singular imperative to identify and build around a human factor within a given technological system. Coined in 1949 by Murrell in England as the science of "Ergonomics," it was a field that owed its emergence to WWII and the subsequent powerful belief in the West that an intricate relationship between Scientific thought and the technology it produced, if let to flourish, could prevent Fascism and fundamentally better humankind. Ergonomics research flourished during this high moment of techno-science[20] in the West. Murrell was attempting to create a multidisciplinary group whose sole purpose was based on the most basic principles of "human research", "health" and "the good." What had been the "Human Research group" became the Ergonomics Society and quickly shifted its scope beyond merely conditions of the work environment and beyond as well as designing machines of war and of the factory. As Murrell laid out, ergonomics functioned to develop a first principle of the machine where it and the human operator were seen as parts of a larger system,

> To achieve maximum efficiency a man-machine system must be designed as a whole, with the man being complementary to the machine and the machine being complementary to the abilities of man.[21]

My dissertation will repeatedly point out examples like this that illustrate how ergonomics and the scientific thought informing it conceive of humans and machines as holistic systems. The larger history of this non-reductive perspective

[20] I take technoscience to be the conflation of science and technology based on the singular belief in their powers to alter reality (physical, political, ethical).
[21] Murrell, *Ergonomics*, xv.

informs communication theory through cybernetics, systems theory, biopolitical theory, and, as I will argue, affect theory.

This project discusses the historical development of knowledge produced within human factors and ergonomics research as it became an autonomous scientific and engineering field. As there is no strong distinction between "ergonomics," as the coinage in the UK and Europe and "human factors," or "human engineering," from the field of practitioners—either in method or theoretical foundation—I take ergonomics as the name representing the discipline. Ergonomics emerged as a field of knowledge suited to the immediate exploration and design of the latest human-machine systems. As such, its principles put into practice new theoretical paradigms—namely, general systems, information, and cybernetic theories.

Claude Shannon produced, in information theory, a systemic or environmental theory of communicative functions, wholly formalizing the language of information and equating both physical systems and models of them to a "stochastic process." He thus articulated a theory of communication that, "avoids any reference to ideas or meanings, and thus to people." Finally, cyberneticians conceived of a theory of machine action that dealt,

> with all forms of [machine] behaviour in so far as they are regular, or determinate, or reproducible. The materiality is irrelevant, and so is the holding or not of the ordinary laws of physics…
> The truths of cybernetics are not conditional on their being derived from some other branch of science. Cybernetics has its own foundations.[22]

[22] W. Ross Ashby, *An Introduction to Cybernetics* (London: Chapman & Hall, 1956), 1.

While this audacity of theory was most certainly part of cybernetics' over-ambition, it also gestured to a figure in Gilles Deleuze's work that would be picked up by posthumanist and affect studies alike—the virtual. The affective powers of machines in cybernetics were not limited to the actual machines that existed nor the scale of human understanding that continued to diminish machines compare to the figure of "Man." Like the threads of physiology and cybernetics which preceded it, ergonomics and its radical conception of humans and machines provided the possibility for multiple, intense re-articulations of a humanist-human figure back into its technological systems. All of this produced, as I argue in chapter 2, a feedback mechanism whereby the radical nature of cybernetics and systems theories produced the humanist desire for an ethical reframing of technologies.

With General System Theory Ludvig Von Bertalanffy put forth the idea that principles and forces in a biological system could be seen as "mirrored" in political and social (human) systems, as well as in purely physical systems devoid of any life whatsoever.[23] His work on a psychology and sociology composed of systems not only informed Niklas Luhmann's work on systems, but influenced myriad scientists and philosophers working in cybernetics, communication, information theory, and environmental/ecological thought. Inevitably these thinkers would reach ethical conclusions resulting from a systems approach. As Bertalanffy put it, the impetus for systems theory, "entailed

[23] L. Von Bertalanffy, *General System Theory: foundations, development, applications* (New York: Braziller, 1968).

that of environmentalism or other-directedness," because a subject's behavior always fundamentally responds to its outside.[24] Crucially for Bertalanffy, as it would be for those he would inspire with systems theory, neither large systems nor the organisms existing within them were closed. They were not predictable nor simplistically mechanical, that is, not devised of smaller, simpler parts as they reduced in scale. Biological systems and systems that could be applied to the social sciences were to Bertalanffy fundamentally open, that is, far from equilibrium or stasis. They were open not only to change but open to the kind of change that endangered a stable identity, where identity matters most to a human epistemological system based on representation, identity, and individualism. As I will illustrate the physiological, cybernetic, and ergonomic perspectives would embrace this openness that was both an expression of self-communication and a threat of destruction for the individual organism or subject.

Ergonomics, an Opening to Biotechnology

Melinda Cooper defines biotechnological practice/science succinctly as the continual "concern with new ways of mobilizing life as a technological resource."[25] As for just what a biotechnology might be as a noun or object, biotechnology can be seen generally as the external manipulation of living matter with the aid of technological instruments or machines. Historian of Science Chunglin Kwa notes that the origins of biotechnology derive from the

[24] L. Von Bertalanffy, *Robots, Men, and Minds* (New York, George Braziller Inc., 1967), 7.
[25] Melinda Cooper, *Life as Surplus: biotechnology and capitalism in the neoliberal era* (University of Washington Press, 2008, 33.

development of molecular biology in 1938. Along with molecular biology's scientific and industrial development came a more general "molecular vision of life." This is consistent with the biopolitical narrative that sees biological sciences and digital/computing sciences as intertwining poles enclosing the concept of life, simultaneously molecularizing and informationalizing it.[26]

Back in 1979 Michel Foucault went on a tangent of sorts in his lecture on neoliberalism's development of human capital as an inherent value. He apologized for the bit of "science fiction" but continued to muse about a future where the field of Genetics became a particular problematic of a population's financial investment into their genetic makeup.[27] This dystopic enframing of the future of biotechnological capital seems to make up the crux of sustained critical response to biotechnology in general. It also describes a much longer standing fear of human life that, since the introduction of a machine metaphor to describe its processes, has had the potential to be measured, predicted, and possibly reproduced in the future. Deleuze prophesized without irony that through digital technologies, identities and persons would wash away. "We're no longer dealing with a duality of mass and individual. Individuals become "dividuals," and masses become samples, data, markets, or 'banks.'"[28] It is again the immediate coupling of biotechnology with profit motive or capital flows that justifies the current

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[26] Dillon, Michael, and Luis Lobo-Guerrero, "The Biopolitical Imaginary of Species-Being," *Theory, Culture & Society 26*, no. 1 (2009): 1-23.
[27] Michel Foucault, *The Birth of Biopolitics Lectures: lectures at the College de France*, trans. Graham Burchell (New York: Picador 2010), 227.
[28] Gilles Deleuze, "Postscript on Control Societies," *Negotiations, 1972–1990* (New York: Columbia University Press, 1995), 180.

critique of its alienating powers over humans. Biotechnology is the most advanced form of control, both in the cybernetic as well as the political sense of control, and is inherently instrumental(ist) because it resides more and more in the machines of molecular sciences. In their theory of networks, Alexander Galloway and Eugene Thacker define biotechnology as the "instrumental enframing" of biological networks, on the cellular level,

> Harnessing the "natural" or biological processes of cells, proteins and genes to manufacture drugs, therapies, "model organisms" for lab testing, and so forth.[29]

As Rosi Braidotti argues,

> Advanced capitalism and its biogenetic technologies engender a perverse form of the posthuman. At its core there is a radical disruption of the human-animal interaction, but all living species are caught in the spinning machine of the global economy. The genetic code of living matter…is the main capital.[30]

Biotechnology has become for many critical thinkers the cutting edge of biopower where the development of powerful computing technologies coupled with biochemical technologies seem to fold in on older totalitarian and racist ideologies, resulting in a regime of neoliberal eugenics. The consequences for privacy, freedom, and public access to the life altering powers of biotechnology has caused more traditionally politically informed critics to speak in a biopolitical register. Jurgen Habermas, for example, objects to the idea of "genetic programming" because the artificially enhanced individual will irreparably alter free societies. The public sphere and social contract of democracy, dependent on

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[29] Alexander R. Galloway, and Eugene Thacker, *The Exploit* (Minneapolis: University of Minnesota Press, 2007), 48.
[30] Rosi Braidotti, *The Posthuman* (New York: Polity, 2013), 7.

the connection between “fee and equal human beings” would disintegrate as the “development of some individuals becomes unhinged from their free and unhindered growth.”[31] Roberto Esposito understands a response like this from Habermas because it is based on the very same humanist assumption of the given-ness of individual identity and of the “naturalness” of community that leads the repetition of the immunitary paradigm. We must continually remake ourselves as definable and politically viable individuals in the face of identity’s erasure by what is improper, and it is not just human beings and animals but also technological objects that may fall into the improper category.

Very quickly the fear over improper artificial identities in the polis shifts to economic uncertainty as the “genetic code of living matter” as Braidotti puts it, translates into the question of what kinds of bodies can produce capital. Our posthuman condition is merely the beginning of the aforementioned musing by Foucault, of an imagined neoliberal genetic market. This is the point where the traditionally held sense of biotechnology as the manipulation of genetic materials, ostensibly by humans who know how and who have access, is butting up against another significant characteristic of technology that alters the conditions of human agency, automation.

Immunity has become one of the major problematics within biopolitical theory, what Cary Wolfe calls a mechanism of framing life in neoliberalism. It is not merely, “a logical or epistemological problem but a social and material one,

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[31] Roberto Esposito, *Bios: biopolitics and philosophy,* trans. Timothy Campbell (Minneopolis: University of Minnesota Press, 2008), Translator’s introduction, xxxiii.

with consequences."[32] The importance of immunization is how its ancient etymological roots intersect with the hyper-individualism of neoliberal modernity. Roberto Esposito defines immunity as a subject within a given community who immunizes themselves, through property, prestige, and violence, to the common burden shared by other citizens. This immunization results not only in the marginalization of those unable to similarly immunize themselves but also destroys the very possibility for anything other than an illusion of a community—a true community is one where individual identity is always superseded by its obligation to give. As Esposito observes, it is never the object, the thing earned or given that actually matters. Instead it is the relationality between an individual in respect to the other(s) he is obliged to.[33] The Immunity paradigm is fundamentally a problem of communication. Esposito describes the obligation of community as a form of giving that destroys both the meaningfulness of the rational transaction as well as the instrumental one to one correspondence of a transmission model of communication.

> this is the gift that one gives because one must give and because one cannot not give. It has a tone so clearly of being obliged [doverosita] as to modify or even to interrupt the one-to-one correspondence of the relation between the gift giver [donatore] and the recipient [donatario]. Although produced by a benefit that was previously received, the munus indicates only the gift that one gives, not what one receives.[34]

The problem in communication for the immunitary paradigm translates as a

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[32] Cary Wolfe, *Before the Law: humans and other animals in a biopolitical frame* (University of Chicago Press, 2012), 6.
[33] Roberto Esposito, *Communitas,* 5.
[34] Ibid. 5.

problem between individual and larger system. On the other hand the figure of community can be translated into the problem of how different individuals within a system, and of differing capacities, can communicate with one another without retreating into their identities. In fact, these are the problems that have concerned the thinkers I will discuss, and for all of them the discussion leads beyond human identity and language, to the imagining of new ethical possibilities for human communication. As I will discuss in Ch. 1, "Physiology," arguments like Esposito's that break out of the above trappings of the individual do so with a turn to the impersonal register of life, what Wolfe describes as a biocentrism or neo-vitalistic philosophy.[35] The main critique being that there is an ethical consequence, or danger inherent in embracing the concept of impersonal life over personal lives. Again, this has to do with a systematic undoing of human identity characteristic of a swath of theories within this dissertation that exist under the umbrella of posthumanism. Gilles Deleuze's work is implicated in this critique and identified danger when he claimed that, "[i]t's organisms that die, not life."[36] Life, in this instance is being treating as the new materialists treat matter—as something unwieldy, out of human control. Thus the conception or rather the imagination of changing, nonhuman systems, when allowed into those thoroughly human systems, language, government, thought, and ethics—become tantamount to death on an individual level and extinction on a species level. The figure of the machine looms large in this threat, either as a system of human language,

[35] Wolfe, "*Before the Law*."
[36] Gilles Deleuze, *Negotiations*, 143.

memory, or the physical objects that extend our bodies' capabilities. Machine is techne, the artifice of human creativity—the thing neither existing of nature or of human kind. I will explain this status of machine as techne and as pharmakon, or what is simultaneously curative and poisonous to the human, in subsequent chapters. However, I want to emphasize here the role of the machine in the death of humanity when it is a nonhuman system "let in" to either our conceptions of nature or what we consider human life. This status of death for machines, what Jacques Derrida describes as a "machinalite," or a, "cutting off from or independence from any living subject,"[37] what Wolfe notes as simply, "dead,"[38] does not stop with the death of the Human. As Claire Colebrook recently noted, the death of the figure of man that so prominently represents rationality, representation, anthropocentrism and androcentrism—a death that leads to posthumanism—then immediately is followed by the death of the posthuman. For Colebrook this is because of a collective apprehension of loss of self, of a falling away from the practice of human reason and all of its anthropocentric trappings, because, "own creations, technologies and desires," become, "the very mechanisms that preclude us from being most properly ourselves…"[39] Such an apprehension of the mechanisms or machines of self-loss will lead either to laments over the loss of uniqueness and distinction in human thought and activity, or, on the other hand, to a kind of posthuman celebration, "that there is

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[37] Jacques Derrida, *Without Alibi*, trans. Peggy Kamuf (Stanford University Press, 2002) 136.
[38] Wolfe, Before the Law, 57.
[39] Claire Colebrook, The Death of the Posthuman: essays on extinction vol. 1 (Ann Arbor: Open University Press) 20.

no such thing as 'man' and that we are really always already at one with one web of life."[40] Colebrook's insight is important in that it reveals the dualistic register of eschatological thought in the west that persists with things that are machines, machinic, artificial, and inorganic. For the purposes of my research the dissertation takes a slightly different path than hers in order to break out of the dichotomy within the death of the human subject. While Colebrook does turn to a productive new concept of subject that she calls the "inhuman," she also calls for a strong return to Theory in a humanities existing "after theory."[41] What results from this call is an implicit retrenchment into an identifiable and proper humanistic scholarship as well as a discouragement of a humanities too open to integrating scientific thought to the detriment of its humanistic qualities. The benefit of a communication orientation, the importance of the field of American communication research is that it is not stymied by the same disciplinary concerns vis a vis its openness to scientific theory. However, history is crucial here, and in specifically extending and complicating the history of the posthuman through machine theories to the 18th and 19th centuries, my project suggests that there may not be such a moment of crisis in subject, thought, and action today, a moment that is marked only by extinction and death. This is precisely because the seeds of a particular posthumanism, one that I refer to as nonhuman life, exist prior to anything like the linguistic turn, posthumanism, or the anthropocene. Instead of focusing on the eschatology of subjects where there can only be an

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[40] Claire Colebrook, *Death of the Posthuman*, 20.
[41] Ibid. 40.

end of subject and a beginning of a subject, my dissertation takes the moment of "crisis," not the subject, as a highly productive for analysis. In what follows, the line of thought I pursue takes a cue from Manuel DeLanda a la Deleuze, who, integrates the very particular works of thinkers/experimenters whose objects are systems and organisms "poised at the edge," of a phase transition, or at the edge of chaos.[42]

Contribution of the Dissertation

New Materialism

My research foregrounds the bodies both human and mechanic within technological systems to focus on the hardware of media systems as organisms within an ecosystem. In this sense my project is in line with the thread of communication scholarship that refocus media studies to new materialist approaches. As Jeremy Packer and Stephen B. Crofts Wiley noted in *Communication Matters: Materialist approaches to Media, Mobility, and Networks,* there are important stakes to rhetorical and media scholarship and much that they could contribute to embodied, physical, and nonsemantic/discursive registers of communication.[43] They recognize as well that the term "new materialism" refers to a much larger multi-disciplinary movement towards a realist perspective that includes much feminist, affective,

[42] Manuel DeLanda, Intensive Science and Virtual Philosophy (New York: Continuum, 2002)
[43] Jeremy Packer and Stephen B. Crofts Wiley, eds. *Communication Matters: materialist approaches to media, mobility and networks* (New York, Routledge, 2013).

environmental, and posthuman scholars. My research here utilizes many of the theorists that share in this materialist, embodied, and realist perspective.

In joining this theoretical shift my dissertation pays attention to the shift away from the human (its senses, language, experience, and culture) as the central analytic category in the analysis of life and matter. Such a move aligns critical thought closer to the empiricism of various scientific thought but also, I will argue, gives us opportunity to further investigate the sciences that have most significantly attempted to conceive of technologies, specifically machines, as communicative agents.

From a communication perspective, this means that language, meaning, and the construction of the symbolic are put into precarity by the analytic focus on technology as a fundamentally communicative organism. As Packer and Wiley also argue, if human language and body are considered technologies (a premise which much Foucauldian and Materialist approaches have done work to show in media studies) then "communication always manifests through technology."[44] In addition, historical focus on the representational in media studies obfuscates the "attention to media infrastructure-its technical capacities, temporalities, and spatial distributions."[45]

Adding to Packer's above call for a non-representational analysis of technology as communication, Jussi Parikka claims that new materialism, object oriented ontology, and speculative realism—the modes of thought that have most

[44] Jeremy Packer and Stephen B. Crofts Wiley. "Strategies for Materializing Communication," *Communication and Critical/Cultural Studies 9*, no. 1, (2012): 108.
[45] Packer and Wiley, "Strategies for Materializing Communication," 109.

radically decentered the human subject—all deal with "mediatic" phenomena.[46] Media technologies and humans become mediators for one another when the capacity to communicate is not defined by being human but rather by being a particular technology that communicates in a particular range, whether physically, symbolically, or affectively. Parikka observes that new materialities necessitate shifts towards corpuses of knowledge, which have closely followed the physical and energetic flows, and facts of matter.

> Instead of philosophical traditions, let us read modern physics, engineering, and communications technology as mapping the terrain of new materialism: the basis for signal-processing, use of electromagnetic fields for communication, and the various non-human temporalities of vibrations and rhythmics-of for instance, computing and networks-are based in non-solids.[47]

In doing so he gestures towards a kind of project that I attempt in following the trajectory of ergonomics. This field puts human and machine matter together as a holistic system worthy of empirical observation.

Affect

While my dissertation gestures to many of the issues in a new materialist framework, its concerns land firmly within the larger questions of Affect Studies. Looking forward to ergonomics today, to claim that ergonomics is the exemplary study of affection is to give a response to many who have been interrogating the "posthuman" condition specifically through what has been deemed an "affective turn." Recently, Patricia Ticineto Clough has identified such a turn as an

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[46] Jussi Parikka, "New Materialism as Media Theory: medianatures and dirty matter," *Communication and Critical/Cultural Studies 9*, no. 1, (2012): 95.
[47] Parikka, "New Materialism as Media Theory," 96.

intensification of interest in the line of affect theory spanning through Gilles Deleuze and Felix Guattari from Henri Bergson, and originally from Baruch Spinoza. In borrowing from Brian Massumi she describes the conception of affect that is of interest at the moment as,

> Bodily capacities to affect and be affected or the augmentation or diminution of a body's capacity to act, to engage, and to connect, such that autoaffection is linked to the self-feeling of being alive—that is, aliveness or vitality.[48]

Autoaffection, which had been Ticineto-Clough's earlier research interest, describes the nonconscious register of life, living, and feeling alive in which affect many times works and that the human subject works to refuse or suppress. Pertaining specifically to the technological and the nonhuman autoaffection was, "crucial to any refusal of an intimacy between the body and the machine, nature and technology, the virtual and the real, the living and the inert."[49]

This crucially brings the contradictory role of technology into affect theory as a nonhuman element through which humans feel varying levels of affection. Mark B. Hansen, who Ticineto-Clough also borrows from in the above description, puts a fine point on the contradiction in technology from the affective standpoint.

> We will find ourselves in a position to fathom the apparent paradox of contemporary subjectivity: the fact that technical expansion of self-affection allows for a fuller and more intense experience of subjectivity, that, in short, technology allows for a closer relationship to ourselves, for a

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[48] Patricia Ticineto Clough, and Jean Halley eds., *The Affective Turn: theorizing the social* (Duke University Press, 2007), 2.
[49] Patricia Ticineto Clough, *Autoaffection: unconscious thought in the age of teletechnology* (University of Minnesota Press, 2000), 19.

> more intimate experience of the very vitality that forms the core of our being…[50]

Where Ticineto-Clough's early work on autoaffection foregrounded thought, the newer affective turn emphasizes new configurations of "bodies, technology, and matter." Two of Ticineto-Clough's claims in particular bring the intersection of affect and ergonomics into clearer view. First, that there is an "affective turn" in critical thought means that our seeking greater understanding in affection, the very intimacies and transmissions between body and technology, nature and technology is, "necessary to theorize the social."[51] Second, as Ticineto-Clough points out, a fundamental difference by which our critical frameworks have to shift is in our recognition of what Manuel DeLanda calls nonorganic life.[52]

It is DeLanda's work in particular that both possesses the most radical insight for an affective turn as a recognition of machines as something like affective agents, but also (for this same reason) may be pushed to the margins of its discourse. This is not to imply at all that he is unknown, nor that his work is not referenced or respected—the fact is that the turn to increased interest in affection has led to greater intrigue in his framing of Gilles Deleuze and his work on scientific knowledge.

Though much of his work is historical in nature and he has theorized assemblage theory as a new paradigm for Sociology, he has explicitly claimed that,

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[50] Mark Hansen, "The Time of Affect, or Bearing Witness to Life," *Critical Inquiry* 30, no. 3, (2004): 589.
[51] Ticineto Clough, *The Affective Turn*, 2.
[52] Ibid. 8.

> It is always better to start with the non-human. Else we trap ourselves within the little provincial space defined by the drives and interests of a single species.[53]

By virtue of this theoretical standpoint he allows for the possibility that affection is limited neither to human action nor human apprehension of just how nonorganic life forms affect them. Further, and this is his crucial contribution to affect studies, the kind of nonhuman affect we may theorize need not be similar or related in any way to the kinds of affect that we now find ourselves familiar with in machines, animals, or any other nonorganic life.

DeLanda argues that on the most general level of existence, the capacities to affect and be affected as well as the tendencies for organisms and objects to do so in the world—need not be actual to be real.[54] That is, the capacity for a machine to affect a human being in a particular way is not diminished because it has not yet done so. Likewise, the list of possibilities for a machine's becoming self conscious, ethical, or self-reproducing, need not have already occurred in order to explore this space of capabilities. This powerful claim is at the heart of my project and guides my conception and use of affect as it pertains to the capacities of machines, human bodies, and systems of thought. It is in this sense that the objects I discuss, Warren McCulloch's theoretical ethical robots, need not have been actually constructed for them to have produced intensities that pushed his and other cybernetician's thought and

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[53] Manuel DeLanda, "The Expressivity of Space." *Some Things Happen More Often Than All of the Time* (Turner/A&R Press, 2007), 103.
[54] Manuel DeLanda, *Philosophy and Simulation: the emergence of synthetic reason* (Bloomsbury Publishing, 2011), 4.

behavior. Likewise, a computer, mechanical arm, or android robot need not currently exist that fulfills criteria of consciousness or emotion in order for us to speak of them as "nonorganic life." This provides an interesting way to explore qualities of affect that, as Brian Massumi describes, unlike emotion, are non-subjective, non-narrative, and existing as "unqualified intensities."[55]

In using DeLanda's claim that bodies, agencies, tendencies themselves can have reality without their actualizations, I understand machines as affecting and being affected similarly to the ways that humans are. Various scholars have theorized this as the "non-conscious"[56] register in which affects act, and this register works comfortably in each of the fields I explore (physiology, cybernetics, ergonomics). Here the observation of human machine interaction begins first with the suspension or bracketing of questions concerning consciousness, inner states, or identities in the interactions of those bodies. Given the dual movements in scholarship toward new materialism, empiricism, and object-centered analyses[57] as well as to study of affection, my dissertation begins from asking one question that at once touches epistemological, ethical, and political valences. What if ergonomics represents the most systematic and radical way of knowing nonhuman otherness within what is taken to be our posthuman condition of global biotechnological economies?

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[55] Brian Massumi, "The Autonomy of Affect," *Cultural Critique 31,* (1995).
[56] Patricia Ticineto Clough, and Jean Halley ed., *The Affective Turn: theorizing the social* (Duke University Press), 2007.
[57] Jeremy Packer, and Stephen B. Crofts Wiley, "Strategies for Materializing Communication." *Communication and Critical/Cultural Studies* 9, no. 1 (2012).

Chapter Outline: Epistemology, Ethics, Affection

The following chapters, in attempting to explore and expand empirical concepts similarly to Deleuze, supply "a retrospective analysis on the basis of an alternative."[58] Specifically, I highlight particular theories of life that have emerged from Physiology, Cybernetics, and Ergonomics, as those fields have conceived human life through the machine. These theories, whether long forgotten by contemporary bio-technological sciences, or whether shown to be foundational in certain ways, push back against the grain of the hegemony of rationalist, mechanistic, and reductionist based thought. They produce instead a conception of what I call vital machines—a theory of technology that simultaneously puts the machine into the realm of human life while acknowledging an incalculability and irreducibility to its agential features.

In the First Chapter, "Physiology, or Epistemology" I provide a sketch of physiological thought as it developed alongside enlightenment philosophies and a general mechanization and reductionism informed by the concept of the modern machine. I will show that beginning most importantly with Renee Descartes, the mechanistic-reductionist figure of the machine gets pushed through rationalist sciences to be seen at the important moments of the development of modern machines. Drawing on Georges Canguilhelm's as well as Michel Foucault's studies of physiology in the 18th and 19th centuries, I

[58] Gilles Deleuze, Difference and Repetition, trans. Paul Patton (Columbia University Press, 1994) Trans. Introduction, xi.

illustrate a counter narrative reductionist-mechanistic ideology, one that will be carried through into cybernetics and ergonomics between the two World Wars.

The early 20th century saw the emergence of behaviorist theories and industrial psychology aimed at reducing motivation and decision-making processes in humans to machinic (i.e. simplistic, predictable, reproducible elements). Again, in the early-mid 20th century, when automation was the key design problem for early computer machines as well as for human labor in industrial and military contexts, the development of information, systems, and cybernetic theories tended to rely on such mechanistic reductions—in the form of the theoretical black box, for example. Cybernetician Gregory Bateson would take both American Engineers as well as computer science to task for their instrumentalist and simplistic view of what a system was. The black box was what those researchers blacked out or saw as irrelevant in relation to their observation of simple predictable and repeatable behavior. Systems were not about input-output because that neglected the important communicative between parts as a whole where, “essentially your ecosystem, your organism-plus-environment, is to be considered as a single circuit.”[59]

However, I acknowledge this particular hegemony of mechanistic reduction in order to show that, when our current investment in technoscientific thought is viewed as one moment in a centuries long struggle to empirically discover and define the processes of life, we begin to see the persistent

[59] Stewart Brand, Gregory Bateson, Margaret Mead, "For god’s sake, Margaret: conversation with Gregory Bateson and Margaret Mead," *CoEvolution Quarterly 10* (1976).

emergence of the mechanistic machine's other—that is, a conception of a machine that is neither mechanical nor reducible to its parts, or again, a vital machine. I envision physiology as the first component of the ergonomic science to come, as an epistemology of nonhuman-humanity. The sketch I provide illustrates a line of thought that, at various proximities to the metaphor of the machine, radically reconceived of human life as early as the 17th century.

Chapter 2, "Cybernetics, or Ethics" will build on the first chapter by illustrating the epistemological bridge from physiology to human machine relations in the form of Cybernetics. I illustrate that as the second radical component of ergonomics, cybernetics illustrates a theory of the machine subject as a nonhuman ethics. Cybernetic thought is generally understood by historians of science and technology to be a foundational nexus for a host of developments in the 20th century, from the history of computers as well as of the digital as a figure of thought and culture,[60] to the biotechnological economy of distributed networks and the control society.[61] My chapter will work to a different path for cybernetics. Pertaining specifically to the vitalist, non-reductionist, and non-mechanistic theories of life from the physiology chapter, Cybernetics will be seen as contributing to and expanded on critical-vitalist view of machine agency. I thus

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[60] Katherine N. Hayles, *Critical Terms for Media Studies*, eds. Mitchell, WJ Thomas, and Mark BN Hansen (University of Chicago Press, 2010), 57; Jean Pierre Dupuis, *On the Origins of Cognitive Science: the Mechanization of the Mind* (Cambridge, MIT Press, 2009); Claus Pias, and Heinz Von Foerster. *Cybernetics: The Macy-Conferences 1946-1953* (Diaphanes, 2003); Andrew Pickering, *The Cybernetic Brain: Sketches of another future* (University of Chicago Press, 2010).
[61] Gilles Deleuze, "Postscript on control societies." *Negotiations 1972-1990* (Columbia University Press, 1995); Terranova, Tiziana. *Network culture: politics for the information age* (Pluto Press, 2004); Alexander R. Galloway, *Protocol: how control exists after decentralization* (MIT press, 2004); Ned Rossiter, *Organized Networks: media theory, creative labour, new institutions* (Rotterdam: NAI Publishers, 2006).

argue in the chapter that where physiology provided an epistemology that ergonomics could draw on for its human machine systems, cybernetics provided an ethical framework that informed it at the level of valuing machine subjects. I take two of the more famous proponents of cybernetics at mid 20th century, Norbert Wiener and Warren McCulloch, as individuals who were exemplary of a line of cyberneticians from the 19th century to the present who strongly observe ethics in their study of machines. I then reconsider cybernetics based on many of its critics, as being a "failure" in its attempts to become a meta-theory and common language among all sciences. I briefly reconsider also the claims that cybernetics was a field dependent on command-control-communication-intelligence (C3I) from U.S. military operations as well as distinguish this cybernetic ethic from cybernetic thought that is perceived to emerge with digital culture. In the next part I discuss primarily Margaret Mead and Gregory Bateson in their attempts to bring cybernetics to the human sciences. Finally, I conclude with Michel Foucault's genealogy of ethics of ancient Greco-Roman subjectivity. I argue that in the process of discovering a subjectivity that is distinct from both a Christian and a Modern(ist) mode of caring for oneself, he describes a technology of self that is foundationally cybernetic or a machine ethic.

In Chapter 3, "Ergonomics, or Affection" I provide the historical context for human machine interaction within the field of Human Factors and Ergonomics engineering. My source materials will be composed primarily of documents/media found either in the "Human Factors" or "Ergonomics" journals,

or the writings of Hywell Murrell, the founder of Ergonomics, as well as other foundational writings on the field.

Two, I attempt to understand how ergonomics continued to theorize and design experiments reliant on material and affective arrangements while much of computer engineering began to focus on microprocessing, software, and the psychology of computing. My project seeks to understand the different path that such a commitment to the bodies of machines and humans led to human-machine communication in ergonomics. In fact, as my final chapter on ergonomic theory and practice will conclude, I gesture towards the field as one of the most significant and possibly productive empirical studies of affection going into the 21st century of human machine interaction. The notion of affect that has migrated from psychology into ergonomics is nothing like the above theorized concept in that it is characterized by its qualification through narrative, emotion, and the individual. However, the continued reliance in the field on systems and cybernetic theories prevents it from remaining so for very long. The empirical understanding is then that affect is material, like other forms of bio-feedback, and must be considered today as part of a complex ecology in which human senses meet machines. Additionally, I discuss the expanse of ergonomic practice beyond best practices for consumer goods designed for individual consumers—the ergonomics of highway systems and urban sprawl, or the ergonomics of honeybee and ant colonies. It is an expansion that sets the ergonomic study of affection beyond the scales of both market economy and human bodies, and is in

need of a greater understanding in relation to the original humanistic premise of ergonomics' development.

I then provide a brief history of ergonomics as it is relevant to humanistic and posthumanistic thought. I show how in its relationships to both psychology and the scientific management of work, namely through Taylorism, that ergonomics is a subjugated science of work. Then I discuss how ergonomics has simultaneously and in a complimentary form introduced humanistic progressive ethics as well as radical theories such as cybernetics and system theory into its science. In the next section of the chapter I discuss ergonomics as a putting into practice of both the epistemology (physiology) and ethics (cybernetics) of machines. In order to do so I highlight two of ergonomics precursors, Wojeiech Jastrzebowski who coined the term ergonomics in 1864, and Lillian Gilbreth who shifted the object of work science from the factory to the home and from the Fordist subject characterized as an abled body male laborer, to that of differently enabled individuals and to female domestic laborers.

Jastrzebowski combined a metaphysical notion of labor as a fundamental human condition and an ultimate good rather than a means to production—with a Spinozist-like physics of bodies in motion. Gilbreth not only provided progressivist and feminist sensibilities to the study of labor during the 20th century but also provided a radical conception that the pairing of a human and machine could constitute a worker as a subject and citizen of rights. Finally, I discuss the Vitruvian Machine as a subject produced by ergonomics. As a historical figure it

derives from Da Vinci's Vitruvian Man as the exemplar of Humanism, Anthropocentrism, and Androcentrism. However, as an aesthetic and ethical figure the Vitruvian Machine has become antithetical to the above ideologies. I then discuss the Vitruvian Machine as a part of the useful mode of anthropomorphizing done in ergonomics as a way to translate the radical notion of machine life into human terms. I conclude the chapter by discussing ergonomics as potentially being a programmatic, ethical, as well as critical study of affection between humans and machines.

Finally, my dissertation concludes by way of speculation for further research into ergonomics. The number of scholastic and industrial papers being produced about the study of our interactions with robots has greatly increased, and this is no doubt connected to the annual increases in robotics sold both in the Americas—20% growth in units sold year 2012, and globally an average of 12% growth annually from 2010 to 2013. I discuss the entrance into new sectors of labor for the human modeled robot or what has been known in science fiction as the "android robot." Given the obvious verisimilitude of the android I draw connections that the android may form with other kinds of human capital currently being exploited. I then speculate on the significance of an even more nascent and possibly radical form of machine, that of programmable matter which may be any proportion of synthetic inorganic and/or synthetic biological matter. I end by suggesting the strong possibility that machines may need to be considered within the frameworks of biopolitics and biopower respectively—as Zoe or bare life—

when these individual specimens evolve to the level of a population of bodies at work in society at large.

As this dissertation is fundamentally a discussion of the limits and possibilities of communication between human and nonhuman actors, I begin with a chapter on physiology. Physiology, or the study of functional life processes in organisms, has a strong element of anti-modern thought within it.

Ch. 2: Physiology or Nonhuman Epistemology

Physiologists like many of scientists, tend to point out the "ancient" history of their profession. Galen and Aristotle before him are portrayed as asking questions about living organisms that were formative and continue to concern modern physiologists. It seems that, when faced with the looming threat of a modern or emerging problem, it can be productive to look outside of the modern to the distant past. When writing about media networks Alexander Galloway began his essay with the "networks" of Aeschylus' Greek tragedy *Agamemnon.* One was an actual, material communication network of fire beacons used to warn of the fall of Troy from hundreds of miles away.[62] The other was an imagined, immaterial network that invoked fear of utter destruction, a, "web of ruin."[63] Both, "unknowable in quality and innumerable in form,"[64] this network's entire purpose was to dissolve all forms of order or organization including

[62] Alexander R. Galloway, "Networks," in *Critical Terms for Media Studies*, ed. W.J.T. Mitchell and Mark B.N. Hansen (Chicago, University of Chicago Press), 280.
[63] Galloway, "Networks," 281.
[64] Ibid., 281.

communication and life itself. Galloway argued that he chose to look to the classics in order to show that non-modern knowledge can tell us something about the problem of communication both then and now. He continued that his purpose was,

> to put in question, at the outset, the assumption that networks are exclusively endemic to the late twentieth and early twenty-first centuries, and more pointedly, that networks are somehow synonymous with the technologies of modernity and postmodernity…[65]

Galloway's ancient network examples show that for the Greek's and their modern Western descendants alike, the network was a Janus face of promise and peril. It is a longstanding fear based on organization, freedom, and chaos. For the promise of the modern network is that it could lead to decentralized, distributed, and non-hierarchical forms of communication. Put differently, the network is one way of looking at the relationship between an individual, its desire for autonomous action, and its larger relationship to the system that governs it.

There is good reason to trace back the ancient survey that physiologists take to describe the major problem of their field, the functional definition of life. Again, the distinction between life and inert matter rests on the conceptual rift between organization of matter such that it lives, vs. dissolution of its organization such that fails to meet life's criteria. In making the distinction between life and matter physiologists assume a very particular theory of communication.

> One of the most pregnant insights into the uniqueness of living beings was Aristotle's observation that living matter possesses a special form, or

[65] Ibid. 282.

> organization, which is uniquely able to communicate itself to other suitable matter. It is just this capacity to communicate form that permits the living organism to replace what it loses through displacement, and to grow, and to reproduce.[66]

This passage points to the important and ancient idea of self-expression as a form of communication that is integral to the persistence of organisms. Aristotle claimed this was an act of self-motion in the universe that was peculiar to the living, where inert matter must derive its motion from an outside mover.[67] The freedom to move oneself was tantamount to a freedom of self-expression or the continual communication of individual form and, in the event of death, the ability to continue that form through the process of reproduction of life. Finally, Aristotle claimed that self-expression or the movement of living things was always done purposefully. Along with communication as self-movement and purpose the category of life offered another crucial feature. Aristotle claimed that, merely by association with a living organism, constituent matter, an organ or body fluids like the blood, for example, was itself, "a kind of living creature."[68] The matter constituting organisms was itself alive and formed a living whole that was irreducible to matter in its living processes. Thus the organizing principles of life were that it could self-move/communicate, that all of its movements were purposeful, and that while it lived it was more than the sum of its material parts.

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[66] Thomas S. Hall, *Ideas of Life and Matter: Studies in the History of General Physiology 600 B.C.-1900 A.D.* (Chicago, University of Chicago Press), 381.
[67] Aristotle, "Physics," in The Complete Works of Aristotle, ed. Jonathan Barnes (New Jersey, Princeton University Press 1991).
[68] Aristotle, "Movement of Animals," in The Complete Works of Aristotle, ed. Jonathan Barnes (New Jersey, Princeton University Press, 1991), 12.

Aristotle already recognized the risks of holding life as a special category of matter. He named that object "automaton" that behaved in a way that seemed to have purpose but *must*, because it was not naturally alive, have happened due to chance or spontaneity.[69] He also tenuously opened up the possibility that a human being could be composed of something other than flesh and blood, of inorganic matter, but did not follow this line of reasoning for long before dismissing it.[70] Even in antiquity the prospect of an "artificial" or nonorganic object exhibiting life-like behaviors was an "imaginary" danger to the sanctity of the principles of living matter. From that point on the idea of an agent so unlike humans but with the powers to communicate its form would continue to persist. The ancient idea of the power of life was as a literal communication of self to others with purpose. Could a body move in space and time with intention, affecting other bodies, and regenerate, grow, and reproduce itself?

This distinction of life as fundamentally communicative would eventually wane in the face of the development of modern knowledge. The predominance of the physical sciences, particularly Sr. Isaac Newton's Mechanics, pushed the study of life as a communicative agency to the margins. Ironically, though rationality, mathematics, and matter were the chief tools of modernity, the imagined criteria for a nonhuman agent became less material or physical. The power of the living in modernity was much more specifically human, it was representational and a power of the mind. Could a thing alien to human resemble

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[69] Aristotle, *The Complete Works of Aristotle*, 29.
[70] Ibid. 104.

human intelligence? Could it become self-aware, that is, conscious, and identify? The older idea of self-communicating life would endure thanks to scientific thought that continued to concern itself with the philosophical possibilities of life and matter. In 1900 Nicola Tesla was already concerned with the ecological existence of human beings. He wrote an essay that discussed the limited resources at the population's disposal as well as the productive ways that humans could continue to increase their resources of energy as their numbers steadily grew. In that same essay he proposed a radically novel description of what life was and how humans could re-conceive it:

> In a crystal we have the clear evidence of the existence of a formative life-principle, and though we cannot understand the life of a crystal, it is none the less a living being. There may be, besides crystals, other such individualized, material systems of beings, perhaps of gaseous constitution, or composed of substance still more tenuous. In view of this possibility,—nay, probability, we cannot apodictically deny the existence of organized beings on a planet merely because the conditions on the same are unsuitable for the existence of life as we conceive it. We cannot even, with positive assurance, assert that some of them might not be present here, in this our world, in the very midst of us, for their constitution and life-manifestation may be such that we are unable to perceive them.[71]

A century later Manuel DeLanda, who closely followed Gilles Deleuze's work on the virtual, and who was not concerned whatsoever with the human mind as the seat of communication, would echo this passage with eerie similarity.

> We owe it to Gilles Deleuze to have equipped us with the tools to break from the idea that all expression is ultimately linguistic, and hence anthropocentric: objective spaces themselves are expressive. For example, before living creatures populated this planet crystals were already expressive. But to whom were they expressing themselves? To no

[71] Nikola Tesla, "The Problem of Increasing Human Energy-Through Use of the Sun's Energy." *The Century Illustrated Magazine* (1956).

one, they simply expressed their identity through their three dimensional geometry.[72]

With this idea DeLanda drew a line extended from Hellenistic period through modernity and into our current philosophical landscape that is alternatively characterized as post-modern and posthuman. The ancient ideas of mass, movement, and energy link up with a still forming canon in critical communication studies today—the study of affect.

This chapter will demonstrate that there are important historical connections between physiology and the ergonomics research that would emerge around human-machine relationships. Additionally it will show that those connections were crucial to the "denaturing" effects that ergonomics had on scientific and popular conceptions of human life. Physiology is important to the development of ergonomics because of three theoretical assumptions in ergonomics that were actually adopted from physiology. First, a physiological perspective continued a commitment to life as an empirical category while resisting the tendency to hierarchize kinds of life based on complexity or proximity to human life. Second, in his treatise on ergonomics Hywel Murrell discussed the fundamental importance of the physical basis of its methods of observation and the extent to which ergonomics pursued basic physical elements of the human body—its structure, function, and capabilities.[73]

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[72] Manuel DeLanda, "The Expressivity of Space," *Some Things Happen More Often Than All of the Time* (Turner/A&R Press, 2007), 103.
[73] Hywel Murrell, *Ergonomics or Man in his Working Environment* (London: Chapman and Hall, 1965).

Part 2: Critical Histories of the Life Sciences

Fatigue

The conditions that would provide the emergence of ergonomics—industrialization, automation, and the scientific study of work—also marks the decline of Physiology as a predominately valued scientific knowledge. Perhaps the most significant epistemological/experimental problem for early 20th century physiology was the human condition of fatigue. It was no coincident that in the reconstruction of industrial infrastructure after World War I fatigue study, and the study of laborers generally, became a priority for managers, owners, and the burgeoning scientific field called experimental psychology. Together, the intensified industrial concern for productivity and the psychological imperative to interrogate inner states of the mind and passions had the effect of marginalizing the physiological work that had been done on the materiality of bodies, their affects, and relationships to factory machines.

The study of human fatigue, which began at least as early as the 17th century in the form of experiment with electricity and animal muscle stimulation was transformed in the 19th century into a "correctible" program. This program sought to address the condition of waste of human movement and potential, in a larger shift to imagining the human body as both a social and physical engine.

> The ability of fatigue to move fluently between science and literature reveals the tendency of nineteenth-century thinkers to equate the psychological with the physical and to locate the body as the site where sociaJ deformations and dislocations can be most easily observed…

> As a tangible and ever-present mental and physical disorder, fatigue could, however, be distinguished from emotional states, for example- melancholy, ennui, and listlessness which were its subjective manifestations. The physical symptoms of fatigue were regarded as mere "representations" of more profound conditions.[74]

The above argues that because of the symbolic uses of the body during industrialization, that the somatic processes of the body as necessary indicators for mental, emotional, and class disease did not have strong meaning as physical processes, which is precisely what physiologists were interested in. The fact of the matter was that physiologists, in their general desire to redesign inefficient or strenuous work places and machines around human workers, were simply not equipped, according to factory owners and industrialist investors to solve the fatigue problem. Psychologists, on the other hand, were keen on shaping human labor through profiling and psychological manipulation to the demands of the factory and workspace.[75]

And yet this claim is not entirely accurate, as physiological research continued, though subdued in the strength or influence of its results, in all of the above. The Gilbreths, who were not only at the forefront of the science management and industrial psychology movements, but are cited frequently as one of the most influential precursors to modern ergonomics, derived their studies explicitly from physiological experimentation known as Motion Studies.

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[74] Anson Rabinbach, *The Human Motor: energy, fatigue, and the origins of modernity* (University of California Press, 1992), 21.
[75] F.J. McGuigan, "*The Historical Development of Cognitive Psychophysiology Theory and Measurement," In Advances in Physiological Sciences: vol 21 history of physiology* (Schultheisz E. ed. Budapest: Pergamon Press, 1980).

Hywel Murrell, who coined the name Ergonomics and was instrumental in the networking of scientists both in England and the U.S. to continue its research, identified wholly as a psychologist of sorts. And yet to look at his major work on ergonomics, "Human Performance in Industry"[76] is to parse the basic structure of a physiology textbook. Physiology has always been included in the panoply of fields that ergonomics makes use of. Ultimately, physiology took a back seat to psychology in the factories as an effective influence on human labor, given its predilections for weighing healthy integrated function of a human body over a singular successful exertion such as a repetitive motion of the hand.

It is not that physiology was incapable of producing knowledge about efficiency of labor or production for it often did. It was simply that, as the trajectory of the life sciences had shown since the 18th century, the physiological would give way to the psychological, and the concept of vital processes or activity (in labor for example) would make way for a mechanistic study of bodies. The key discipline that would supplant physiology as the key study of fatigue was the branch of experimental psychology that came to be associated with work science or scientific management that thrived at the turn of the 20th century. Perhaps the most famous public attackers of human fatigue in labor, Frederick Taylor, met before a Special House committee in 1912 in order to investigate the state of the "Taylor system" as a monopoly in American scientific management. In testimony given to inform the committee of the essence of scientific

[76] This was the U.S. title for the book first published in Britain as "Ergonomics: man in his working environment" which indicates both the youth of Ergonomics field at the time as well as its need to be "translated" into the quite different American approach of Industrial management.

management, Taylor stated that scientific management is concerned only with those "sentiments" which surround those on the side of management and those on the side of workers. He went on to list all of those things that his system was not:

> Scientific management is not any efficiency device…It is not a system of figuring costs; it is not a new scheme of paying men; it is not a piecework system…it is not holding a stop watch on a man and writing things down about him…[77]

Taylor was simply not interested in material, embodied, or physiological discoveries, and this is key because the Work of Gilbert and Lillian Gilbreth, who pioneered both time and motion studies and were seminal to early ergonomics—was precisely concerned with human and machine bodies. On the other hand, Taylorism was "not motion study nor an analysis of the movements of men…"[78] Instead the essence of Taylor's system was tantamount to an entire "psychological revolution."[79] The idea that the industry of scientific management marked a "revolution" and not the instrumental manipulation of individual's psychology at work was hugely influential. For a time in the 20th century it would solidify the beneficial relationship that industrial psychological research had with military and industrial fields. The psychology of efficiency would become known through the popularity of surveys, diagnostic and aptitude exams and the Rorschach test, among other psychologist tools. It was also the reason that from its beginnings in 1949 ergonomics was considered a social science and the

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[77] Taylor, Frederick Winslow, *Scientific Management* (New York: Harper and Row, 1947), 26.
[78] Taylor, 1947, 26.
[79] Ibid. 26.

employ of the psychologist, though the language and object of the physiologist—the processes of the human body in action, would remain with it.

George Canguilhem and Foucault on Physiology

I briefly go over the work of Michel Foucault and Georges Canguilhem with attention to how their works describe physiology in the 18th and 19th centuries. I do so in order to highlight how my project resonates with the general biopolitical register of these accounts. The chapter then moves to histories of science that have dealt specifically with physiological thought, where I suggest that for physiology, just as Michel Foucault says of History, "things weren't necessary as all that."[80]

While acknowledging that scientists participate in particular rationalities or ideological discourses, I use Foucault's historical method in order to pinpoint particular epistemological breaks from those dominant discourses. These breaks which occur particularly within physiology as a repetition of a problem space, or an indetermination over human life, results in an indecision towards life and matter that short-circuits instrumentalist thought and provides an openness to what we know as a post-human perspective. I move on to particular moments of these instances from physiology: first in its infancy in the 19th century, then at the turn of the 20th century to trace the effect of science management and industrial

[80] Michel Foucault, *Foucault live: interviews, 1961-1984* (New York: Semiotext, 1996.

psychology on physiological thought, and then at mid 20th century when the emergence of ergonomics would again mark physiology's trajectory.

Georges Canguilhem used "scientific ideology" in order to distinguish between the discourses of what he called Science and Non-Science. He traced the rise of a "modern" autonomous physiology as a product of the 19th century with little epistemological difference from any of the life sciences in its subservience to that ideology. Of the three phenomena that produced significant change to European medicine at turn of the 19th century,

> …physiology gradually liberated itself from its subservience to classical anatomy and became an independent medical discipline, which at first focused on disease at the tissue level, as yet unaware that eventually it would come to focus even more sharply on the cell. And physiologists looked to physics and chemistry for examples as well as tools"[81]

Canguilhem highlighted a hegemony of thought in the life sciences devoted to the pathological, with the birth of an autonomous Physiology as seemingly no different. This prompts his characterization of the emergence of the field as just one more approach to the study of the mortified/dead to understand the living. However, unlike the medical practitioners who felt a preexisting "need to know the dead in order to understand the living"[82] in the 19th century, physiologists did chaff against the mortification of life science discovery. "Dead nature cannot help us, but living nature provides us with acceptable terms of comparison."[83] This

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[81] Ibid. 54.
[82] Michel Foucault, *The Birth of the Clinic: an archaeology of medical perception*, A.M. Sheridan Smith, trans. (New York: Vintage Books, 1994), 126.
[83] Georges Canguilhem, *Ideology and Rationality in the History of the Life Sciences* (Cambridge, MA: MIT Press, 1988), 71.

was the epistemological push back against the ideology of mortification that Foucault and Canguilhem identified.

We can see that physiology, not unlike the other sciences, was rife with divergences and conflicting thoughts about how to theorize living organisms. It developed against the emergence of its twin pathological medicine, just as it would develop contra reductionist and mechanistic sciences. Physiology continued, as natural philosophy had done prior to the 18th century, to explore the possibilities of a vitalism in organisms as opposed to a mechanism that simplified and vivified living bodies in attempts to reduce life to its simplest constituent parts.

Before the 18th century physiology or "all of natural philosophy" was concerned with questions of life and matter in the universe, our access to them, and their unified relationship. Beginning in the 1700's physiology came to define "the study of the nature, powers and functions of human beings."[84] Beyond the designation of "human" physiology, the function of the science had now become the study of the normal functions of organisms and living systems. The term normal, especially as it pertains to human life is well articulated by Michel Foucault as an example of the rise of modern scientific discourse as well as its inclusion in governing of a citizenry. It is through the abnormal, Foucault observed, that scientific discovery in the 19th century gets transposed to both a medical treatment and a pedagogical problem for normal human bodily function. We are struck immediately with the implications for a science whose definition

[84] Canguilhem, *Ideology and Rationality*, p. 1.

includes such a normative criteria of proper life in the concept of normal—to become a "moral physiology" regulating sin, monstrosity, and perversion through the more modern "discipline of the useful body".[85]

> Consequently, this notion of condition has a formidable capacity for integration: It refers to nonhealth, but it can also bring into its field any conduct whatsoever as soon as it is physiologically, psychologically, sociologically, morally, and even legally deviant. The notion's capacity for integration in this pathology, in this medicalization of the abnormal, is clearly marvelous. At the same time, the second big advantage is that the notion of condition makes possible the rediscovery of a physiological model.[86]

Understanding what Foucault's concerns on the abnormal bring to the history of physiology, we can use his historiographic method in order to illuminate physiology beyond its significant normativizing effects. Using an archaeological method reveals what Foucault called the positivities of knowledge, a "positive unconscious of knowledge: a level that eludes the consciousness of the scientist and yet is part of scientific discourse."[87] As Foucault stated, the finding of positivities distinguished his history from those that attempt to dispute science's validity or "diminish its scientific nature."[88] Archaeology, on the other hand, through the positivity of the ground of knowledge finds the episteme in which "diverse forms of empirical science" appear.[89]

That is to say, archaeological perspective on the sciences illuminates to us that "knowledge succeeds in engendering knowledge, ideas in transforming

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[85] Michel Foucault, *Abnormal: lectures at the Collège de France, 1974-1975*. Vol. 2 (New York: Macmillan, 2007), 194
[86] Foucault, *The Order of Things* (New York: Routledge, 2002), 313.
[87] Michel Foucault, *The Order of Things*, xi.
[88] ibid. xi.
[89] Ibid. xxiv

themselves and actively modifying one another"[90] without and despite the intentions of human intentions. Finally, in taking Foucault's archaeology seriously for the history of physiology this chapter attempts to illustrate the diverse and denaturing qualities of particular physiological theories within a larger perceived hegemony of thought—what Foucault describes as an "eventalisation."

> [Eventalisation] means making visible a singularity at places where there is a temptation to invoke a historical constant, an immediate anthropological trait or an obviousness that imposes itself uniformly on all. To show that things weren't 'necessary as all that' . . .[91]

The positivity that appears from beginning an archaeology of physiology is the marginalized yet persistent idea that, as Canguilhem argued, knowledge and life, the former of human beings and the latter of nature, rather than being opposed are coconstitutive of one another.[92] Further, if there was an inequality in the relationship between knowledge and life, from the perspective of physiology it was not that life could be mastered by the ingenuity of human knowledge, but conversely the case of "the inadequacy of analytical thought to any biological object."[93]

In proposing that physiological thought was not "necessary as all that" is to say two things from the outset about its definition. First, the concept of "normal" in defining physiology's concern is actually nonessential to the study of living organisms and has been substituted with other concepts such as optimal, or

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[90] ibid. xxiv
[91] Michel Foucault, "Impossible Prison," *Foucault Live* (New York: Sylvere Lotringer, 1996), 277.
[92] Georges Canguilhem, *Knowledge of Life*, eds. Paola Marrati and Todd Meyers, Trans. Stefanos Geroulanos and Daniela Ginsburg (New York: Fordham University Press), 2008.
[93] Canguilhem, *Knowledge of Life*, xx.

regulated, for example, and the ideological power of normal and its other abnormal in particular cases produced nonconforming conceptions of organism. Second, what this method attempts to bring out is another, more persistent if less obvious imperative within physiological thought that was present at 19th century. What began to distinguish Physiology as it gained autonomy in the 19th century from the rest of the life sciences was its historical fascination not with the relationship between life and death but between life and the lifeless.[94] That life-matter relations are inextricable to physiology can be more easily understood by the proposition that on some level of reduction human beings are composed of lifeless materials. Physiological thought has historically shown this tendency and experimented with the shared limit-threshold between what can empirically be concluded as living tissue vs. what is inert matter. This is why it has historically vacillated between a vitalist and mechanistic tendency.

Siegfried Zielinski noted that, deriving from the ancient discourse of "natural philosophy" physiology was important because its aim of understanding encompassed everything that concerned philosophical thought in the West.

> Observations of nature, mind, and the soul, as well as the mathematical calculations made by the early philosophers, cannot be separated. Their conception of physiology encompassed it all.[95]

This conception of physiology provides a notion that is no longer agreeable to much of scientific as well as humanistic scholarship that has become so

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[94] Thomas S Hall, Ideas of Life and Matter: studies in the history of general physiology 600 B.C.-1900 A.D. (Chicago: University of Chicago Press), 1969.

[95] Siegfried Zielinski, *Deep Time of the Media: toward an archaeology of hearing and seeing by technical means* (Cambridge, MA: MIT Press, 2006), 53.

specialized. It is the idea of integration or holism, and physiology, as a subset of biological science, has to various extents continued to theorize life in this non-mechanistic, non-reductionist manner.

Additionally, Zielinski made the most explicit connection between physiology and media theory. Like Galloway with media networks, Zielinski believed that ancient thought had much to offer contemporary media.

> What I have tried to show is how one can arrange some of the extant text particles of Empedocles and Democritus on perception to extract ideas and statements that have some bearing upon the frenetic contemporary sphere of activity that is theory and praxis of media: the interface between the one and the other, which can be defined as the interface between media people and media machines.[96]

The above supports two major points of this chapter. First, that the rigorously studied technical concepts within physiology, such as "perception" or "sensation", "movement" or "energy," can be imported into media studies with many productive results. In this sense a physiological media studies intersects with work in the areas of new materialisms and affect studies that engage in a "technical"[97] turn in their thought. It is my hope that my study contributes to these areas, particularly the historic-theoretical bent of new materialism as well as the ethical openness to otherness possessed by affect studies. I have discussed earlier my dissertation's connections to these other projects. However, I am arguing that Zielinski's use of media people/media machines expresses the same

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[96] Zielinski, *Deep Time of the Media*, 53.

[97] As mentioned in my introduction the recognition of a fundamental mediated/medial character to modern life has resulted in many theorists' reorientation towards science and technology.

vitalist tendency as Canguilhem and puts together the technological with the organic in a way that doesn't privilege one over the other.

Georges Canguilhem and the Vitalistic Tendency

> In its educational web site the Physiological Society defines physiology as, the science of life. It is a broad science which aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behaviour of the whole body.[98]

The running distinction between biology and physiology since the 19th century has been that, where biologists look for the most basic structures or organizations underlying organisms, physiologists study the functions of organisms. The structure/function distinction accounts for why biology historically developed towards microscopic, molecular, and genetic levels. On the other hand for physiology the question of function or purpose for a particular living thing, be it an organism, organ, or cell, was dependent on its relation to its complimentary living things. None of the three aforementioned live in isolation, nor would understanding them isolated provide meaningful knowledge. As Georges Canguilhem observed of the physiological approach,

> The difficulty, if not the obstacle, lies in approaching through analysis a being that is neither a part or segment nor a sum of parts or segments, a being that only lives by living as one, that is to say, as a whole:[99]

This holistic approach was and is a very specific outlook on physiology or science in general for that matter. In fact, this holistic physiology, especially after

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[98] "Understanding Life," accessed from Physiological Society web site on May 5th 2014, http://www.understanding-life.org.
[99] Georges Canguilhem, *Knowledge of Life* (New York: Fordham University Press, 2008), 11.

the 18th century, saw its work and status increasingly marginalized in favor of life sciences that were willing to model themselves after the reductionist and mechanistic principles from enlightenment physics. This chapter will trace a few examples of physiological thought that takes its objects as whole, integrated, and connected to larger systems. In order to do so it utilizes George Canguilhem's work on the life sciences and their underlying philosophies of what life was. Canguilhem, a historian, scientist, and philosopher was highly influential to post-1960's French theory. Michel Foucault claimed that without him "we" would lack key understandings of French Marxism, French Sociology, Lacanian Psychoanalysis, and that,

> Further, in the entire discussion of ideas which preceded or followed the movement of '68, it is easy to find the place of those who, from near or from afar, had been trained by Canguilhem.[100]

Additionally, Canguilhem represents a reconsideration of the usefulness of the philosophy of Vitalism. In particular, as my dissertation owes much to the works of Michel Foucault and Gilles Deleuze, Georges Canguilhem stands as a key thought in the development they would continue. Canguilhem brought the life sciences to the forefront of historical and philosophical understandings. Foucault and Deleuze would continue, with Biopolitical theory and philosophy of Becoming, respectively, as thinking that was fundamentally concerned with the powers of Life. As I discuss in the next chapter both Foucault and Deleuze would explicitly ponder Life in general in their last published essays. Canguilhem, on

[100] Georges Canguilhem, *The Normal and the Pathological*, trans. Carolyn R. Fawcett and Robert S. Cohen (New York: Verso Books, 1991), 8.

the other hand, worked on the problems of understanding it throughout his career and began his own argument that "Life cannot be grasped by logic,"[101] with a review of the mechanist vitalist debate.

He showed the mechanist's derision towards the life sciences as encapsulated in one of their most prominent critics, Jacques Monod, who also happened to be a nobel prize winning biologist.

> Biology is marginal because—the living world constituting but a tiny and very "special" part of the universe—it does not seem likely that the study of living things will ever uncover general laws applicable outside the biosphere. (emphasis added)[102]

The vitalistic strand of physiology did not result in a solipsistic skepticism that we could never truly distinguish life from the nonliving. Rather,

> The phenomenological experience of life is indisputable. We are aware of ourselves as living creatures and as sharing the attribute of life with other creatures which are patently distinguishable from inanimate objects. The crassest of mechanists is ready to acknowledge a discernible difference between the living and the nonliving. His disagreement with the vitalist is over the explanation of this phenomenon, not over its occurrence.[103]

According to Monod and other mechanists the explanation for the phenomenon of life was merely chance or probabilistic occurrence.

That the physiological view of human life since the 17th century had vacillated so greatly between machinic and a powerful and mysterious vitalism resulted in a hybrid and highly complicated conception of living things. I argue

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[101] Charles T. Wolfe, "The Return of Vitalism: Canguilhem and French Biophilosophy in the 1960's," (2011) Conference Presentation, 1. http://hdl.handle.net/2123/7216.
[102] Robert Rosen, *Essays on Life Itself: complexity in ecological systems* (Columbia University Press: 2006, Kindle Edition,) 8.
[103] Hilde Hein, "The Endurance of the Mechanism—Vitalism Controversy," *Journal of the History of Biology* 5, no. 1, (1972): 161.

that this complication is one of the strongest epistemological influences on ergonomics that has until now gone unrecognized. Ergonomics provides a picture of the study of life that has both elements of mechanistic and vitalist thought, but cannot be reduced to either. Physiology is important as a precursor because it shows that the persistence of a vitalist scientific/philosophical perspective is, even today, far from an "antiquarian interest," nor a "closed case history."[104]

The physiological perspective, highly influenced by vitalism, gave the insight that, "nothing is more human than a machine, if it is true that man distinguishes himself from animals through the construction of tools and machines."[105] Hegemonic science was modeling its understandings of the "problem" of the relationships between machine and organism,

> only in one direction: almost always, the attempt has been to explain the structure and function of the organism on the basis of the structure and function of an already-constructed machine.[106]

However, there were scientists and philosophers who continued to see humanity constructed within machines and engaged in that rare reversal of hegemony, seeking to, "understand the very construction of the machine on the basis of the structure and function of the organism."[107] The machine was not the simple model by which more complex organisms' functions could be reduced and simplified for explanation. It was instead held to be like the organism, "a

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[104] Hein, "Endurance of the Vitalism-Mechanism Controversy," *Journal of the History of Biology* 5, No. 1 (Spring, 1972): pp.159.
[105] Georges Canguilhem, *Knowledge of Life* (Fordham University Press), 2008,
[106] Canguilhem, *Knowledge of Life*, 76.
[107] Ibid. 76.

repository of meanings and impredicativities."[108] We can trace in physiology a thread that will pull together the later developments of cybernetics and ergonomics. The concept of the machine is held up to and intertwined with that of organism, in the process the machine is taken out of its immediate mathematical and scientific contexts. As Canguilhem argued, the vitalist tendency produces the, "problem of the originality of the technical phenomenon," the machine, "in relation to the scientific phenomenon."[109] The machine is not, from the physiological perspective, a product of human thought so much as it is, I suggest, an emergent phenomenon like the organism. Canguilhem's contribution to posthuman media theory is expressed strongly in his conclusion to his defense of Vitalism:

> by considering technique to be a universal biological phenomenon and no longer only an intellectual operation of man, one is led, first, to affirm the creative autonomy of arts and crafts from any knowledge capable of appropriating them so as to apply itself to them or informing them so as to multiply their effects. Second, in consequence, one is led to inscribe the mechanical within the organic.[110]

In the above, Canguilhem rearticulated humans and technology (technique) to Life in general or the category of Nature. This category was the epistemological outside to all that was human, (Language, Culture, Technology) within the Human/Nature binary. In addition, "arts and crafts" or human technology was now conceived of as an autonomous "biological phenomenon," thus de-emphasizing the uniqueness of human thought and invention. Finally, in

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[108] Rosen, *Essays on Life Itself*, 4.
[109] Canguilhem, *Knowledge of Life*, 76.
[110] Ibid. 96.

inscribing the "mechanical within the organic," Canguilhem broke down the distinction and hierarchy implicit in the life/matter binary. In doing so he contributed to the more general project of saving the technical object by way of a physiological perspective—by allowing it into the conversation of life.

Vitalism vs. Mechanism and Emergence

Chemist, philosopher, and doctor Georg Ernst Stahl provided one of the first examples of a vitalistic principle in science. He claimed that all living matter was pervaded by and presided over by its "anima sensitive," a sensitive or sensational soul.[111] Living matter possessed a vital force that by definition made it alive, as opposed to inert matter that necessarily lacked this force. Life was imbued with an immaterial force such that,

> the reactions in living organisms are not completely explicable in terms of physics and chemistry; that there is some supernatural or ultranatural element in these processes which puts them beyond the range of jurisdiction of so-called natural laws.[112]

On the other hand, mechanistic thought posited that life and all of its processes were no different than nonliving, physical, material processes. To quote one of mechanistic sciences' notable 20th century proponents Edwin Goodrich,

> The metabolic process in living matter draws in inorganic substance and force at one end, and parts with it at the other; it is inconceivable that these should, as it were, pass outside the boundaries of the physico-

[111] Michael Foster, *Lectures on the History of Physiology During the Sixteenth, Seventeenth and Eighteenth centuries*, (Cambridge University Press, 2012), 167.
[112] F. H Pike, "Vitalism, Mechanism, and Organicism," *Science* 76, no. (1974, 1932): 384.

> chemical world, out of range of the so-called physico-chemical laws, at one point to reenter them at another.[113]

Where vitalism saw in living matter a distinct and separate category of matter the mechanistic view believed that there was no distinction to be made singling out any kind of matter out from another.

Vitalism and Mechanism are scientific and philosophical worldviews described as coming together in controversy, debate, and war. The battle is generally viewed between the biological and physical sciences (reduced to Physics) over the primacy either of matter over life or vice versa as the most valid scientific object of study. As Georges Canguilhem noted, from the scientist's point of view, the term vitalism is appropriate for any biology careful to maintain its independence from the annexationist ambitions of the sciences of matter."[114] In other words, there is a strong disciplinary component to the debate that leads to the legitimacy of certain sciences over others. From the perspective of the historian of biology the progress of classical and modern mechanics have thrived in direct correlation to the perceived waning of the study of life. This is not to say that the biological sciences have not continued to grow in size and complexity or stay timely and well supported—they have. Rather, I point out that, especially through the influence of Isaac Newton and Renee Descartes in the 17th century, the biological sciences would emulate the study of material objects such as astronomical objects, chemical substances, and of course mechanical machines.

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[113] Edwin Stephen Goodrich, *Living Organisms: an account of their origin & evolution* (The Clarendon Press, 1924), 21-22.
[114] Georges Canguilhem, *Knowledge of Life*, 60.

There exists an epistemological bias found in the mechanistic worldview that matter seems to be a stronger empirical object of study than life[115], or as Biologist Robert Rosen observed, "one must never, ever, claim to learn anything new about matter from a study of organisms."[116]

The so-called "molecular revolution," can be traced back to Warren Weaver's coining the term molecular biology at the Rockefeller Foundation in 1938. This marked the beginning of a new vision in American (government funded) science that historians of science have called the, "molecular vision of life."[117] It is no coincidence that a decade later Weaver would work to popularize Claude Shannon's mathematical model of communication, known widely as the beginning of Information Theory. After the emergence of the fields of molecular biology and information sciences there was a large scale importation of the language of information theory (not to mention cybernetics) into biological sciences pertaining to microscopic/cellular structures. Thus RNA and other genes began to be described as "controlling," "expressing," and "transferring" biological information. Interestingly this terminological shift can be seen as similar to Friedrich Kittler's idea of discourse networks whereby large scale shifts in language, imagery, and thought occur because of shifts in a society's predominate media forms. In this case the language of information is inextricably

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[115] Thomas, S. Hall, *Ideas of Life and Matter: Studies in the History of General Physiology 600BC-1900AD, vol. 2 From the Enlightenment to the End of the Nineteenth Century*, (Chicago: University of Chicago Press1969), 174.
[116] Robert Rosen, *Essays on Life Itself,* 2.
[117] Chunglin Kwa, *Styles of Knowing: A new history of science from ancient times to the present* (Pittsburgh: University of Pittsburgh Press, 2011), 250.

linked to the digital medium, and this had a profound effect on how biological science made meaning of genetics and cellular reproduction. As Hans Jorg Rheinberger argues molecular genetics developed discursively as scientific discourse historically always has:

> It operates in a framework established by the technical means and media available for the development and realization of experimental systems to which it refers and that lend it its force.[118]

While the history of molecular sciences is fascinating in showing the intimately "linked histories of molecular biology, cognitive science, and computer science,"[119] the prominence of information and molecularization did little to change the historical dominance of matter over life. From a biopolitical perspective the creative powers of Life are discursively and materially effaced when modern neoliberal biotechnologies simultaneously informationalize it and reduce it to its most basic parts.[120] In addition, molecular science has rarely been funded for the "pure" research that many scientists hope exist. Instead its encouragement and nurture have generally been tied to material products, patents, and weapons. Also, as Rheinberger observed, this "new biology,"

> ..takes its place alongside long-standing attempts to reduce the phenomena of the material world to their physical and chemical foundations: attempts at making such reductions have characterized the modern sciences in the West for a good three hundred years.[121]

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[118] Heinz Jorg Rheinberger, *An Epistemology of the Concrete: Twentieth-Century Histories of Life* (Durham: Duke University Press, 2010), 214.
[119] Susan Oyama, *The Ontogeny of Information: developmental systems and evolution* (Durham: Duke University Press, 2000), 213.
[120] Michael Dillon, and Luis Lobo-Guerrero, "The Biopolitical Imaginary of Species-being," *Theory, Culture & Society* 26, no. 1, (2009).
[121] Rheinberger, *An Epistemology of the Concrete*, 10.

The molecular revolution was on a most general level a continuation of the dominance of matter over life in scientific rationality.

And yet the controversy of vitalism was that it would never simply admit defeat to mechanistic and reductionist science and die away. Even the most eminent physicists still held a fascination with life as a "special" category of matter. Albert Einstein commented on the ability of physics to explain the existence of organisms stated that, ""One can best feel in dealing with living things how primitive physics still is."[122] Erwin Schrodinger, "concluded that organisms were repositories of what he called new physics."[123] Similarly, many strong proponents of quantum physics (itself concerned with complexity, chaos, and uncertainty) believed it was important because its insight into the "innermost secrets of matter" would in the end also yield the "secrets of life" itself.[124]

From Stahl's anima sensitiva in the 18th century would follow numerous vitalist principles contributed by both scientists and philosophers. Importantly this would include the contributions in the early 20th century of Henri Bergson's "élan vital" (vital force), philosopher and biologist Hans Driesch's "entelechy" (or a perfecting principle within life). These two in particular would represent a break from a mystical or religious element within vitalism and would form instead a "critical" vitalism.[125]

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[122] Rosen, *Essays on Life Itself*, 7.
[123] Ibid. 7.
[124] Ibid. 9.
[125] Frederick Burwick and Paul Douglass, *The Crisis in Modernism: Bergson and the vitalist controversy* (Cambridge University Press, 1992), 118.

> Whereas naïve vitalism had posited a substance (archeus, vital fluid) in order to fit the evidence of a materialist ontology, critical vitalism focused on process and dynamic impulse in the context of an ontology of energy and idea…[126]

In place of substance was process and in place of object there was relationality—between matter and life and between what was alive and the processes that maintained its living. The conception of vitality—or capacity for purpose and action—was expanded through critical vitalism. As Jane Bennett observes in her essay on Hans Driesch,

> the scope of critical vitalism was not restricted to biology, for the same vital principle was also thought to be responsible for the progressive development of personality and history: insofar as seeds, embryos, personalities, and cultures were all organic wholes, there was an isomorphism between physical, psychological, and civilizational orders.[127]

Vitalism opened up conception of life that does not rest upon the active life/inert matter dichotomy in order to "favor" the living. Instead it begins its observation of phenomena in the universe with an inversion of hegemonic mechanistic thought. Critical Vitalism shifts away from questions about identity or what things are made of and how they are structured, toward questions of function or what things do, how things interact with one another. Most importantly was how this vitalism dis-inherited anthropomorphism. By upsetting the life/matter distinction it left behind the hierarchized levels of complexity of organism ranked from single cell organisms to human beings' privileged position at the top.

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[126] Burwick and Douglas, *The Crisis in Modernism*, 1.
[127] Jane Bennett, "A Vitalist Stopover on the Way to a New Materialism," *New Materialisms: ontology, agency, and politics* (Durham: Duke University Press), 48.

Critical Vitalism at once inherited the anti-modernist bent of physiology that practiced a holistic and integrative study of the natural environment with no distinctions made for humanity, culture, language, or human made technology. For example, critical vitalism inherited and further developed the ideas of the German naturalist, physiologist, and anti-rationalist philosopher Raoul Heinrich France.

> For France, "the Law of the World ensures that, in the end, the technology of the organic and the technology of humans, are identical."…if human technology is a subset of organic technology, then it is not something foreign to or necessarilty destructive to ecosystems. Just as we stand to profit from observing the working of biozonose [ecosystems] in nature, we stand to benefit from our observation of naturally occurring technologies.[128]

France's bringing together of machine and organism in dissolution of the human vs. nature distinction has all of the key components of critical vitalism. His passage is telling as well since France's passage was in part a response to a, "critique of rampant urbanization, industrialization, internationalization, and the instrumentalist view of nature,"[129] in the European Neo-Romanticism movement. While France passed on a sort of naturalistic holism in his worldview he stopped short of scapegoating the material objects of modernity. His response is important because it expresses not pessimism towards the technologies thought to produce such modernizing effects, but rather a call to reconceive of their relationship to human life. As well as bridging earlier naturalist responses to the rationalism and mechanism in modernity, France presages much later work such

[128] Oliver Arpad Istvan Botar, and Isabel Wünsche, eds. *Biocentrism and Modernism* (Ashgate Publishing, Ltd., 2011), 29.
[129] Botar and Wunsche, *Biocentrism and Modernism*, 27.

as Donna Haraway's, with cyborgs and species-companions. Generations before she theorized the epistemological and ethical benefits of becoming cyborg, France proposed that humans could learn from all the naturally occurring technologies:

> Technologies of all kinds, including non-human ones, and our ability to learn from them, France termed Biotechnik, a predecessor of today's "bionics" or "biotechnology."[130]

The inscribing of the technological object into life was the most important component of the development of vitalism as an inroad into radical continental philosophy and social theory. Before Haraway it was Gilles Deleuze who proposed a critically vitalistic view of subjectivity, action, and life. John Marks argues that Deleuze's entire approach to philosophy is built upon vitalism, and observes that to Deleuze just like the above critical vitalists, Bergson in particular who he is so influenced by, "the distinction between the organism and the mechanism is redundant: both are machines."[131]

> It's organisms that die, not life. Any work of art points a way through for life, finds a way through the cracks. Everything I've written is vitalistic, at least I hope it is, and amounts to a theory of signs and events.[132]

We can see here that Deleuze uses vitalism in order to get to a point of observation where, as Robert Rosen argues, life ceases to be an action or adjective and becomes more like a noun, a thing, a being in itself, and a "legitimate object of scientific scrutiny," in its own right without referral to

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[130] Ibid., 20.
[131] John Marks, Gilles Deleuze: *Vitalism and Multiplicity* (Pluto Press, 1998), 49.
[132] Gilles Deleuze, Negotiations (New York: Columbia University Press, 1995), 143.

matter.[133] It also quickly becomes clear that the legitimation of life as an object traversing organic and inorganic matter results in a rejection of traditional human categories, as Deleuze demonstrated:

> It's not a question of being this or that sort of human, but of becoming inhuman, of a universal animal becoming - not seeing yourself as some dumb animal, but unraveling your body's organization, exploring this or that zone of bodily intensity, with everyone discovering their own particular zones, and the groups, populations, species that inhabit them.[134]

The serious treatment of life in general or what Deleuze referred to as an impersonal, subject-less life carries with it the very same dangers to ethics and politics as much of vitalist philosophy. Among the critics of vitalism are philosophers as well as cultural critics in the humanities. Deleuze himself was charged with having the metaphysics of a serial killer.[135]

Carey Wolfe has argued that the insistence on vitalism results in the radically dedifferentiating discourse of " life" which is unworkable both philosophically and pragmatically."[136] Not only that, but in terms of biopolitical theory vitalism such as the one present in Esposito's affirmative biopolitics, "simply reinstates the very autoimmunitary, thanatological movement," that it sought to escape, at least as human individuals and populations are concerned.[137] Wolfe went on to argue that such a holding of vitalism in the contemporary moment fits in easily with the obsession over Life in U.S. political

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[133] Rosen, *Essays on Life Itself*, 6.
[134] Deleuze, *Negotiations*, 11.
[135] Anthony Paul Smith, "Does Deleuze have the Metaphysics of a Serial Killer," An un Fur Sich, accessed July 26th 2014, http://itself.wordpress.com/2007/02/07/does-deleuze-have-the-metaphysics-of-a-serial-killer-part-i/
[136] Carey Wolfe, Wolfe, Cary. Before the Law: humans and other animals in a biopolitical frame (University of Chicago Press, 2012).
[137] Wolfe, *Before the Law*, 58.

culture in terms of the pro-choice/life war. More importantly, he observed, "neovitalism" now is rehashing the ethical problems of vitalism in the Deep Ecology and other environmental movements in the 1970's and 80's.

> As Tim Luke notes, if all forms of life are given equal value, then we face questions such as the following: "Will we allow anthrax or cholera microbes to attain self-realization in wiping out sheep herds or human kindergartens? Will we continue to deny salmonella or botulism micro-organisms
> their equal rights when we process the dead carcasses of animals and plants that we eat?"[138]

To the staunch vitalist or her modern equivalents the biocentrist or the bio-diversity activist, Wolfe responded that for those

> who would argue that, yes, all forms of life should be equally allowed to take their course, even if it means massive die-off of the species Homo sapiens. But biopolitically speaking, that hardly solves the problem, of course, because when we ask what the demographic distribution of such an event would likely be, we realize that the brunt would surely be absorbed by largely black and brown poor populations of the south, while those in the " rich North Atlantic democracies" (to use Richard Rorty's no-nonsense phrase) who could afford to protect themselves would surely do so.[139]

Wolfe's argument here is compelling and in grounding the philosophical problem in the political it shows how vitalism arrests its own usefulness. The problem for a vitalist mode of thought then becomes how to release it from what Eugene Thacker called its "hovering, wavering space between an onto-theology and an onto-biology."[140] Or, as Claire Colebrook argued, how we may propose a "queer vitalism" such that the Life being held up does not represent an undifferentiated

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[138] ibid. 59.
[139] Ibid. 60.
[140] Eugene Thacker, After Life (University of Chicago Press, 2010), 240.

“universal humanity” but rather, “life as a multiple and differentiating field of powers that expresses itself in various manners.”[141] Colebrook insisted that in such a vitalism Life must be thought of as virtual but real. This brings Deleuze front and center into the discussion of vitalism but also introduces another concept that has moved vitalism forward beyond its biopolitical consequences in physiological thought—that of emergence.

Emergence

Where vitalism quite literally to the matter vs. life distinction, emergence had no need for such a distinction in order to describe and understand the emergence of novel organization. It was not that either life or matter was foundational to the other but instead what happened in between the two that mattered in emergence theory. All sorts of arrangements could be explored when the theorist set out

> to catch things where they were at work, in the middle: breaking things open, breaking words open…for new things being formed, the emergence of what Foucault calls "actuality."

The theory of emergence is foundational to both cybernetics and ergonomics, and its roots can be seen in the vitalist tendency. What they all have in common is, again, a holistic, non-reductive perspective on the organization of matter.

> In simplest terms Emergence refers not to life but rather, refers to the arising of novel and coherent structures, patterns,

[141] Claire Colebrook, "Queer Vitalism," New Formations 68, no. 1 (2010): 80.

> and properties during the process of self-organization in complex systems. Emergent phenomena are conceptualized as occurring on the macro level, in contrast to the micro-level components and processes out of which they arise.[142]

Immediately we can point to the "macro" quality of emergence as a kind of holism that interests a series of radical theories including cybernetics, systems theory, as well as ergonomics and the field of scholarship that the following chapters will continually gesture towards, Affect theory. Whether dealing with a chemical compound, a weather system, a group identity or a society, the focus is away from constituent individuality and towards a connected whole. Patricial Ticineto Clough and colleagues speaks to this holism when she formulates an argument shifting from the specificity of affective labor to the study of "affect-itself."[143] The authors recognize that the deployment of affect into social theory requires engagement with the scientific foundations that characterize affect, key among them emergence.

> the scientific conceptualization of affect has led social criticism to rethink matter, energy, measurability, value and information on one hand, and on the other, labor power, capitalist productivity and governance.[144]

They go on to note how governance and productivity in the human and specifically neoliberal sense is interconnected with the scientific conceptions of "control on the one hand and indeterminate emergence on the other."[145] Key to

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[142] Jeffrey Goldstein, "Emergence as a construct: History and issues," *Emergence* 1, no. 1, 1999, 49.
[143] Patricia Ticineto Clough, Greg Goldberg, Rachel Schiff, Aaron Weeks, and Craig Willse, "Notes Towards a Theory of Affect-Itself," *Ephemera: Theory and politics in organization* 7, no. 1 (2007): 60-77.
[144] Ticineto-Clough et al., "Affect-Itself," 63.
[145] Ibid. 63.

Ticineto-Clough's et al. argument and the linking of the virtual to emergence is the shift in social theory to thinking about modeling and simulation.

> We will propose that governance is now a matter of pre-emption, but not only to anticipate and control the emergent but rather to precipitate emergence and thereby act on a future that has not yet and may not ever arrive.[146]

The way to precipitate (as opposed to predict or control) emergence is to better understand the "historically contingent identity" of any whole, in other words to understand how things that emerge have tendencies and capacities towards certain behaviors given certain conditions.[147] In desiring precipitation of emergence Ticineto-Clough strongly gestures towards Manuel DeLanda's work on emergence.

The theory of Emergence began, as Manuel DeLanda notes, as an attempt by realist philosophers in the 19th century to, "eliminate from biology mystifying entities like a 'life force' or the 'elan vital.'"[148] What is different in today's (or his) theory of emergence is the epistemological status of emergence. Like earlier vitalists, earlier emergence theorists stopped investigation at the claim that emergence was ultimately un-explainable. With DeLanda's emergence, "it does not have to be accepted as a brute fact but can be explained without fearing that it will be explained away."[149] In other words we neither have to reify emergence or classify and differentiate different general kinds of

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[146] ibid. 63.
[147] Manuel DeLanda, *Philosophy and Simulation: the emergence of synthetic reason* (Bloomsbury Publishing, 2011).
[148] DeLanda, *Philosophy and Simulation*, 2.
[149] Ibid. 3.

emergence, categories like “Life,” “Mind,” or “Deity,” in order to empirically study emergence. Though what has remained the same is the ontological status of emergence as something “objectively irreducible,”[150] the emergent theorist does not have to ask why that is in order for emergence to be useful. DeLanda stresses that studying emergence is tantamount to simulating emergence or recreating emergence or even practicing emergence.

> Simulations are partly responsible for the restoration of the legitimacy of the concept of emergence because they can stage interactions between virtual entities from which properties, tendencies, and capacities actually emerge.[151]

His use of “actually” should be pointed out as DeLanda holds, because of his investment in Deleuze’s notion of the virtual, that a thing need not actually exist to be real, thus the importance and non-representational characteristic of the simulation in the case of emergence theory. Finally, it is clearly not science but rather philosophy for DeLanda, and what amounts to critical thinking in general, that is,

> the mechanism through which these insights can be synthesized into an emergent materialist world view that finally does justice to the creative powers of matter and energy.[152]

The concept of emergence, based on its widespread use, is rich and versatile enough to be a crossroads for many different perspectives. It represents the event of historical change and creative, novel organization that captivates scientists and critical humanists alike. According to Patricia Ticineto Clough, the

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[150] Ibid. 3.
[151] Ibid. 6.
[152] Ibid. 6.

stakes surrounding emergence in a socio-political context are no less than a war between neoliberal technologies seeking to control and prevent emergence—vs. affective and scientifically informed humanities attempting to precipitate the emergence of uncontrollable social arrangements at every turn.[153] It is the recapitulation of the potential for order vs. chaos via technologies that can engender different forms of life. I will have more to say about emergence in the subsequent chapters. It suffices for now to suggest that emergence in its current form would not have occurred without the marginalization of holistic physiological thought and the critical vitalist tendency through the hegemony of Mechanistic thought. It is the beginnings of this hegemony that I turn to next.

Part 3: Descartes or the Hegemony of Mechanism

Though Physiology's official disciplinary history arguably begins in the 19th century[154] it was the weight of Renee Descartes' 17th century work that influenced and antagonized physiology for centuries, even if his work as a proper physiologist had been quickly dismissed. My epistemological thread thus begins with his ideas about human and animal organisms and how his metaphysics, his thought about mind and body pushed his theories of life functions.

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[153] Patricia Ticineto Clough, Greg Goldberg, Rachel Schiff, Aaron Weeks and Craig Willse, "Notes Towards a Theory of Affect-Itself," *Ephemera*, v. 7, 1 (2007).

[154] See Goodfield, June. *The Growth of Scientific Physiology: Physiological method and the mechanist-vitalist controversy, illustrated by the problems of respiration and animal heat* (Arno Press, 1975); Canguilhem, *Ideology and Rationality* (Cambridge: MIT Press, 1988); Zielinski, *Deep Time of the Media* (Cambridge: MIT Press, 2006).

In his study of Descartes' physiology, *Spirits and Clocks: machine and organism in Descartes*, Dennis Des Chene argues first that there is a dearth of study on his contribution to physiological thought compared to his physics or philosophy of mind. Second, he claims that ultimately in Descartes' physiology there is no strong quality to distinguish living from nonliving in nature other than human beings. Nature is reduced to matter and space, and the heat of the animal heart is the same as the heat produced from a fire.[155]

What Des Chene constructively points to is that Descartes produces the earliest mechanistic approach to human life processes, and a severely reductive and "austere" mode of thought, as such was also a highly peculiar mechanistic thinking. Descartes' physiology is derived from his metaphysics, which produced the Cartesian cogito—thus the mind/body split is affixed or transposed to the problem of human verses nonhuman organisms. We can even formulate Descartes' mind body distinction as containing a human/nonhuman distinction though it refers specifically to human mind and body. The body, its capacities, and organs could never be conceived of as exhibiting conscious-like behavior. The body is only ever controlled, acting in the service of the mind. This inconceivability of body/organ volition played out practically in a well-documented dispute between Descartes and physiologist William Harvey on the workings of the heart. Descartes simply could not accept that the musculature of the heart

[155] Des Chene, Dennis. *Spirits and clocks: Machine and organism in Descartes* (Cornell University Press, 2001), 1.

moved without consciousness of the mind, where Harvey, on the other hand had no problem admitting the "unconscious active movement of the body."[156]

Only human beings have souls, and yet the soul or spirit or mind is completely disconnected from the vital operations of the body. Descartes describes bodies as body-machines, which do not live in any strong sense since they have no powers, only passive attributes.[157] "The elimination of the souls of animals and plants is of a piece with the elimination of qualities generally from nature."[158] (1) Self motion, that ultimate quality along with autopoiesis/self-generation, are the touchstones of the distinction of life from matter, and the fundamental problematics for those interested in creating intelligent machines.

However, Descartes' primary desire in his physiology was to account for generation and movement in (animal) life without "appealing to faculties or active powers." In essence he mapped "the phenomena of life onto the behavior of "mechanical things'."[159] Without going too far into the intricacies of Descartes' philosophy, this conflating of mind with life is one of the most significant epistemological fixtures of the modern human sciences which manifests as the assumption that we can extrapolate an inner state of thought from the observation of life processes. It is the significance of Descartes' production of the cogito as a mind/body split, but also of his equally provocative "relegation of the

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[156] Gorham, Geoffrey. "Mind-body dualism and the Harvey-Descartes controversy." *Journal of the History of Ideas* 55, no. 2 (1994): 233.

[157] Des Chene, *Spirits and Clocks*, 2001, 3.
[158] Ibid. 1.
[159] Ibid. 31.

vital powers of the soul to the body alone," as a physiological process, that contributed to the separation of psychology or the cognitive elements of human beings from their physiology.[160]

In Descartes we see the most extreme form of reductionist philosophy as well as a disregard for origins, purpose, or any phenomena other than machinic organism behavior—leading to a philosophy of life that will encourage the development of behaviorism in science. I would like to point out that though Descartes' provided a mechanistic view of life that observed it as so many machines, the power of reduction and explanation that is associated with such mechanistic thought becomes lost precisely because Descartes reintroduced the mystifying figure of a soul into his physiology, one that was always disconnected from body. Physiology then becomes useless to further description or explanation of human life, and so a metaphysical account is required to say anything more. Implicit in Descartes was a theory that precludes meaningfulness from material or vital processes, only representationalist, discursive means may communicate what is in or on the mind.

Descartes' mind over matter distinction translated into the life sciences. This resulted in the treatment of somatic or physiological in animals and humans as merely representations or symptoms of inner immaterial processes, stress, emotion, or ill health. Seen historically this way Descartes' work marginalized physiology as a major scientific field two centuries before it even emerged in

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[160] Ibid. 6.

universities and laboratories. It set up the conditions of possibility, as an enduring and predominate mode of human sciences, for the growing importance of psychological thought in research, industrial, and popular contexts, as well as our current moment of so called neuro-scientific revolution.

Finally, Descartes' physiology, like his metaphysics, strove to leave no room for a human soul/mind with any "suspect relation to matter"[161] In doing so he not only provided a legacy of highly anthropocentric thought but also produced a methodologically "practical" science of physiology in particular which had absolutely no higher or loftier ends beyond the functional measure of normality and health in human beings. However, within a generation his vision of a purely mechanistic physiological explanation would already wane to the reemergence of vitalism, with its scientific disposition towards the uniqueness and *je ne sais qua* of life, and particularly of human life.

Crucially physiology would continue to develop as if Descartes was at most a minor thinker in its history, if not an erroneous and uncomplicated physiologist. All the while his influence to enlightenment thinkers in other fields would continue to grow. As Des Chen concludes, Descartes did not just produce a highly reductive mechanistic physiology, but one that was also highly confused, lacking internal coherence. This was undoubtedly due to his fidelity to the first principles of deduction as opposed to experiment, and to the inner life of the mind that dictated in his physics that machines necessarily "operates solely on

[161] Ibid. 64.

mechanistic principles."[162] This is not necessarily the case with a conception of machines or nonhuman life forms.

Though Descartes' physiological findings would be dismissed in less than a generation and the likes of Gottfried Wilhelm Liebniz would respond to his reductionism and mechanism, ironically with a strong vitalism.[163] Descartes' absolute skepticism of the body and matter and assuredness of the mind's representations would maintain, philosophically in a line leading through John Locke, Berkeley, Leibniz, Immanuel Kant, down to Bertrard Russell[164], and arguably to modern American Analytic philosophy.

It is generally held that the vitalism/mechanism dispute in physiological theory was resolved, to the general disavowal of the idea of a vital principle at work in organisms, in the 19th century, through the work of Claude Bernard. What developed during the 19th century as well was the overall medicalization of an entire side of government in Europe and America, as Michel Foucault observed. He described the complimentary poles of new regulation, the one a biopower that acted on the assumption of a human body as machine, the second, a macro scale biopolitics of regulation of population health and (self) production.[165] Canguilhem added to Foucault's biopolitical insight, observing that the century before physiologists in particular, as they expunged support for vitalism, were

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[162] Ibid. 157.
[163] Ibid. 12.
[164] Justin Lieber, in Mettrie, Julien Offraye De LA, *Man a Machine: And, Man a Plant* (Hackett Publishing, 1994).
[165] Michel Foucault,.*The History of Sexuality: Volume 1: an introduction*, trans. Robert Hurley (New York: Vintage, 1978), 139.

adopting wholeheartedly another concept based on mechanism—animal economy.

Physiologists integrated Hippocrates ancient enduring claim of *medicatrix naturae*, translated as the healing powers of nature. Organisms left to their own physiological processes would heal themselves, which scientists described through the newly adopted concept of regulation, and the result was a conflation of political and economic theory of the day.[166] For it was a large conceptual step from the idea that organisms did sometimes heal themselves of disease to the claim that human beings had physiological self-preserving powers, let alone a picture of nature as supplying a common good through "the autocracy of Nature."[167] It was then a short step for physiology's commentators to extrapolate to society writ large, as Antoine Lavoisier did.

> The moral order, like the physical order, has its regulators: if it were otherwise, human societies would have ceased to exist long ago, or, rather, they never would have come into being.[168]

It is residing in the thought of Thomas Robert Malthus, that Canguilhem finds the most potent allusion to physiological conception of animal economy on a social scale.

> The great vis medicatrix rei publicae, the desire to improve one's lot and the fear of making it worse, has never ceased to guide men in the straight and narrow, despite all the arguments that would tend to make them abandon it. This powerful principle of health…"[169]

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[166] Canguilhem *Ideology and Rationality*, 89.
[167] Ibid. 89.
[168] Ibid. 91.
[169] Ibid. 93.

Along with the beginnings of a conception of a general health care was the medical definition of health or healthy life in individuals and populations.

It was the very adoption of the concept of health, of healthy activities both literal and figurative, that demonstrates not only Foucault's major recognition of a shift to biopolitical register in governance, but also importantly the continued inheritance of' philosophical and scientific legacy. To be sure it was not Descartes alone who established the conditions of possibility for a health-obsessed complex of medical sciences, government, and industry, but, as Foucault reiterated, the philosophical certainty that Descartes' demanded, in the face of the mental ill-health of madness, for example—demanded the implementation of the Cartesian cogito onto the somatic; the mind intervening on the body.

> This absolute awakening, which dispatches the various forms of illusion one after another, was what Descartes had sought at the beginning of his Meditations, and which he had found, paradoxically, in the consciousness of dream, in the consciousness that consciousness was deceived. But in the case of the mad, it was up to medicine to operate the awakening, transforming the solitude of Cartesian courage into the authoritative intervention by a waking person sure of his or her wakefulness into the deceived wakefulness of the lunatic. This was a shortcut that dogmatically cut through Descartes' long path to certainty.[170]

The authority here, the doctor, the researcher, the life scientist, became the "cogito from the outside" with the aid of all her knowledge of healthy human function. As a final word on Descartes' philosophico-medical legacy, it may not

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[170] Michel Foucault, *History of Madness* ed. Jean Khalfa trans. Jonathan Murphy and Jean Khalfa (New York: Routledge, 2006).

be exaggerating, from reading one of his clearest descriptions of his work and method, to claim that his ideas of physiology motivated all the rest of his thought.

> I perceived it to be possible to arrive at knowledge highly useful in life…and thus render ourselves the lords and possessors of nature…this is a result to be desired…especially for the preservation of health, which is without doubt, of all the blessings of this life, the first and fundamental one; for the mind is so intimately dependent upon the condition and relation of the organs of the body, that if any means can ever be found to render men wiser and more ingenious than hitherto, I believe that it is in medicine that they must be sought for…[171]

The idea of health was central to his idea of a practical philosophy that yielded expedient material and physiological results. As this passage shows, there are 3 express concepts in Descartes that are fundamental to his thinking, instrumentalism of thought, mastery of nature, and the regulation of health. This mode of thinking would continue, outside of its philosophical context and into the ideology of science. Particularly in the contexts of the military and in industry the Cartesian instrumental use of reason towards desired ends found a comfortable home. Finally, the above passage hints at the future emergence of biopower and biopolitics. The maintenance of individual health and the governance of a healthy population respectively would result from an underlying thought. The good life, whether spiritual, social, or economic, was always dependent on the basic healthy function of the human organism. As Claire Colebrook argued, the Cartesian "error," meant that generations of humans had been produced continuing to believe they are an, "autonomous, disembodied, affectless and world-divorced subject," and this is the measure of a healthy mind. Instead, to

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[171] René Descartes, *Discourse on Method, optics, geometry, and meteorology* (Hackett Publishing, 2001), 50.

push beyond the mechanistic Cartesian framework Colebrook claimed that we must put, “an end to human exceptionalism and cognition-oriented models,” and conceive of the human, “from one already integrated, dynamic and connected world.”[172] Physiology’s journey out of the Cartesian error began through materialist philosophy with one of Descartes’ peers.

Part 4: Beginnings of Machine without Mechanism

La Mettrie

It was a polemic written in 1748 and published anonymously that would pose the greatest threat to the Cartesian cogito as well as the Christian influence that would support its schisms between man and beast, soul and body. The medical physician Julien Offray de la Mettrie wrote *L’Homme Machine*, *Machine Man*, with the fundamental aim of sketching a “thoroughgoing materialism” based precisely on his study of human medicine, and later claimed to do so, ironically, as an extension of Cartesianism. Claiming such an affinity had the effect of more publicity/circulation for Machine Man, no doubt, but also put scrutiny on the flawed mechanistic thought in Descartes that resulted in the spiritual and immaterial priority given to the status of humans. The generally accepted positioning of La Mettrie is as a contemporary advancing Descartes’ work on the

[172] Claire Colebrook, *Death of the Posthuman: essays on extinction, vol. 1* (Ann Arbor: Open Humanities Press), 20.

mechanism of life processes[173], however, his singular desire to obliterate a meaningful soul as a feature of life altogether puts La Mettrie in direct contradistinction to Cartesian Metaphysics. La Mettrie proposed what Descartes' "sleight of hand" dualism[174], his followers, and society at large could not, that human beings animals, and matter generally, were all on equal footing as machines. Philosophically he produces a sustained materialism which destroys epistemological dualism by bestowing souls to all animals.[175] This was the particular danger of physiological thought as it opened up serious comparison physically first but then by extrapolation socially and politically, between man and beast.

La Mettrie's practical examples and empirical evidence, in short his entire method for producing materialism, was based on physiological discovery. He mentions the rudimentary divisions of brain and its functions by Thomas Willis, for example as evidencing that mind or thought[176] are properties of matter. He uses the explanation by William Harvey, who is considered the founder of modern physiology, of the circulation of the blood and the heart as system of pump and tubing, and Italian physiologist Marcello Malpighi's microscope discoveries—in doing so situating his philosophical machine-man within the

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[173] Thomas S Hall, Ideas of Life and Matter: Studies in the history of general Physiology (Chicago: University of Chicago Press), 1969.
[174] Ibid. 14
[175] Julien Offraye De La Mettrie, *Man a Machine: And, Man a Plant* (Hackett Publishing, 1994), 76.
[176] This was the case for the soul as well because it too was located in the head.

physiological and technological changes that allowed humans to view mechanism at work in their own bodies.

However, La Mettrie's entire schema or mode of observation was constituted by the strong comparative nature of Physiology that was developing in the 18th century. Scaling from most basic to complex machine and from the largest (the 18th century astronomical galaxy) to the smallest, (the cell), the figure of man could be compared to and conceived of as anything else. A polyp, animal corpuscle, the inside of a clock, a furnace, or a plant, all of these could be used to think through human life and its constitution.

The underlying theoretical belief within La Mettrie's work[177] was that all matter contains sensitivity and motive force, which we observe as adaptation and motion in living organisms. This philosophical position that questions of mind or the "why" of life need not go beyond matter was one that was being worked through in physiology of the time in the work of Albrecht von Haller, who had developed his theory of irritability in muscular tissue and sensibility in nerve tissues. Haller's theory amounted to a basic claim that force or volition was located in living matter instead of a mind, will, or soul. The extent to which La Mettrie was committed to provocation of man machine was called into question from the outset as he was not associated with mechanics/physics, and by the fact that he also published Man as a Plant, drawing strong lines of affinity with organic bodies. While displaying the metaphor of the machine writ large La

[177] La Mettrie saw his own materialism as synonymous and fully compatible with the immanentist philosophy of Baruch Spinoza. Julien Offray de La Mettrie, *Man Machine and Other Writings*. Edited by Ann Thomson. Cambridge University Press, 1996, Translator's introduction, xiii.

Mettrie "was inclined to see life in all things," and, in line with the Spinozist philosophy he publically espoused, produced not a physicalism, but a panvitalism into physiology.[178] The strongest refute of La Mettrie's connection to Descartes' mechanistic thought emerges when he wrote "'The author of Machine Man seems to have written the book to defend this sad truth' (That the human being is an automaton)."[179]

However, just as La Mettrie's Machine Man and Haller's theory that informed it were approaching an independent mechanistic way of understanding life, the question of immaterial causes quickly threatened its viability. The dilemma for La Mettrie was whether such force/sensitivity existed in the smallest isolated bits of living matter, or that it was the particular organization of some matter and not others that resulted in life. So, on the one hand the molecule was in some sense "alive" in the same way that the body it constitutes is. On the other, if particular organization of matter gives it life, then Machine Man fails on a basic explanatory level to tell us why, for example, the primary characteristic which compels humans to elevate themselves above inert matter and plant and animal life—thought—is acquired in brain matter. This is an ignorance La Mettrie "freely admits."[180]

His conclusion that man was a machine was symptomatic of a larger scientific and philosophical position. La Mettrie theorized all life, based on his

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[178] Des Chene, 2001, 12.
[179] Julien Offray de La Mettrie, *Man Machine and Other Writings*, ed. Ann Thomson (Cambridge University Press, 1996), Editor's introduction, xiii.
[180] Ibid. xxiii.

observation of physiological processes that there was "in the whole universe only one diversely modified substance."[181] Where Cartesian physiology foreclosed on matter as an answer to life processes and human consciousness, La Mettrie concluded that those immaterial and representational aspects associated with organisms—thought, identity, and human or animal will, were all bound up in their physical machinery. In La Mettrie was a form of materialism that saw an affinity among human, animal, and plant bodies.

Purkyne and the agency of Organs

The singular object of health is important to Zielinski's understanding of physiological theory, and he provides a 19th century counterexample, in the work of Jan Evangelista Purkyne, to the hegemony of physiology at the time, as well as a fidelity to healthy functions in humans.

It was Zielinski's precise observation that physiology, as it has pertained to human perceptions of their bodies and of machines, had been on a very different path even in the 16th century. The line of natural philosophy, that speculative practice taught in the university that Descartes sought to diverge from with his practical philosophy, bridged the ancient and the modern in Purkyne.

> From Empedocles to Lucretius to Porta in his Magia naturalis. All of these thinkers still viewed physiology as identical with "investigation of the phenomena, forces, and laws of nature in all its domains."[182]

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[181] Ibid. xxiii.
[182] Siegfried Zielinski, *Deep Time of the Media: Toward an archaeology of hearing and seeing by technical means*, trans. Gloria Custance (Massachusetts: MIT 2006), 54.

Zielinski found in Purkyne a contravening physiological standpoint, as Purkyne began each experiment with

> the assumption that each human sense is an "individual," he ascribed to each sense organ a life of its own, both with regard to perception of external reality and its production of phenomena independent of external reality.[183]

The first effect of Purkyne's work, as Zielinski explained, is that of a complete decentralization of the working nervous system and with it the de-prioritizing of the brain/mind to the now separated and autonomous sense organs. The second was that the observation or experimentation with the physiological was to Purkyne a wholly material experience—without any reliance on a mechanistic one. The visual organ was not observed as a machine but rather as an "animal within the animal."[184]

His work on the human visual faculty, for which he was most renown, observed the act of seeing as much more an auditory, vibrating, tactile event than a visual reflective and representational one. Against an entire tradition of Optics, Purkyne's human eye was not a passive receptor of light, but rather an active organ of vibration. Producing Augenmusik or eye music, the eye works by sense of touch and also becomes the site where memory and imagination occur. Purkyne's work on vision thus also de-centered the priority of the eye in science and popular culture as well. Media determine our situation, perhaps, in ways Friedrich Kittler did not intend. According to Purkyne, the visual apparatus did not work as a camera, camera obscura, or the moving image machine that was to

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[184] Zielinski, *Deep Time of the Media*, 200.

come—it was more akin to a stringed instrument or a drum that needed physical contact to in order to function or play.

As far removed from mechanistic physiology as Purkyne's work was, it retained one shared characteristic: the nonhuman organism, whether an animal, plant, or organ was still treated as an object that could be isolated and studied objectively. This, again would have something to do with a particular theory of communication within physiology and scientific that was not available to him. A mode of communication between humans and nonhuman organisms that would allow the nonhuman to be a subject in the world had yet to be conceived.

Goethe, Gestalt, and Communication between a Whole and Parts

Johann Wolfgang Goethe, known much more for his prolific literary writing, was also a practitioner of botanical experiments and developed from it a general physiological theory. He claimed that, "the human being himself, to the extent that he makes sound use of his senses, is the most exact physical apparatus that can exist." Goethe thus apprehended a concept of observation that would be developed similarly many years later in cybernetics.

It is why he wrote an essay called "The Experiment as Mediator of Object and Subject" and argued for a mode of science that was primarily experiential or phenomenological in nature. In it he also suggested that on a basic level the scientist must be highly aware, "reflexive" if you will, of one's own subject in the

role of observation.[185] Like Purkyne, who had literally put the scientist into his study by experimenting on himself, Goethe described the scientist or observer as being a part of the experiment he observed. This was an important step away from an "objective" rational mind divorced from the world it observed. It also marks a strong precursor to the cyberneticians, spurred by Heinz Von Foerster who would over a hundred years later theorize reflexivity as the most important factor in scientific observation.

Goethe concludes, inimically to enlightenment conception, that any experiment, any object we encounter is first and foremost an individual entity not to be deduced from or extrapolated to another object, lest we fall into error.

> "We conceive of the individual animal as a small world, existing for its own sake, by its own means. Every creature is its own reason to be. All its parts have a direct effect on one another, a relationship to one another, thereby constantly renewing the circle of life; thus we are justified in considering every animal physiologically perfect. Viewed from within, no part of the animal—as so often thought—is a useless or arbitrary product of the formative impulse.[186]

Friedrich Kittler took Goethe's literature to be exemplary of the discourse network of 18th century and the writing medium that determined life and language of the time. Though perhaps Goethe's physiological writings expressed something different, not human life that was coded through language and technical objects (media), but life, in general as technical object that produced and distributed itself through mediation. Finally, Goethe's work culminates in a fundamental idea that

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[185] Johann Wolfgang Von Goethe, *Scientific Studies*, ed., trans. Douglas Miller (New York: Suhrkamp Publishers), 1988, 12.
[186] Goethe, *Scientific Studies*, 121.

will be shared by physiologists, cyberneticians, and ermergence theorists alike—the Gestalt. Gestalt, translated simplistically as shape or form, is popularly characterized as a complex form that is more than the sum of its parts. Goethe introduced it thusly, first for how it is generally use by Germans and then for the purposes of his scientific use.

> the complex of existence presented by a physical organism…With this expression they exclude what is changeable and assume that an interrelated whole is identified, defined, and fixed in character. But if we look at all these Gestalten, especially the organic ones, we will discover that nothing in them is permanent, nothing is at rest or defined---everything is in a flux of continual motion.[187]

With this description Goethe introduces a scientific study that is not so much about identifying shape or structure, as the terms gestalt and morphology, which is what he calls his method, would suggest. Instead it is about observing the constant flux of processes of creation or emergence. For Goethe, as it would be the case for systems theorists and cyberneticians generations later: the continual motion or behaviors within an organism, what might be called its contingent identity, was never fully defined by its constituent parts. At the same time the identities of its parts were never fully defined or fully controlled by the organic whole they were working within. In concluding on the question of life he said the following:

> No living thing is unitary in nature; every such thing is a plurality. Even the organism which appears to us as individual exists as a collection of independent living entities. Although- alike in idea and predisposition, these entities, as they materialize, grow to become alike or similar, unalike or dissimilar.[188]

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[187] Ibid. 63.
[188] Ibid. 64.

Within Goethe were all the elements needed to push forward to cybernetics and systems approaches to the study of humans and machines, where they could each be seen as autonomous "independent living entities."

Part 5: Conclusion:

Uexkull, Physiology ushers in Environment, Systems and Cybernetics

It was not until the turn of the 20th century, when a young German scientist would begin his work based on the idea that biological science had it all wrong in modeling itself after physics and chemistry.[189] What was necessary was a strong theorization of how the nonhuman communicates itself to human beings. Jacob Von Euxkull shared Purkyne's characterization of nonhuman phenomena as subjective in their behavior. However, he further developed his physiology with two key concepts, Umwelt or "environment" of an organism, and purpose. He used Umwelt to mean the perceptual world, the space and time of any particular organism. On the description of an environment Uexkull states that,

> The animal's environment, which we want to investigate now, is only a piece cut out of its surroundings, which we see stretching out on all sides around the animal—and these surroundings are nothing else but our own, human environment.
> The first task of research on such environments consists in seeking out the animal's perception signs and, with them, to construct the animal's environment.[190]

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[189] Brett Buchanan, *Onto-ethologies: The animal environments of Uexkull*, *Heidegger, Merleau-Ponty, and Deleuze* (New York: Suny Press: 2008).
[190] Jacob Von Uexkull, *A foray into the world of animals and humans, trans. Joseph E. O'Neil* (Minneapolis, University of Minnesota Press), 53.

Uexkull is positing that fundamentally observation in science is neither objective, nor a passive apprehension of reality, but rather, constructive and active. His work will continue to posit that animals, in their own perceptual worlds, are similarly active and constructive in their sensations. Key to understanding living organisms is, for Uexkull, a matter of identifying two characteristics, its perceptual and its functional properties. An organism's perceptual side is based on the perceptions it produces in the human who observes it, so, as he states, a bell would not produce a ringing sensation without a human to hear it even if it was moved by the wind. However, the function of the bell as a thing that meant to ring cannot be disputed as its functional quality.

Purpose is key to his physiological understanding of what can be observed in the universe, as there is nothing living or nonliving matter that exists without a function built into its particular form. The importance of understanding purpose in terms of subjectivity will lead him to claim that "plan versus matter is the watchword of the new science of life."[191] Function exists for Uexkull as a harmony between matter and its form such that living and nonliving matter cohere in very particular configurations. He deliberately used harmony, and continually referenced the sonic/aural in his work, because Uexkull fundamentally understood the variety of sensations beyond the visible in nature as well as the recognition that the massive variety in temporal/spatial scales of environment exceeded the explanatory powers of visual metaphor.

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[191] J. V Uexkull, "The New Concept of Umwelt: a link between science and the humanities," *Semiotica* 134, no. 1-4 (2001), 122.

His physiology began with the perceptual sign as its most basic unit, a unit of perception marked with purpose. Within a tick's environment and within a tick's own body are ubiquitous perceptual signs being sense-read by said tick, its singular sense of smell, butyric acid, temperature, its host, etc. Additionally, beyond merely representational and formalist discourses, the scientist needed to identify these signs as the tick would recognize and react to them. Thus Uexkull's purposeful environment would mark the beginning of bio-semiotics, the inscription within nature. These "perception-signs" Uexkull takes to be features of reality that can be counted on by the observer. We discover objects based on the four senses wrapped around us like four envelopes, or an island.[192]

> Although we are not familiar with the sensations of our fellow human beings, we do not doubt that they receive seeing signs by means of their eyes which we call colors, and we doubt just as little that they receive hearing signs by means of their ears which we call tones. By the same right, we ascribe to their noses the ability to awaken smelling tones, to their palate to awaken tasting signs, and to their skin to awaken touching signs, which, one and all, consist of self-tones. We summarize all these qualitatively different sense signs under the name "perception signs," which, transposed outward, become perception marks of things.[193]

Organisms, objects, and environments were all capable of producing this perception signs. In fact, there was no choosing not to create signs within an environment. The simplest acts of living, growing, moving, and changing resulted in signs that could be experienced by another subject. Though Uexkull expected work of the life scientist to be free from anthropomorphizing the animal umwelt

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[192] J Von Uexkull, "An introduction to Umwelt," *Semiotica* 134, v. 1/4 (2001): 107.
[193] Von Euxkull, *A Foray into the World of Animals and Humans*, 164-5.

and to maintain the rigor and accuracy expected from science,[194] the radically subjective nature of the umwelt he proposed immediately problematized those goals.

> The kind of structure of the environments is also decided thereby, for every subject can only transform the perception signs that are at his disposition into the perception marks of his environment.[195]

Though the scientist must construct an organism's environment as if she were able to be in its environment as itself, she is limited to her human environment of senses.

Uexkull deployed both environment and purpose to advance as much as he could the idea that nonhuman organisms are subjects that perceive their worlds where those worlds are as many as there are organisms, every single one differentiated from "our" human world.

> We comfort ourselves all too easily with the illusion that the relations of another kind of subject to the things of its environment play out in the same space and time as the relations that link us to the things of our human environment. This illusion is fed by the belief in the existence of one and only one world, in which all living beings are encased. From this arises the widely held conviction that there must be one and only one space and time for all living beings.[196]

While his theory provided for both an empirical observing/experimenting of the senses it also acknowledged that based on its individuating subjectivism, that the human scientist would be made aware at every stage of observation that she is not a tick, that a tick does not even live in her world. What is implied in Uexkull's

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[194] Buchanan, *Onto-Ethologies*, 8.
[195] Von Uexkull, *Foray into the World of Animals and Humans*, 166.
[196] Ibid. 54

work is acknowledgement of the inescapability of our being human, of our making nonhuman things human, which Jane Bennett, in her laying out of a vital materialism, counts as a good thing when she claims that, "a chord is struck between person and thing. And I am no longer above or outside a nonhuman 'environment.'"[197]What is present in Uexkull's physiology that is absent, to varying degrees, in all the above mentioned physiologists, is an attempt at understanding life processes, without hierarchical or reductionist observation, as a form of communication. His was the most fully realized physiological science that was both integrative (in that it saw organism with environment) rather than reductionist, and comparative rather than isolating. In addition, his theory of purposeful environments and organisms did not rely on Darwinian concepts of adaptability and species success, in fact Uexkull was unconvinced by merely evolutionary bases for life.[198] Instead, he felt that the study of life meant the observation of different species in various environments all of whom produced and read the "signs" of nature.

Uexkull is considered to be a crossroads for many other firsts in radical forms of knowledge. As mentioned he is credited as pioneering biosemiotics, as being a "crypto-semiotician" which he may have had some idea of himself when writing that his concept of umwelt was a "bridge between science and the humanities."[199] He is credited also with influencing Ludvig von Bertalanfy, whose

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[197] Bennett, Jane. *Vibrant matter: a political ecology of things* (Durham: Duke University Press 2009), 120.
[198] Buchanan, *Onto-Ethologies*.
[199] Von Uexkull, "Umwelt: an introduction."

creation of his general systems theory would later influence Niklaus Luhmann. Systems Theory would be in a mutually influencing relationship with Cybernetics and would be visible as the explicit “systems approach” methodology of ergonomics starting in the 1960’s.

I ended with Uexkull because he has such a strong connection with Cybernetics as one of its most direct precursors. We should note that while it would emerge at mid-century with the digital computer and the automation of machines, cybernetics theoretical link to physiology and organisms of flesh and blood were just as strong. Uexkull’s influence is summed up in his introduction to his most influential work, “A Foray into the World of Animals,”

> From this, we can conclude that every living cell is a machine operator that perceives and produces and therefore possesses its own particular (specific) perceptive signs and impulses or "effect signs" ["Wirkzeichen"].[200]

In addition to setting up the study of machines as organisms that cybernetics will produce, Uexkell’s passage expresses the non-mechanistic, holistic and integrative conception of organisms that cybernetics would inherit. Cells of the body are not its molecular or constituent elements but are, just as the whole organism, operators or subjects that perceive and act based on external signs.

Decades after Uexkull another radical physiologist from Mexico, Arturo Rosenblueth together with Norbert Weiner would define Cybernetics in “Behavior, Purpose, and Teleology” which would kick off the first Macy Conference, and set certain events and knowledge productions into motion. The

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[200] Jacob Von Uexkull, *A Foray into the World of Animals*, 47.

first cyberneticians, including Norbert Wiener, Walter Pitts, and Warren McCulloch, "considered cybernetics as a branch of physiology" and "modeled computers to match physiology—all this in 1943."[201] Years earlier Uexkull had entertained the "converse but not opposite idea" that the functions of living organisms could be modeled using theories of machines,[202] for the purposes of entertaining a subjective experience of other species, opening up a foray into the world of the Other.

> There is also the manifold of environments, in which things repeat themselves in always new forms. All these countless environments provide, in the third manifold, the clavier on which Nature plays her symphony of meaning beyond time and space.[203]

This will be discussed in the following chapter where we will understand why it was that Norbert Wiener claimed that "organism is seen as message"[204] or that Warren McCulloch would attempt to use Cybernetics in order to construct a "physiological theory of knowledge."[205]

Chapter 3: Cybernetics or Nonhuman Ethics/Subjectivity

Introduction:

This chapter describes cybernetics the second element of the triad (Physiology, Cybernetics, Ergonomics) constituting what I call a posthuman

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[201] Lagerspetz, "Uexkull and the Origin of Cybernetics", *Semiotica* 134 n. 1/4 (2001): 648.
[202] Lagerspetz, "Uexkull and the Origins of Cybernetics," 643.
[203] Ibid. 207.
[204] Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society*, (Da Capo Press, 1988).
[205] Warren McCulloch, *Embodiments of Mind* (Cambridge: MIT Press, 1988)

matrix of vital machines, Cybernetics. In the previous chapter I characterized physiology, with its archaeological links to natural philosophy and its theoretical resistances to Cartesian mechanistic philosophy, as the foundation for a posthuman epistemology. It is a mode of knowing the co-constitutive affections between matter and life and a framework providing vital powers in an empirical, not mystical sense—one that conceives life beyond human scale into an ecological or cosmic scale.

If the significance of physiology is as a posthuman epistemology, then the importance of cybernetics as this chapter attempts to show, is that of a posthuman Ethic. The two unique readings that an ethical account of cybernetics will show are: 1) cybernetics has been more concerned with processes of life and organism that computing and automation. 2) This discussion will ask, as Michel Foucault did of the Ancients in his last works, what is the "ethical substance" or the foundation which techniques work on? For cybernetics the substance where a machine ethics begins includes self-reflexivity, self-governance, and recognition of a system, which led both to freedom and responsibility. Where a machine ethics ends is the larger narrative this chapter builds towards in the practice of Ergonomics.

Where in the previous chapter I was interested in the archaeological thread of physiological knowledge that expressed both a vitalist tendency as well as an openness to machines, in this chapter I provide a historical look at cybernetics as a "genealogy of problems, of problematiques," as Michel Foucault

described his genealogical approach.[206] This genealogy appears as fragments from the middle of the twentieth century, when "modern" cybernetics, characterized as related to information theory, digital computers, and the cold war, is generally thought to have emerged. The chapter also considers threads from the 19th century as well as from ancient Hellenistic and Roman cultures from which the etymology of cybernetics derives. My chapter considers the writings of cybernetician's working during the 20th century such as Norbert Wiener, Warren McCulloch, Heinz Von Foerster, and Gregory Bateson, particularly those writings that exceed a scientific or explanatory model for cybernetics as a theory of knowledge. There is another reason I use the term genealogy. When explaining his method of genealogical interpretation, Michel Foucault said that three domains were possible for genealogy, knowledge, power, and subjectivity. Foucault claimed that genealogy could provide a "historical ontology" of how subjects constituted either as knowing subjects; subjects who act over others, or as subjects that constitute themselves through ethics.

Two things strongly connect all the cyberneticians I discuss. One is a strong commitment to explore the limits of cybernetics into their respective fields of knowledge. That is to say, not satisfied with the strict application of cybernetic theories to real world machines, cyberneticians engaged in imaginative thought experiments on abstract machines. In order to push machine subjectivity to its

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[206] Michel Foucault, *The essential Foucault: selections from essential works of Foucault, 1954-1984*. Ed. Paul Rabinow, and Nikolas S. Rose (New Press, 2003),114.

outer threshold they engaged not only in formal modeling but also in the kind of philosophical simulation that Gilles Deleuze called the virtual. As

The second, and what I believe is a key feature of cybernetic thought is that each of them had throughout their work thought and wrote vigorously—in excess of scientific discourse—about the ethical and metaphysical implications of cybernetics. In short, I argue that the founding cyberneticians had recognized early on that cybernetics was problematic, dangerous, or precisely, as what Michel Foucault characterized, a "'problematization'—which is to say, the development of a domain of acts, practices, and thoughts, that seem to me to pose problems for politics."[207] This chapter suggests that this problematization had little to do with "Control and Communication in the Animal and Man" as a formal or predictable formula, nor was it concerned with the solutions to cold war logics of operations research, or to command-control-communication-intelligence (C^3I) as many commentators have suggested.[208]

Instead, I argue that their writings provided the beginning of a radical theory of machine-subject, one that was formed with the politico-ethical consequences of a possibility for new subject formations which the theoretical machine of cybernetics had illuminated. This chapter also describes the 19th century etymological route of English "cybernetics" as it was coined for an encompassing theory of government in French political thought. Additionally, I focus on its ancient register and Greek etymological route, of "navigation" or

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[207] Michel Foucault, *The Essential Foucault,* 114.
[208] Donna J Haraway, *Simians, Cyborgs, and Women: the reinvention of nature* (New York, Routledge), 2013.

"steersman" (Kubernetes)—especially, as I will conclude, through the late work of Michel Foucault on ancient subjectivity.

Cybernetics or designing ethics

In 1973, the British cybernetician Stafford Beer was commissioned by newly elected leader Salvador Allende to move to Chile and design a computer controlled socialist state. The goal was to create project "Cybersyn" or cybernetic synergy, which was to be the first ever functioning computer network used for socio-economic management on a national level.[209]

This was far from the first time that a cybernetician had attempted to take the science of machines and apply it to human issues. Or more accurately put, Beer's and Allende's project was but one in a long line of deployed cybernetics in order to create a better world. As president Allende stressed for his socialist cybernetic government, it must be "decentralizing, worker participative, and anti-bureaucratic…"[210] And when,

> Beer finally reached the top level of his systematic hierarchy, the place in the model Beer had reserved for Allende himself, the president leaned back in his chair and said, "At last, el pueblo".[211]

El pueblo or "the people" as a Chilean Spanish colloquialism, this was, at least, the plan or design for Allende's cybernetic social-democracy.

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[209] Eden Medina, "*Designing Freedom, Regulating a Nation: socialist cybernetics in Allende's Chile." Journal of Latin American Studies* 38, no. 3 (2006), 572.
[210] Medina, *Designing Freedom*, 572.
[211] Ibid. 573.

Anthropologist Gregory Bateson had, beginning at least as early as the 1950's developed a cybernetically informed theory of mind and psychoanalytic therapy. For him, cybernetics was the corrective to the Cartesian cogito, it was the necessary reunification of Mind with Nature. The separate and privileged mind was tantamount to an ecological disaster resulting from our continued use of an obsolete system of thought, and he on more than one occasion spoke to his board of regents about the perils of turning away from a cybernetically informed university pedagogy.[212] In his introduction to "Cybernetics: or control in the animal and the machine" Norbert Wiener claimed that the ultimate answer to avoiding catastrophe "of course, is to have a society based on human values other than buying or selling." This he said was the reason that he first shared his information and work on cybernetics to the Labor Unions of the United States.[213] Margaret Mead, who along with then husband Gregory Bateson helped put together/host the first Macy Conference on Cybernetics, wanted to first understand the effects of cybernetics on American society.[214] She then deployed cybernetic theory in hopes that distant cultures could not only be understood but also predicted in cultural production. Her attempt with cybernetics was nothing less than an empirical cultural studies at the beginning of the Cold War. The results of which can be seen in her monograph, "The Study of Culture at a

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[212] Gregory Bateson*, Mind and Nature: a necessary unity* (New York: Dutton), 1979.
[213] Norbert Wiener, *Cybernetics or Control and Communication in the Animal and the Machine* (Massachusetts, MIT Press), 1965.
[214] Heinz Von Foerster, "Ethics and Second-Order Cybernetics," In *Understanding Understanding,* (New York, Springer, 2003), 288.

Distance." Calling it a "manual," Mead combined the methods of historian and anthropology in order to practice,

> Interdisciplinary research practices as they apply particularly to the study of cultural character structure in cultures that are spatially or temporally inaccessible.[215]

The importance of Mead's early work as a cybernetician cannot be overemphasized and those engaged in the combining of posthuman studies with the study of sociological or cultural studies would benefit further investigation of her systems method that was informed by,

> dynamic psychology, especially as practiced clinically; studies of growth and development, including concepts drawn from embryology; studies of constitution and temperament; learning theory; experiments in change; theories of group behavior, ecology, and cybernetics.[216]

These cyberneticians' efforts represent the enduring problem for cybernetics—the attempt to apply machine theories to a social or human domain. The idea of "designing" better ways of life for humans with the use of technology quickly opens itself up to criticisms of technological determinism as well as anti-democratic governance. The critique generally breaks down along the lines of de-generated possibility for true "human" communication in such instances of technological interference. The idea could be one of the seductive but incomprehensible speed with which machines produce and circulate spectacular images that short-circuit human deliberation and decision making. Likewise machines are seen as perpetuating a transmission rather than ritual model of

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[215] Margaret Mead and Rhoda Metraux ed. *The Study of Culture at a Distance* (Berghan Books 2000) 5.

[216] Mead and Metraux, *The Study of Culture at a Distance*, 19.

communication—whereby the extension of messages across geography allows greater control over geography and people.[217] Gilles Deleuze frames the fearful position of human freedom in the Control Society where technological machines design life based on the movements of capital. Because of code, the digital language of machines along with the imperative for controlled access to information, "'Individuals become'" "'dividuals,'" and masses become samples, data, markets, or "'banks.'"[218] Alexander Galloway observed that this risk was not lost to the liberal humanist Norbert Wiener even as he developed and diligently publicized cybernetics after WWII. Wiener wrote with a regular fear of "general social exploitation" whether it came alternatively from the recently defeated fascist regime or a "more bullish American Capitalism."[219] Given the most recent dire results of technological design, namely in the Obama administration's deployment of the drone as a fully operational warfare strategy or the National Security Agency's utilization of web infrastructures for the mass collection of individuals' private information—I understand the need for pause.

However, critiquing structural inequalities or the domination of one group by another and attempting to "save the technical object"[220] that is caught up in that domination do not have to be mutually exclusive. In fact the point of recognizing the power of technologies lies in recognizing resistance in those

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[217] James Carey, "Cultural Approach to Communication," *Communication as Culture, Revised Edition: essays on media and society* (New York: Routledge, 2008), 5.
[218] Gilles Deleuze, "Postscript on Control Societies," *Negotiations*, (Columbia University Press, 1995), 180.
[219] Alexander Galloway, *Protocol: how control exists after decentralization* (Cambridge: MIT press, 2004), 107.
[220] Gilbert Simondon "Save the Technical Object," *Esprit* 76, 04 (1983).

materials and processes thought at first to be predictable and easily controlled. Galloway recognized the philosophical possibilities in Norbert Wiener wcith this observation:

> Yet I would argue that the proximity between man and machine in late twentieth-century life has more utopian possibilities in Wiener's thought than it has derisive possibilities. Wiener is important because he valued the contingency of matter, be it man or machine. He recognized that material reality is the most important thing and that, contrary to a more static Newtonian view of matter, it can change. The self-determinism of material systems is therefore the essence of cybernetics, and it is a positive essence, one that also reflects the positive potential of protocological organization.[221]

Galloway's passage reflects a recent engagement with cybernetics for its philosophical and ethical contributions rather than anything it might have to say about digital culture per se. His reading of Wiener's work is a valuable reinterpretation deploying cybernetics as a materialist and realist philosophy rather than a formalist, mathematical approach to machines. Finally, Galloway highlights a critical insight in cybernetics that has been picked up by new materialists and affect scholars, namely the agency of material objects. The "self-determinism of materials systems," has become a productive way to rethink human systems of power and social change, particularly those that rely so heavily on technological infrastructures and mediated communication. Objects, machines, communication networks, and bodies all act in unexpected ways that result in larger novel formations that cut across political and cultural contexts. Gilles Deleuze's theory of the assemblage comes to mind as a descriptor of these novel systems of disparate forms of matter and life. Galloway reminds us in

[221] Galloway, *Protocol*, 107.

his passage that this kind of radical thinking, a theory of subjectivity existed in the experimental sciences in America at least since the 1940's. As the rest of my chapter illustrates, Wiener and the other cyberneticians were themselves accessing and modifying a conception of material agency that preceded them by a century.

Contribution of Chapter

In this chapter I hope to provide two important contributions to critical media studies. In her entry on cybernetics for "Critical Terms for Media Studies," N. Katherine Hayles contends that the "connection between media studies and cybernetics is prefigured by Gordon Pask's definition of cybernetics as the field concerned with information flows in all media, including biological, mechanical, and even cosmological systems."[222] First, it provides further context on why scholarship concerned with governmentality studies and biopolitical theory specifically, and theories of subjectivity generally, should begin to see cybernetics as less concerned with digital culture specifically and more concerned with the politics of the self-regulation of organisms.

The conceptual distinction between the first cybernetics to emerge in the 20th century and the next generations should be of particular interest to media scholars as it resonates with discourses of technology, governmentality and biopolitics. N. Katherine Hayles illustrates succinctly the historical division between a first order and second order cybernetics that was characterized

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[222] N. Katherine Hayles, eds. Mitchell, WJ Thomas, and Mark BN Hansen, *Critical Terms for Media Studies* (University of Chicago Press, 2010), 57.

through reflexivity.[223] This categorization she borrows from Heinz Von Foerster, who claimed that a cybernetician was neither objective nor apart from the system she observed and thus,

> the cybernetician, by entering his own domain, has to account for his or her own activity. Cybernetics then becomes cybernetics of cybernetics, or second-order cybernetics.[224]

This meant that cyberneticians from roughly 1960 on included the hypothetical observer within any biological or technical system being observed. Hayles characterizes a third or contemporary order of cybernetics that she characterizes as "virtuality." This phase of virtuality is to Hayles particularly important to media (studies) because, "media are important primarily for their differential capacities to store, transmit, and process information." Additionally cybernetics treats both human and animal bodies, namely organisms as media since they also act as storage, retrieval, and transmission devices. Media scholars Mark B. Hansen and Bruno Clarke argue that there are only two orders of cybernetics first order and neo-cybernetics, which begins with Hienz Von Foerster's "Cybernetics of Cybernetics." Importantly Hansen and Clarke similarly characterize the first iteration of cybernetics as a "technoscience of communication and control."[225] The differences between First order and Second order or Neo-cybernetics had as much to do with their historical contexts and disciplinary participations as it did their conceptual differences. First order began,

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[223] Hayles, "Cybernetics."
[224] Heinz Von Foerster, *Understanding Understanding: essays on cybernetics and cognition* (New York: Springer), 289.
[225] Bruce Clarke, and Mark BN Hansen ed., *Emergence and embodiment: New essays on second-order systems theory* (Durham: Duke University Press, 2009), 2.

> a base connecting biological and computational systems by way of information theory and communications technology. cybernetics was academically mainstreamed under the names Artificial Intelligence (AI) and, more broadly, computer science in the service of command-and-control systems.[226]

Two things marks neo-cybernetics as distinct from first order, 1) the passage of time and distancing from the context of WWII and so called "command control" research programs; 2) the circulation of cybernetics principles into other academic areas including the social sciences, the humanities, and of course the life sciences. What resulted conceptually was a general shift from the figure of homeostasis that worked to solve instrumental communication problems such as target tracking and guiding munitions—to the figures of emergence and autopoiesis.[227] [228] The object for first order cybernetics was the abstract machine and "was theorized as an entity distinct from the environment in which it was embedded"[229] ostensibly so that it could be instrumentalized—designed, controlled, and governed from its outside. On the other hand in Hansen and Clarke's account for "neo-cybernetic" scholars the machine is embodied, alive, and always emerging within a larger system or environment. Though it is interconnected with environment the neo-cybernetic emphasis is on its individual

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[226] Ibid. 2.
[227] Hansen and Clarke, "Neo-Cybernetics," 5.
[228] Humberto Maturata and Matthew Valera, *Autopoiesis and Cognition: the realization of the living.* (London: D. Reidel Publishing Company, 1980). "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 (H) 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." (78-79)
[229] Hayles "Cybernetics," 147.

ability to emerge, organize, and maintain itself. We can see in first vs. neo-cybernetics two distinct form of governance with respect to machine or organism and it bears more than a passing resemblance to the historico-political shift sketched out by Michel Foucault as the movement from Liberalism to Neoliberalism.

The trajectory of cybernetics from an industrial and scientific regime to a framework for individual action follows nicely Michel Foucault's trajectory of historical inquiry that "shifted from technologies of power and domination" to the ways "a human being turns him- or herself into a subject."[230] Media scholars have for years taken media forms—representations, discourses, and communication technologies—as communicative forms people actively use and participate in for the purposes of producing and managing their identities. Michel Foucault described governmentality as the point of contact between technologies of domination of others and technologies of the self.[231] Toby Miller summarized the formation of governmentality in U.S. cultural studies. In it he suggested that a particular formation interested in Foucault and specifically Governmentality in U.S. Communication and Cultural Studies scholarship served as a corrective to the liberal/conservative paradigms in the field. He also claimed that unlike humanism that "underpins" a liberalist framework,

> studies in governmentality do not begin from the presumption of a

[230] Michel Foucault, *Technologies of the self: A seminar with Michel Foucault* (University of Massachusetts Press, 1988), 19.
[231] Foucault, *"Technologies of the Self,"* 19.

> fully-formed human, preferring instead to see what defines and animates that subject.[232]

Jeremy Packer writing in the same special issue observed that governmentality as it pertains to studying communication technologies is valuable for,

> the importance of communication as a means for organizing not just thought, but the movement of bodies and machines. Communications technologies… are coordinating machines.[233]

We see in the above passages the dual character of governance that variously attempts to foreground individual self-governance as well as external structuring of that individual. Packer's quote is also an early indication in the field of the affective character that technologies of self imply and that communication machines/media have long stood at the crossroads of both technologies of power and domination as well as practices of self-governance.

Laurie Ouellette and James Hay argued that the "cultural power" of television as a communication technology was productive of viewers' individualistic "active role in caring for and governing themselves through a burgeoning culture of entrepreneurship."[234] Importantly they point out as well that this characteristically neoliberal form of governmentality, particularly in the televisual form of the "life intervention" becomes intimately tied to a regime of health that deploys medical expertise and, ostensibly scientific measurement that aid individuals in managing the physiological markers of health and well being.

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[232] Toby Miller, "The Self-Governing Journal," *The Communication Review* 5, no. 1 (2002): 4.
[233] Jeremy Packer, "Mobile communications and governing the mobile: CBs and truckers." *The Communication Review* 5, no. 1 (2002).
[234] Laurie Ouellette and James Hay, "Makeover Television, Governmentality and the Good Citizen." *Continuum: journal of media & cultural studies* 22, no. 4 (2008): 472.

Ouellette and Hay's insight here illustrates two important relationships, 1) between neoliberalism, biopolitics, and 2) the crucial role of mediation in the process of an individual managing one's health or well being.

The biopolitical register of technologies of the self within the biotechnological revolution in life sciences has, as Melinda Cooper observed, resulted in a particular sort of neoliberal-biopolitics. It is a neoliberalism that attempts to capture,

> not simply the public sphere and its institutions, but more pertinently the life of the nation, social and biological reproduction as a national reserve and foundational value of the welfare state.[235]

And, contra Foucault's analysis of the development of homo economicus in early neoliberalism[236], for those individuals doing self work in neoliberalism today,

> The operative emotions…are neither interest nor rational expectations, but rather the essentially speculative but nonetheless productive movements of collective belief, faith, and apprehension.[237]

Technologies of the self in this case are those discourses, networks, and machines actively deployed by people to avoid or surmount various perceived scenarios of biological risk that prevail today based on neoliberal-biopolitics' "vested interest" in profiting off of one form or another of "biological catastrophe."[238] The life sciences and biotechnologies become caught up in this culture of speculation and risk over literal and figurative biological contagion.

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[235] Melinda Cooper, *Life as Surplus: Biotechnology and capitalism in the neoliberal era.* (University of Washington Press, 2008)
[236] Michel Foucault, *The Birth of Biopolitics: lectures at the Collège de France, 1978-1979*, trans. Graham Burchell. (New York: Picador, 2010).
[237]. Cooper, "*Life as Surplus,*" 11.
[238] Ibid. 12.

The shift in focus from technologies of domination to technologies of the self also reveals interesting interactions between science, individuals, and media. As Nicholas Rose has recently observed, national government, scientific communities, and citizens all have a new interest in "democratizing" science, opening up access to its knowledge production, and engaging the public in its affairs. This all has the effect of a change in the status of truth and democracy within scientific discourse. Rose observes an even more astonishing phenomenon that he calls the "active biological citizen." Such an individual is not only managing herself through the instructions of biological and genetic sciences, but uses the threat of her survival as a form of biopolitical power back to state and capitalist interests.[239]

> This is manifested in new forms of collectivisation, new forums for debate, new styles of activism, demands for access to knowledge and for the funding of research into specific conditions: 'it is "genetic citizenship" that connects discussions of rights, recognitions, and responsibilities to intimate, fundamental concerns about heritable identities, differential embodiment, and an ethics of care' (2004, p. 57, emphasis in original).[240]

The biological citizen then actively works to redirect and recuperate the "collective belief, faith, and apprehension" that Melinda cooper saw as the motor driving neoliberal-biopolitical catastrophe.

Put another way, through the various communication technologies, networks, and scientific knowledge, the biological citizen is capable of recuperating her capacity to affect and be affected in the future. This is, again, a

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[239] Nikolas Rose, "*Democracy in the Contemporary Life Sciences*." *BioSocieties* 7, no. 4 (2012): 459-472.
[240] Rose, "Democracy," 463.

sort of active corrective to the simplistic representations of crisis, fear, health, and success that state and corporate media institutions deploy to control that affectivity. Through what he calls distributed mediation, Richard Grusin attempted to call attention to the "similar distribution of affect across human and nonhuman actors."[241] This is the key register on which cybernetics has deployed the notion of an autonomous, self-regulating agent that is at the same time inextricably linked to other agents as well as a larger system. Keeping in mind both governmentality and biopolitical registers the cybernetic subject is no longer limited to cyberspace or the digital but rather expanded all forms of the social. The traditional sociopolitical categories of: of identity and community no longer hold up to a cybernetic machine-subject that, as Patricia Ticineto-Clough described, make it,

> so that the defence against accusations of contagion and suggestibility among human subjects or in human groups and communities would no longer be required as a way of also defending a fixed boundary between the organism and the environment, between human affect and the affect of matter…[242]

As a second contribution to media studies, I illustrate that the theory that increasingly informs critical media studies, namely continental philosophy, has strong and intricate ties to cybernetic thought. Increasingly in engaging with French and German philosophy North American media studies resembles cybernetics and related scientific or technical thought. Mark B. Hansen and

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[241] Richard Grusin, "Premediation: affect and mediality after 9/11" (New York: Palgrave MacMillan, 2010), 90.
[242] Patricia Ticineto Clough, "Afterword: The future of affect studies," *Body & Society* 16, no. 1, 2010, 227.

Bruno Clarke above, for example, have continued to develop a "neocybernetics" with the express purpose that "contemporary understanding that the human is and has always already been posthuman could not have emerged" without the cybernetic perspective.[243] More work is being produced on the historical connections between Continental Theory and cybernetics at the middle of the 20th century including "Lévi-Strauss, Lacan, Foucault, Derrida, Lyotard, Deleuze and Guattari" as a French philosophical movement embodied in a typically "American technological innovation."[244]

The most glaring example of this would be the work of Friedrich Kittler. He explicitly adopts Claude Shannon's Mathematical Theory of Communication, or what would become Information theory as the founding theory of what he calls the "scientific history of media." It liberated, Kittler thought, communication from an "unfathomable confusion" in the "bonds of language" because technical communication avoided, "any reference to ideas or meanings and thus to people."[245]

However, I wish to point out that cybernetics has and continues to contribute to a more general thinking that strives for what Rosi Braidotti described as alternative, conceptually creative, and affirmative new subjectivities

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[243] Bruce Clarke and Mark N.B. Hansen, *Emergence*, 24.
[244] Céline Lafontaine, "The Cybernetic Matrix of French Theory'." Theory, Culture & Society 24, no. 5 (2007): 27-8.

[245] Kittler, Friedrich. "The History of Communication Media," *CTheory Special Issue*, ga 114 (1996), accessed May 1st 2013, www.ctheory.net/articles.aspx?id=45.

in light of the Posthuman.[246] As such, this chapter highlights the relationship of cybernetics to the ethical leanings of French Theory. For example, Felix Guatarri, who has influenced Mark B Hansen and others to form a "Neo-cybernetic" theory, gestured towards ethics through his strong reliance a theory of the machine. As Hansen notes, Guatarri,

> Privileged the technical machine over all machinic orderings that impose a universal referent (capital, energy, information) precisely because they cut across material domains… they are mediators for human co-evolution with the environment…[247]

Hansen believed that from our coevolution with machines along with our recognition of the important ways that they affect us result in ethical imperatives. After studying machines and accepting their form of alterity humans feel compelled towards cooperation and co-functioning:

> for if the human is to retain its relevance, if not necessarily its centrality, in the face of the massive and massively accelerating complexification of the world, human beings must welcome the alterity of machines as a crucial source of connection to a world ever more difficult to grasp directly.[248]

As I will conclude in this chapter Michel Foucault in particular belongs in this

> growing body of scholarly work is rethinking the shape and evolution of the relations among science, technology, sociology, psychology, philosophy, history, literature, and the arts through neocybernetic terms…[249]

Particularly in his later work on ancient subjectivity he provides a cybernetic form of subjectivation as an imagination and strategy for de-familiarization of the

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[246] Rosi Braidotti, *The Posthuman* (New York, John Wiley & Sons), 2013.
[247] Bruce Clarke, and Mark BN Hansen ed., *Emergence and Embodiment: new essays on second-order systems theory*, (Durham: Duke University Press, 2009), 125.
[248] Clarke and Hansen, *Emergence and Embodiment*, 125.
[249] Ibid. 5.

humanist subject, what Braidotti has described as a critical posthumanism.[250] As I have mentioned my interest in governmentality or the art of governing self and others leads me to introduce a reading of Foucault under a cybernetic lens.

Part 2: Norbert Wiener, Warren McCulloch, and observing Ethics in Machines

Norbert Wiener likened machines in the modern world to the Golem of the Rabbi of Prague. This metaphor is interesting for quite a few reasons, at least some of which Wiener must have intended. Golem is an old Hebrew term translated as "shapeless mass or embryo, connoting the unfinished human being before God's eyes."[251] Like Frankenstein or stem cell research, the Golem is the creation from forbidden knowledge, that which should only be brought to life by God. And like Frankenstein's monster, or Pinocchio, or the android Data from Star Trek, the golem is precisely that creation that humans seek out, and it is one that is necessarily flawed or lacking in some significant way. The Golem is also, from Jewish lore, one of the earliest ideas of human beings seeking that hidden knowledge (literally the Kabbalah) to create a life form in their own image. The

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[250] Braidotti, *The Posthuman*, 193.

[251] Cathy S Gelbin, *The Golem Returns: From German Romantic Literature to Global Jewish Cultures, 1808-2008* (Ann Arbor, University of Michigan Press).

Golem of Prague tells the specific story of a Rabbi's Golem that is not only a servant but a hero that, "averted many calamities and blood libels."[252]

Wiener described the modern machine, a product of computer science and robotics engineering, as a Golem for purposes that were ethical and metaphysical. It is one of the many examples of cybernetician writings that cross or bridge the discrete boundaries between scientific and philosophical discourses. He believed that Cybernetics as a science impinges on the realm of Religion precisely because "machine" is a problematic third term between human and God. He concluded that creative activity (creation), which is the ultimate purpose of cybernetic thought, is not a power endowed differently to God, humans, or machines.[253] To the extent that cybernetics impinged on religion it was because the machines it theorized marked a new form of creative power that was not entirely in the realm of the human.

Warren S. McCulloch who, through his investigation into cybernetics, endeavored to produce a "physiological epistemology of mind" also wrote an essay on the possibility of an ethical robot. In it he contributes to the contours of this machine subject theory. While admitting that "Science" could not currently say anything about good or evil, and dubious about the prospect of a "tautological theory of the good" akin to formal languages like math and logic, McCulloch did believe that humans

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[252] Nissan Mindel, "Rabbi Judah Loew – 'The Maharal of Prague'" "Chabad.org", accessed May 5th, 2014, http://www.chabad.org/library/article_cdo/aid/111877/jewish/Rabbi-Judah-Loew-The-Maharal-of-Prague.htm

[253] Wiener, Norbert, *God and Golem Inc.* (Cambridge: MIT Press, 1964).

> …can construct an observational science of evaluation. He must watch the choices of the organisms or machines to discover the causes of such conduct. But to be ethical, these must include other organisms and machines which must share effort and reward or no social questions of good and evil will arise. I shall investigate what Machines, by cooperation and competition, can constitute a society where their conduct becomes self-disciplined in a way that serves the ends created by their association.[254]

From this passage we see vast similarity in McCulloch's conception of observation and evaluation to his fellow first-order cyberneticians Gregory Bateson and Margaret Mead, who both happen to be anthropologists.

Gregory Bateson took the concepts of various cyberneticians and the comparative work across sciences and across objects of different species in order to produce "defensible metaphors"[255] for human communication and cognition. For Mead, the influence of cybernetics on Anthropology resulted in the ability to observe and analyze "Culture at a Distance" where distance meant that those societies observed were for different reasons inaccessible to direct observation. [256] Beyond the fact that McCulloch proposed that robots could learn to behave ethically by living together is a proposition he seemed to have borrowed from his cyber-anthropologist colleagues. That humans could establish a system and method of observing robot behavior is strictly speaking a suggestion of ethnographic knowledge of them. And what culture is more at a distance, more radically other to human observation than a community of robots?

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[254] Warren S. McCulloch, "Toward Some Circuitry of Ethical Robots: or an observational science of the genesis of social evaluation in the mind-like behavior of artifacts," *Embodiments of Mind* (2nd printing. Cambridge, Mass.: MIT Press 1989).
[255] Gordon Pask, The Cybernetics of Human Learning and Performance: a guide to theory and research (London: Hutchison and Co., 1975), 15.
[256] Margaret Mead, and Rhoda Métraux, eds. *The Study of Culture at a Distance* (Berghahn Books, 2000).

McCulloch's thought experiment exhibits an idea that anthropologist Samuel Collins would decades later call "virtual culture."

> Culture construed as virtuality, on the other hand, foregrounds culture as pure difference; actualizations of cultural difference not only fail to exhaust the potentials of a virtual multiplicity, but they enrich the virtual (here coincident with the past) with potential as-yet unactualized (but no less real).[257]

Robot culture, while not physically manifested either in McCulloch's time nor arguably today, exists virtually as the pure difference of communicative robot agency. The post-human anthropology currently things' abilities to influence and create human culture might productively include things that create their own culture. Anthropology's inclusion of robot culture might force the replacement of Anthro- with another prefix designating an openness, not only to nonhuman but to inorganic culture.[258] Taking the virtual to be real, as Collins argued, the new study of culture would prescribe new political and ethical configurations around such a culture. Hence the observation of culture would bring in the observer and become a social and political practice; "anthropology here is still descriptive, but it is also catalyzing, energizing, and morphogenetic."[259]

In this section I discussed two of the founding members of the first generation of cyberneticians. I showed each as attempting to theorize the ethical implications for a field of science dedicated to the study of machines. I believe

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[257] Samuel Gerald Collins, *All Tomorrow's Cultures: Anthropological engagements with the future* (Berghahn Books, 2013), 121.
[258] At least since 2010 there has been recognition in North American Anthropology of "multi-species" ethnography that put insects, microbes, and other nonhuman life forms at the center of study.
[259] Collins, *All Tomorrow's Cultures*, 122.

that part of the misunderstanding and dismissal of cybernetics includes an unawareness of the social and ethical components to its theories. Machines, outside of an engineering context, was taken as a whole subject or organism, and one that was meant to interact with and affect humans directly.

Part 3: Cybernetics Reconsidered

In this section I expand on some of the misunderstanding and skepticism surrounding cybernetics. The discourse generated by the term Cybernetics in the last 60 years suggests that it has been difficult for a theory of machines with conceptions of their autonomy, to withstand objections concerning human dignity and freedom. Particularly in political and cultural realms there seems a direct correlation between the increase in number, powers, and prevalence of machines—and an increasing alienating effect on human life. From Baruch Spinoza's "spiritual automaton" to La Mettrie's "Man a Machine" to the "Automaton theory" of 19th century psychology[260], or even John Von Neumann's "Theory of Reproducing Automata," any scientific theory that either sets out the existence of machines beyond human control or that takes seriously the comparison between machine behavior and human volition, has but the briefest shelf life both in scientific and humanistic contexts.

[260] William James wrote a well received and now famous renunciation of the Automaton movement in psychological sciences. James, William. *The principles of Psychology*. Digireads. com Publishing, 2011.

The one exception, as I discussed earlier in Physiology, has been the philosophical and physiological work of Renee Descartes. Though, again, Descartes' is a machinic theory only insofar as he uses the actual word in his prose. His fidelity lies instead with the immutability and irreducibility of mind as a substance to the attribute of body. His materialism is a stop-gap at the least and disingenuously idealist at worst, and most importantly the perseverance of Cartesian thought in philosophy, science, and industry, is due to a practicable "mechanization" that I have laid out previously—and mechanization is by no means a synonym for machine. This brings up a recurring claim in my dissertation, one originating from my sketch of physiological vitalist-machine theories that machines neither have to be mechanical in any particular sense, nor must they be reducible to their smallest parts. My discussion of cybernetics continues exploration of this claim and takes cybernetics to be a successful "failed" intellectual project that has contributed to the concept of a vital machine.

As a Failure

Peter Galison argued in 1994 that, "Cybernetics no longer appears as a futuristic bandwagon or as a rising worldview…"[261] Historian and philosopher Jean Pierre Dupuy opens his history of cybernetics by explaining that its history should be a recognition of what it got wrong as a cognitive science so that history would not repeat its mistakes.

> For I saw the history of cybernetics—the first great attempt to construct a physicalist science of mind—as the story of a failure. And indeed

[261] Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21, v. 1 (1994): 233.

> cybernetics was soon forgotten, apparently consigned to a dark corner of modern intellectual history.[262]

The below definition also suggests that what is key to Cybernetics is a basic failure of reception and that what was not well received was its dissolution of Identity—of unique humans, organisms, and machines

> Any attempt to reconcile these legion cybernetic understandings would likely be as fruitless as it would be misguided: like many other ambitious projects, contradictions, inconsistencies, paradoxes, and programmatic failures have long been hallmarks of cybernetics. Wiener's failed attempts to improve fire-control in the 1940's, the Macy Conferences failed effort to develop a universal science of control and communication in the 1940's and 1950's, and the ambivalent appropriation of cybernetics by theorists ever since speak to the difficulty—and likely impossibility—of reconciling humans, animals, machines, and societies into a consistent, coherent or unified intellectual program.[263]

This definition is highly instructive and representative in that it reflects a general consensus that the cybernetics project has always been attached epistemologically to its failure. Cybernetics has alternatively been characterized as a "scientific farce founded on sloppy analogies between computers and human organisms."[264]

From the above quote we also see the implication of the personal stakes of failure for the founders such as Wiener, often characterized as individually failing at his employed task with the U.S. military during WWII. This is not an isolated event of connecting these cyberneticians' foibles with the fate of

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[262] Jean Pierre Dupuis, *On the Origins of Cognitive Science: the mechanization of the mind* (Cambridge: MIT Press, 2009), 1.
[263] Bernard Geoghegan & Benjamin Peters, "Cybernetics," Bernard Dyonisius Geoghegan personal web site, accessed December 20th 2013, http://bernardg.com/blog/definition-cybernetics.
[264] Geoghegan and Peters "Cybernetics".

cybernetic thought. According to Peter Galison it was not only Wiener's obsession with an imagined nonhuman-human hybrid enemy, or that with developing anti-aircraft weapons, but his entire biography that led him to develop cybernetics as a violent "philosophy of nature."[265]

N Katherine Hayles provides an in depth psychoanalytic read of Wiener's writings, arguing that his strong commitment to a liberal humanist worldview was itself one of the perceived victims of cybernetics' success. The dissolution of the distinction between human and machine severely threatened the investment in "a coherent, rational self, the right of that self to autonomy and freedom, and a sense of agency linked with a belief in enlightened self interest."[266] This threat resulted in vast contradiction, not only in his work but also in his behavior as he worked. The conceptual boundaries in Wiener's cybernetics, those that elided the "very real differences existing between the inner structures of organisms and those of machines" for example, was mirrored in the boundaries he saw in his personal life as "an outsider, standing apart from a privileged group whose boundaries did not include him."[267]

As Hayles sees it, Wiener's "intense identification of personal conflicts with conceptual problems" another aspect of his liberal humanism, would be productive of his theory making in cybernetics, as "boundary formation and

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[265] Galison, 1994 "Norbert Wiener".
[266] N. Katherine Hayles, *How We Became Posthuman: virtual bodies in lybernetics, literature, and informatics* (Chicago: University of Chicago Press, 1999), 86.
[267] Hayles, *Posthuman,* 93.

analogical linking collaborate to create a discursive field in which animals, humans, and machines can be treated as equivalent cybernetic systems."[268]

> Viewed in historical perspective, Wiener was not successful in containing cybernetics within the circle of liberal humanist assumptions…It is to Wiener's credit that he tried to craft a version of cybernetics that would enhance rather than subvert human freedom. But no person, even the father of a discipline, can single-handedly control what cybernetics signifies when it propogates through the culture by all manner of promiscuous couplings…the voices that speak the cyborg do not speak as one…[269]

Hayles' analysis, both fascinating and personal, illustrates the inextricable link between cybernetics and its failure. In the above instance it is both that Wiener "failed" in his attempt to authorize a monolithic version of cybernetics that enhanced liberal humanism, but also, that cybernetics failed insofar as it was successful at laying bare the illusion or construction of the autonomous and unique human subject.

Part 3: The Cybernetics of the Human ushers the Posthuman

This section begins with the work of Plato as it is one of his meditations on the value of government that provides a powerful sense of cybernetics as a recognized form of knowledge. Cybernetics can be seen as a field that bridges antiquity and modernity as an inquiry into the government of life. It also affirms Foucault's interest in analyzing the ancients and providing in them a very different kind of subject, a point I will conclude with. Making one of its first

[268] Ibid. 93.
[269] Ibid. 112.

appearances in Plato's Clitophon, the political dimension of cybernetics appears quite strong. In the dialogue Clitophon reiterates Socrates' philosophy:

> …someone who doesn't know how to use his soul is better off putting his soul to rest and not living at all rather than leading a life in which his actions are based on nothing but personal whim. If for some reason he must live, it would be better for such a man to live as a slave than to be free, handling over the rudder of his mind, like that of a ship, to somebody *else* who knows [kubernetes/cybernetics] that skill of steering men which you, Socrates, often call politics, the very same skill, you say, as the judicial skill and justice.[270]

The key to this ancient cybernetics is still a relationship between the governance of self vs. governing others based on the proper living of a life. As cybernetics is the skill of steering men it is already in antiquity a technology of governance. And this technology of governance, as a power over others is made necessary only after a human being has already lost or never has had the ability to manage the use of her own soul. Foucault put the insight into Greek steersmanship succinctly claiming that the modes of training the self, pedagogy or healing, and politics were all the same in the techne of government created by the ancients. Further, the latter two derived from the former,

> that is, the possibility of making oneself like the doctor treating sick ness, the pilot steering between the rocks, or the statesman governing the city*-a skillful and prudent guide of himself, one who had a sense of the right time and the right measure.[271]

The next time the concept of cybernetic government would be used would be by Andre Marie Ampere, the French physicist and experimenter. He would borrow

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[270] John M. Cooper and D. S. Hutchinson. *Plato Complete Works* (Hackett Publishing, 1997), 967.
[271] Michel Foucault, *The History of Sexuality Vol. 2*: *The Use of Pleasure* (New York: Penguin, 1987),134.

cybernetique from the Greek kubernetes in 1834 in part to describe the art of the natural sciences. Cybernetics was to be the exemplary science of government. His description of cybernetics sounds strikingly similar to the steersmanship the ancients in his "Essai sur La Philosophie des Sciences." In it Ampere wrote not as a scientist or naturalist, but as someone who believed that an empirical understanding of government could enact the greatest good. Cybernetics or the "art of governing in general," was to be an active, ongoing, and all encompassing practice for the leader of the nation. Each and every decision by a leader was made in response to numerous external variables or "diverse" elements making up the State. The list of objects a leader must empirically identify included the State's: "character", "morals", "opinions", "history", "religion", its "means of existence and prosperity", and its "laws".[272] Ampere no doubt had in mind the recent "July" revolution in which the French monarchy was replaced by a constitutional one when he concluded that everything done by government should be for "l'amélioration de l'état social" the betterment of the social state.[273] It should be stressed again the integrative or "global" way in which cybernetics would work according to Ampere:

> Ampere's idea of cybernetics is not marred by debilitating physicalism. For contrary to the narrow outlook of physicalism, Ampere emphasized that the science of governing should be based on a thorough attentiveness to every facet of human life and activity. Cybernetics…far transcended the skill of establishing quantitative correlations. It was, rather, a science that had to ponder carefully the character, manners, history, religion, and laws

[272] André-Marie Ampère, *Essai Sur la Philosophie Des Sciences, ou, Exposition Analytique d'une Classification Naturelle de toutes les Connaissances Humaines* (Chez Bachelier, 1856), 140.
[273] Ampere, Essai Sur la Philosophie, 141.

> of society before trying to formulate the general patterns of human activities.[274]

Ampere not only borrowed the name from the Greek's but also seemed to recognize that they had already extrapolated from the individual act of navigating or steering one's ship to the regulating or steering of numerous movements whether physical, linguistic, and social. As Michel Foucault noted of the ancients "their idea of piloting as an art" was a "theoretical and practical technique necessary to existence."[275] Ampere thus did not just call cybernetics a science of government but also a "theory of power" at work in society.

Gregory Bateson, Margaret Mead, Heinz Von Foerster: The Cybernetics of Ethics

I have already mentioned that Wiener and McCulloch were scientists who theorized the ethical implications of powerful and social machines. In this section I discuss three cyberneticians who, more than any others perhaps, applied machine theories to the human sciences. Gregory Bateson is key figure of cybernetics to explore in order to investigate it as a theory of subjectivity and ethics. In March of 1976, after some thirty years, Margaret Mead and Gregory Bateson reflected on the circumstances and ideas that generated the Macy Conferences. They briefly keyed in on the concept of feedback that is historically attributed as fundamental to cybernetic thought.

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[274] Stanley L. Jaki, *Brain, Mind and Computers* (Indiana: Gateway Editions, 1969), 40.
[275] Michel Foucault. *The Hermeneutics of the Subject: Lectures at the Collège de France 1981--1982. Vol. 6* (New York: Macmillan, 2005), 249.

> **Mead:** Yes, and shifting back and forth between these levels and keeping everything straight was very interesting. So we used the model, 'feedback,' and Kurt Lewin - who didn't understand any known language, but always had to reduce them to concepts - he went away with the idea of feedback as something that when you did anything with a group you went back and told them later what had happened. And he died before anything much else happened. So the word 'feedback' got introduced incorrectly into the international UNESCO type conferences where it's been ever since.
>
> **Bateson:** In the small group cult, feedback now means either telling people what they did, or answering.
>
> **Mead:** Yes. 'I don't get any feedback from you,' or 'I can't go on with this without some feedback.' It wouldn't have survived if Kurt had lived. He would undoubtedly have got it right.[276]

On the surface the two are recalling the game of telephone that can result from the politics of conferencing, and more crucial to Mead's life work, to the popularization and supporting of social theory. On a deeper level, this conversation indicates the misunderstanding, at the most basic level, and at the moment of inception of the concept. This misunderstanding led to an instrumental view of a dynamic and changing concept in cybernetics from outside observers. It speaks to the problematic nature of building a first philosophy of communication, or as cybernetics was called, a meta-science.

From Mead and Bateson's recognition of the problem of "feedback" we may view the starting point of simplification by the misrecognizing cybernetic critic—that characterizes feedback as merely "talking back" or, as a reflexivity,

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[276] Stewart Brand, "For God's Sake Margaret: conversation with Gregory Bateson and Margaret Mead," Downloaded from Project Alice, accessed May 1st 2014, http://www.alice.id.tue.nl/index.htm, 6.

another concept from anthropology and that has circulated, in the form of participant observation, throughout the humanities. What becomes evident is that the founding principle of Bateson's particular project, with special attention to self-integration in mechanisms and processes, is quite apart from a teleological causality of a feedback loop. Instead, the concepts generated by Cybernetics would lead him to posit that human beings, their culture and language constitute a much larger system, or an ecology.

The "black box" is the figure of bracketing or hiding a set of phenomena from systematic analysis. It is the underlying figure of Hayles' critique of cybernetic thought, and also plays into her understanding of Gregory Bateson's alteration of cybernetics. In her discussion of cyberneticians' conflation of man and machine it is by the very act of black-boxing mechanisms in favor of patterns of general form that human beings and machines seem very similar.

At heart of 1st order cybernetics' concept of information is this "black boxing" effect inherited in part from behaviorism that first simplified all human phenomena. For purposes of illustrating the tenuous position of the observer in cybernetics—the objective myth and black boxing of observer by engineers, as well as the rudimentary revision by Norbert Wiener's cybernetics, Hayles drew on the interview between Mead, Bateson, and Stewart Brand. She paraphrases a moment in the event where Bateson draws a diagram of an input/output communication model before cybernetics:

> The drawing shows a black box with input, output, and feedback loops within the box. The space labeled "Engineer" remains outside the box. A

> second drawing represents Bateson's later understanding of cybernetics…In this drawing the observers are included within the system rather than looking at it from the outside.[277]

The figure of the black box here demonstrates the simplistic form of reflexivity that will need a robust theory of embodied subjectivity for her purpose, and the overall bracketing of reflexivity at the conferences lead also to the black boxing of the psychoanalytic perspective, and any interest in the unconscious. It is productive to look at the commentary that accompanies Bateson's diagram at length:

> [T]here's an input and an output. Then you work on the box. What Wiener says is that you work on the whole picture and its properties. Now, there may be boxes inside here, like this of all sorts, but essentially your ecosystem, your organism-plus-environment, is to be considered as a single circuit…
> And you're not really concerned with an input-output, but with the events within the bigger circuit, and you are part of the bigger circuit.[278]

Here Bateson is shirking the outmoded language of the box, as he reminds Brand that the lines of the box are always only conceptually drawn by us. The consequences for this conceptual boxing of what we observe are ethical to Bateson.

While it is quite clear that he has no intention of getting at reflexivity through the figural inclusion of the observer, through mediating linguistic practices of self-disclosure, or the literary process of narrative, Bateson is attempting to open up observation to the material integration of human and nonhuman systems. The circuit here both is and is not a metaphor, as opposed

[277] Ibid. 74.
[278] Brand, "For God's Sake," 12.

to the conceptual "box." That is, a circuit is figural for purposes of explanation only, and, with the advent of electronics and then digital computing technologies, the circuit became specifically articulated to an inorganic mechanism. However, there is a transparency between concept and physical object and the metonymy is unnecessary when an observer "as" a circuit is a circuit. A circuit is merely a circular route that may fit within the context of bodies, ideas, energy, or information.

Additionally, unlike the conceptual closed-ness of a box, which signifies metaphorically, as Hayles is arguing, a closed mindedness or un-self reflexive positionality, a circuit literally opens and closes based on its use, based on stimuli from its environment. Moving away from the boxing off of an object or problem, Bateson instead uses the figure of a "circuit" in relation to an overall ecology whereby both organism and environment are composed of an overdetermination of processes, physical, biological, and cultural.[279] Organism and environment are both within a larger circuit as relays at the same time as they are circuits constituted from below with other relays that interact and complete their own circuits.

N. Katherine Hayles admitted that Bateson's thought at mid century, unlike Wiener, McCulloch and others, had a non-semantic and emergentist sense of information.[280] It seems the case that he anticipated a particular cybernetic moment, though not the one that manifested at Macy, through his conceptual

[279] Gregory Bateson, *Steps to an Ecology of Mind*, New Jersey, Jason Aronson Inc., 1987.
[280] Hayles, *Posthuman*, 1999, 78.

work on Schismogenesis and in Bali through the 1930's, and on schizophrenia studies where he and others at the Palo Alto School used cybernetics and communication theory to center psychoanalysis on interpersonal communication.

Gregory Bateson was never preoccupied with the potential of information as a power, quantity, or language.[281] In perhaps Bateson's most memorable aphorism, information was neither data nor energy specifically, but generally "a difference that makes a difference." It is pattern, finally, that would unify his work in a quasi-mystical practice of observation that would eliminate the human in universal sameness. But pattern, without quantity, without measure or instrument, would take his work out of cybernetics, out of information, the world of technology and out of Hayles' full purview. Her posthuman thesis, one grounded ultimately in an integrated comparison of the plentitudes and variations in language, patterns of thought, and patterns of life. "The pattern which connects;" Bateson sought the underlying structures that mapped similarity across all the radically different living things.

> What pattern connects the crab to the lobster and the orchid to the primrose and all the four of them to me? And me to you? And all the six of us to the amoeba in one direction and to the back-ward schizophrenic in another?[282]

To be aware and moved by the pattern that connects all living things, the biosphere that Bateson knew to be threatened by modern human civilization, was to be both scientific and ethical.

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[281] Ibid. 78-79.
[282] Gregory Bateson, *Mind and nature: A necessary unity*, New York: Dutton, 1979, 8.

> There is this much connection certainly between scientific truth, on the one hand, and beauty and morality, on the other: that if a man entertain false opinions regarding his own nature, he will be led thereby to courses of action which will be in some profound sense immoral or ugly.

This was why he returned again and again to writing about the question of why so few teachers in most schools were not teaching students the pattern that connects, the cybernetic skill that empowered a human being to meet their environment/ecology with "recognition and empathy." After all, cybernetics above all marked a revolution in the study of communication in learning[283]—whether it be how an organism learns to stave off disease and death, or how a machine learns to mimic certain human characteristics, or how a human being learns to communicate with family members or spouses. Living, learning, and communicating were tantamount to the same organism action. Cybernetics was to Bateson, a living art, a technique of continually putting oneself back into one's environment. Thus by "aesthetic" he meant "responsive to the pattern that connects."[284] This was the ethical urgency of putting the observer into its system, the performative nature of a reflexive cybernetics that brought together cognition and living properly, consciousness with attending to one's environment: "We might say that in creative art man must experience himself—his total self—as a cybernetic model."

Reflexivity from Cybernetics

[283] Gregor Bateson, Steps to an Ecology of Mind, New Jersey, Jason Aronson Inc. 1987, 205.
[284] Bateson, Mind and Nature, 8.

N. Katherine Hayles argued that since the turn of the 20th century there emerged a revolution in modern thought that she thought was represented by a "field theory" worldview replacing one based on teleology, simple cause and effect, and the knowability of the universe—in a word, objectivism.[285] In place now are what she identified as the new heuristics for perceiving ourselves and our environments as caught up in "'cosmic dance," a "network of events," and an "energy field.'"[286] A foundational characteristic of the field worldview, one that Hayles believed is shared by modern scientific and humanistic (literary) thought, is the enduring problem of the external, outside observer based on the modern emergence of self-referentiality. On the self-referentiality of language existing within a field Hayles claimed,

> Because everything, in the field view, is connected to everything else by means of the mediating field, the autonomy assigned to individual events by language is illusory. When the field is seen to be inseparable from language,
> the situation becomes even more complex, for then every statement potentially refers to every other statement, including itself.[287]

At heart of the issue with the field worldview is the problem of knowledge, but it is a twofold problem because in a field an individual loses both knowledge of an observed object as well as self-knowledge because of the self-reference that makes identity dependent on the outside, on the object before the fact of identification.

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[285] N. Katherine Hayles, *The Cosmic Web: scientific field models and literary strategies in the twentieth century.* Cornell University Press, 1986.
[286] Hayles, *Cosmic Web*, 15.
[287] Ibid. 10

The power of Hayles' argument, now over 25 years old, is her observation that through the concept of self-referentiality, what she will later write on as reflexivity in observation in her book on cybernetics and the posthuman, we can see a general isomorphism between science and the humanities. Whether one's object is Goethe's poetry or Einstein's Theory of Relativity, or "Godel's theorem[288] or Gravity's Rainbow, self-referentiality is a crucial issue."[289] Hayles later defined reflexivity as the refinement of self-referentiality seen in cybernetics. It was,

> the movement whereby that which has been used to generate a system is made, through a changed perspective, to become part of the system it generates.[290]

Taken together we can see that humanistic and scientific thought, most recently through self-referentiality or reflexivity, shift their perspective in similar if not complementary ways.

> This definition of reflexivity has much in common with some of the most influential and provocative recent work in critical theory, cultural studies, and the social studies of science. Typically, these works make the reflexive move of showing that an attribute previously considered to have emerged from a set of preexisting conditions is in fact used to generate the conditions… It is only a slight exaggeration to say that contemporary critical theory is produced by the reflexivity that it also produces (an observation that is, of course, also reflexive)[291].

Hayles' comparative work here on literature and sciences pushes us to entertain the notion that despite their disciplinary concerns and historically

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[288] Kurt Godel's mathematical "incompleteness theorem" or theory of non-computability of things in the universe.
[289] Hayles, *The Cosmic Web*, 41.
[290] Hayles, How We Became Posthuman, 8.
[291] Ibid. 9.

constructed “two cultures,”[292] the humanities and sciences are interacting parts of a single, much larger conceptual field. Take as an example Marshall McLuhan’s contribution to the transformation of Literary Studies and the development of Media Studies. His affinity for complexity and information as derived from the sciences are strong, and particularly he read “critically, but avidly,” cybernetic literature in the 1950’s and,

> Could almost instantaneously intuit the relevance of Norbert Wiener’s and C.E. Shannon and W. Weaver’s ideas about cybernetics and systems theory in the light of modernist art, literature, poetics, aesthetic theory, and cultural production.[293]

McLuhan’s innovation in historical method was what he called a “mosaic or field approach” to historiography.

> Such a mosaic image of numerous data and quotations in evidence offers the only practical means of revealing causal operations in history. The alternative procedure would be to offer a series of views of fixed relationships in pictorial space. Thus the galaxy or constellation of events upon which the present study concentrates is itself a mosaic of perpetually interacting forms that have undergone kaleidoscopic transformation particularly in our own time.[294]

Importantly Hayles too lands on the concept of a kaleidoscope to explain the movements and communications between objects in field, noting that while as observers we try to stop the kaleidoscopic movements in order to see pattern that by doing so we lose the, “dynamic essence of the dance, for the static "patterns" never in fact existed as discrete entities…”[295] within the field.

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[292] Charles Percy Snow and Baron Snow, *The Two Cultures and the Scientific Revolution. Vol. 2,* Cambridge: Cambridge University Press, 1959.
[293] Donald Theall, *Virtual Marshall McLuhan*, McGill-Queen's Press-MQUP, 2001, 30.
[294] Marshall McLuhan, *The Guttenberg Galaxy,* University of Toronto Press, 1962, preface.
[295] Hayles, *Cosmic Web*, 20.

As another example we can hold up the similar conception shared between Norbert Wiener and Marshall McLuhan during the time when information and cybernetic theories emerged. Ten years before *Understanding Media* was published, Norbert Wiener wrote that the "organism is the message." The lexical resemblance to McLuhan's "the medium is the message" illustrates the same shape in thought they each had produced regarding new forms of technological communication. Neither organism or medium stood in as metaphors for communicative figures such as message, content, or information, but rather were identical to them, having the same communicative capacities as language and thought.

Wiener was writing profusely and in philosophical terms about something he recognized was, to use Michel Foucault's words, neither good nor bad, but dangerous.[296] His intention, as N. Katherine Hayles has commented, was to utilize that danger in the service of liberal humanism, to "enhance rather than subvert human freedom."[297] Marshall McLuhan in the same way theorized in response to the danger that had exploded literary form, the electronic medium. The cybernetic organism and the (electronic) medium, these became of singular importance to Wiener and McLuhan and shaped their thoughts as a continual vacillation between their liberal humanist commitments and what they observed as radical in the tendencies of modern machines. On the one hand, McLuhan spoke publically about the end of humanity through technologically determined

[296] Michel Foucault, and Paul Rainbow, *Essential works of Foucault, 1954-1984. Vol 1., Ethics: subjectivity and truth.* Penguin, 1997, 256.
[297] Hayles, *Posthuman,* 112.

catastrophe. On the other, he heralded an electrified and totally automated society, his global village, concluding that any panic about automation was merely a product of our previous mechanical media bias, a bias and worldview that, "was now past."[298]

I highlight the similar danger perceived by Wiener and McLuhan in order to reframe the picture of reflexivity emerging from the sciences and most explicitly in cybernetics. Largely reflexivity in scientific observation, to the extent that it provided a "powerful critique of objectivist epistemology,"[299] has seemed to remain in the realm of epistemology, shifting from simplistic and erroneous formulations to more complex and valid observations. However, with the critical humanities the figure of reflexivity has been deployed explicitly for the dynamics of power engendered by objectivity in science, such is the "deadly fantasy identified by feminists and others" as Donna Haraway noted, in "objectivity doctrines in the service of hierarchical and positivist orderings"[300] that ultimately route back to "white capitalist patriarchy."[301] Or, as Hayles noted of feminist science scholars, the posthuman occurs when critics replace substitute old concepts with new ones, emergence instead of teleology, reflexivity instead of objectivism, and distributed cognition instead of autonomous human will.[302] What soon gets replaced are not epistemological concepts but rather ethico-political ones. To use Hayles' example, with the posthuman,

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[298] McLuhan, Marshall, *Understanding Media: the extensions of man*. (1964) 311.
[299] Hayles, *How We Became Posthuman*, 134.
[300] Haraway, *Simians and Cyborgs*, 188
[301] ibid. 197.
[302] Hayles, How We Became Posthuman, 188.

> a dynamic partnership between humans and intelligent machines replaces the liberal humanist subject's manifest destiny to dominate and control nature.[303]

The crucial point is that looking more closely at cybernetics while analyzing it within the same epistemological field as the critical humanities produces two results. One, it becomes clear that reflexivity, what in cybernetics is called 2nd order observation or placing the observer within the system it observes, was deployed expressly with an ethical science in mind. Two, beyond the intentions of the cyberneticians I discuss, the move of the observer into the system has the result of producing not just a self-reflexive observer but one that self-monitors and self-regulates—in short a subject that actively works on itself given its connection to system and other.

Heinz Von Foerster

Heinz Von Foerster named 2nd order cybernetics as a therapy for a perpetual blind spot in the West's "problem solving conceptual apparatus." He called the blind spot a 2nd order blind spot because, "we do not see that we do not see" particular phenomena or we are not aware of having any deficiency that blinds us in presence of particular events. This is due to the fact that if something cannot be explained by causation or deduction—if we cannot show a cause or provide a reason for it, if we cannot readily explain something—then "we don't wish to see it."[304] The root of this blind spot that was twice removed was the

[303] Ibid. 289.
[304] V. Foerster, *Understanding Understanding*, 284.

tradition of objectivity, or the proposition that "the properties of the observer shall not enter the description of his observations."[305]

Instead Von Foerster sought to ask, "what are the properties of an observer" and include the results of the inquiry in the system; description of observer together with object or system observed. Adding another layer to his description of 2nd order cybernetics Foerster spoke in terms of the observer needing to "account for his accounting" in other words to be responsible not just for observing but for stating or producing language.[306] Thus he added an important element to the binary of observer/observer or if you will subject/object. Language would be the third term that would make observation a necessary and interrelated triad. Observers (not subjects and objects), their language, and the "society" that forms on account of their language. None of the three exist before or after the others, and you need all three to have all three. Thus Von Foerster, to the extent he believes cybernetics is a therapy to objectivism, shifts its cure from the epistemological to the social.

> From this it appears to be clear that social cybernetics must be a second order cybernetics—a cybernetics of cybernetics—in order that the observer who enters the system shall be allowed to stipulate his own purpose: he is autonomous. If we fail to do so somebody else will determine a purpose for us. Moreover, if we fail to do so, we shall provide the excuses for those who want to transfer the responsibility for their own actions to somebody else: "I am not responsible for my actions; I just obey orders." Finally, if we fail to recognize autonomy of each, we may turn into a society that attempts to honor commitments and forgets about its responsibilities.[307]

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[305] ibid. 285.
[306] Ibid. 285.
[307] Ibid. 286.

Von Foerster emphasized here the role of the observer that enters the material system and then "must" be allowed to contribute to its autonomy, to self govern. At this point Von Foerster took the legacy of scientific epistemology that had conceived of the self-regulating organism and constructs an ethical proposition for such autonomous acting agents in what he calls the "responsibility operation." In reflecting, just before he died, on his work, Von Foerster expounded on a statement by one of his favorite philosophers, Wittgenstein, that "it is clear that ethics cannot be voiced."

> If I begin to put ethics into words, I will be moralizing, well, and then ethics becomes a moral sermon…If I'm preaching morals, I'm always saying to others: You must do this, or you may do that…Ethics on the other hand doesn't refer to the other but to one's self. I must do this, I should do that, and so forth…[308]

Margaret Mead was one of the first anthropologists to conceive of and advocate for a meta-theory of anthropological theory—a way to reflect on identity, authority, and responsibility for the production of its work.

> "When it comes to the ethics and politics of their discipline," Margaret Mead wrote in 1978, "anthropologiests have shown themselves to be extraordinarily incapable of applying the principles of their own discipline to themselves."[309]

She had been thinking precisely about the problem of un-reflexive disciplinary research for at least 25 years prior to the above statement, and reflexivity was the concept she worked throughout to get into the consciousness

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[308] Albert Muller and Karl H. Muller ed. Trans. by Elinor Rooks and Michael Kasenbacher, The Beginning of Heaven and Earth Has No Name: seven days with second order cybernetics, New York, Fordham University Press, 169.

[309] George W Stocking, ed. Malinowski, Rivers, Benedict and others: Essays on Culture and Personality. Univ of Wisconsin Press, 1987, 184.

of Anthropology. To the extent that it lacked a systematic way to self-apply ethical principles anthropology was not unique. Mead had expressed similar sentiment about some of the very scientists she was working with to produce the seminal features of cybernetics at the beginning of the 1950's. She told a story about the founding of the Society for General Systems Theory in 1954 where she had proposed that systems theory should be applied to human society. Mead spoke of the utter confusion that resulted from the suggestion that a radical new scientific concept be turned in on the scientist in a different context.

> When the Society for General Systems Research was formed, I proposed that we apply general systems to our society. Nobody knew who I was and I was feeling like the little old lady in tennis shoes. I went up at the end of it and talked to Ashby, and he said, 'You mean we should apply our principles to ourselves?[310]

Mead recognized the reflexive character in Norbert Wiener's work years before Heinz Von Foerster introduced his 2nd order observer. In "The Cybernetics of Cybernetics," She proposed that the remnants of Weiner's theory be put to sociopolitical and ethnographic discourse after it clearly had not become "a way of thought."[311] Throughout the essay Mead emphasizes the need to integrate other disciplines and concepts into cultural theory, from cold war international policy, to the then burgeoning field of "ekistics."

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[310] Stewart Brand, "For God's Sake Margaret: conversation with Gregory Bateson and Margaret Mead," Downloaded from Project Alice, accessed May 1st 2014, http://www.alice.id.tue.nl/index.htm,

[311] Heinz Von Foerster et al. ed. Purposive Systems: proceedings of the first annual sumposium of the American society for cybernetics. New York: Spartan Books, 1968, 1.

On the other hand, she saw cybernetics primarily as a communicative corrective to "a world of increasing scientific specializations."[312] Above all else, Mead called for a concerted empirical effort to "take another step and develop ways of thinking about systems that are still bounded but within which there are loci of very contrasting degrees of organization and disorganization."[313] She also imported the concept of disorganization from cybernetics. In Entropy is foregrounded as an object of analysis important for human beings also as noise and the potential for disorganization may surround consciousness, subjects, and importantly, discourses (or communicative intention).

An important question is why embrace, as she had for all of her career, myriad disciplines of thought, while on the other hand, cautioning against a "sort of social metastasis in which there are fragments of formerly highly organized behavior which are unsystematically related to each other?"[314] The answer was that Mead continued to exhibit a strong balancing act in her thought between diversity and uniformity, freedom and control, and organization and complexity in her conception of human systems. The evolution of social science, the "cybernetics of cybernetics," the next order of observation would, for Mead, have to include observation of the social because the cybernetic idea of reflexive observation was also the idea that all observation was communicative in nature. All observation in the scientific study affected was affected by human sociality or,

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[312] Heinz Von Foerster et al. ed. *Purposive Systems,* New York: Spartan Books, 1968, 4.
[313] Ibid. 4.
[314] Ibid. 9.

as Von Foerster argued, because subject, its other, and the system were interdependent, “reality=community.”

In the ashes of cybernetics’ waning popularity and its re-assimilation into the specialization of American sciences, it was now to anthropological theory that Mead looked as a possible meta-discourse on the dynamics of Anthropology that must be able to pull the concept of reflexivity into the field of human action, namely culture, and make 2nd order observation a general way of thinking.

The Ethics of Emergence

The attempts to posit an ethics by cyberneticians culminates in the concept of emergence. The recent development of emergence shows up most prominently in the work of Chilean biologists and philosophers Humberto Maturana and Francisco Valera, who are considered 2nd wave cyberneticians. Scientists, philosophers, and neo-cyberneticians see the concept as inseparable from an ethical understanding of how human beings exist in larger systems. The concept of emergence is then picked up not only to theorize what is possible in a given human or nonhuman system but the very process of emergence is taken as what is preferable or what “should” take place in all systems. Umberto Maturana in particular explicitly characterized the emergence of new phenomena as a fundamentally ethical act because from his biological perspective of autopoiesis a human social system, or society, was merely a sub-set of numerous other social systems in the universe. Key to Maturana’s understanding

is that the kinds of interactions between individuals within a system define the type of society it is. Just as the "science" of cybernetics led Norbert Wiener to the prescription that "community=reality,"

Maturana was led to the conclusion that any individual, human, biological, or otherwise, to the extent that it acted as an autonomous agent, was only ever realized as such through its "neighborhood relations."[315] Emergence is "ethical" where humans are involved because however individual or isolated they may be, "constitutively affect" other agents or neighbors.[316] Maturana finally got to the point where, considering emergence, self-organization, and communication between individuals as ethical occurrences—the regulation and diminution of such occurrences for the order and organization of the larger system was unethical in both biological and social contexts. The call for emergence as increasing creativity through a multiplicity of choices led him to conclude that at the very least, "a social system is an essentially conservative system."[317] At its worst,

> the spontaneous course of the historical transformation of a human society as a unity is towards totalitarianism; this is so because the relations that undergo historical stabilization are those that have to do with the stability of the society as a unity in a given medium, and not with the well being of its component human beings that may operate as observers.[318]

Maturana's passage was a socio-political extrapolation, a prescription to keep systems of life away from equilibrium and closer to the chaotic state of constant

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[315] xxiii.
[316] Maturana and Valera, *Autopoeisis and Cognition*, xxvi.
[317] Ibid. xxvi.
[318] Ibid. xxvii.

change. Andrew Pickering believed that a worldview open to emergence to "what the world has to offer us," was a choice one could make to be non-modern in nature and utilizes materialism and bodies in motion in order to escape modernity's linguistic turn.[319] The importance of such an escape was to realize first that the "constitutive role" for material reality lay in performance of an agent within a system, in "worldly happenings, not in in knowledge.[320] As a historian of cybernetics Pickering was in full agreement with Von Foerster, Bateson Maturana, and others that ultimately ethics was an aesthetic, a techne as art or craft that necessarily puts together human and nonhuman agencies in a "dance."[321] To the extent that he and the cyberneticians he agrees with are "constructivists" it is so that they might help construct an "ontological theatre," as "somehow staging and dramatising configurations and interrelations of human and non-human agency."[322] In other words, the possibility for ethics requires this "staging" of uncontrolled experiments between human and nonhuman, what I have discussed as the virtual modeling of abstract machine systems. This machine aesthetic is found in the practices of ergonomics as well, and it is not only the observation of but also the participation in such systems that is valued as an insight into the novel ways that humans and machines might interact.

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[319] Andrew Pickering, "Ontological Politics: Realism and Agency in Science, Technology and Art," *Insights* (Institute of Advanced Study, Durham University 2011).
[320] Pickering, "Ontological Politics," 4.
[321] Ibid.

[322] ibid. 7.

Conclusion: Continental Thought and Michel Foucault's Cybernetics as pushing beyond Machine Bare Life

Recent work by Celine de Fontaine and others have show the strong epistemological affinities between French continental thought, particularly Structuralism and poststructuralism, and cybernetics of mid 20th century.[323] Jacques Lacan devoted much his 2nd seminar on integrating psychoanalysis with cybernetic to understand the "nature of language" and its relationship to the real. It has even been suggested that Lacan's work with mathematics and cybernetics resulted in his uncovering of a "cybernetic unconsciousness" in cold war Euro-American culture whose recognition helped Lacan develop his, "paradoxically nonlinguistic view of language, the symbolic order, and the unconscious."[324] Bernard Dionysius Geoghegan highlighted what he called the "cybernetic apparatus," a historical matrix of cybernetics, information theory, and new technical instruments and communication technologies at early mid 20th century. He argued that specifically those who study new media and deploy continental theory should be aware of their shared history, one that offered

> a repertoire of sources, methods, and perspectives for recognizing how this apparatus yoked together the development of "French" theory, media studies, informatics, and global science. The appeal of poststructural theories within the United States during the 1980s and 1990s owes much to this neglected history. Considering recent university-level efforts to reconceive the humanities in light of digital media, this revisionist history

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[323] Celine LaFontaine, "Cybernetic Matrix of French Theory"; Bernard Dionysius Geoghegan, "From Information Theory to French theory: Jakobson, Levi-Strauss, and the cybernetic apparatus," *Critical Inquiry* 38, no. 1 (2011); Lydia H. Liu, "The Cybernetic Unconscious: Rethinking Lacan, Poe, and French Theory." *Critical Inquiry* 36, no. 2 (2010): 288-320.
[324] Lydia H Liu, "The Cybernetic Unconscious," 290.

may prove timely.[325]

What Geohegan called an apparatus Celine de Fontaine called a cybernetic matrix in that, as a

> true matrix of techno-science…[that] made its imprint on the outset of an epistemological revolution, the scope of which we are only beginning to fully measure.[326]

She went on to argue that while a rereading of "deconstructionist, multitude, rhizome and 'everything is language' thinkers" through cybernetics seems unnatural to many in the humanities, it sheds new light on the fact that many of these French thinkers' were more influenced by a post-war American, not French context.

In "The End of the Book and the Beginning of Writing," Jacques Derrida took cybernetics as the fundamental break in our way of thinking difference through language. He argued that

> whether it has essential limits or not, the entire field covered by the cybernetic program will be the field of writing. If the theory of cybernetics is by itself to oust a metaphysical all concepts-including the concepts of soul, of life, of value, of choice, of memory-which until recently served to separate the machine from man,[327]

And reading Foucault, particularly in Discipline and Punishment one senses that in defining power as diffuse, systematic, and fundamentally as an apparatus that works on macro and micro levels—that the disciplinary power Foucault had in mind was in line with the "Zeitgeist," of the, "cybernetic rupture"

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[325] Bernard Dionysius Geoghegan, "From Information Theory to French Theory," 98.
[326] De Fontaine, "Cybernetic Matrix," 44.
[327] Jacques Derrida, *Of Grammatology*, trans. Gayatri Chakravorty Spivak (Baltimore: Johns Hopkins University Press, 1997), 9.

of 20th century.[328]

However, I am more interested in the less acknowledged insight that post-structural attempts at ethics resemble Cybernetician's own account of subjectivity and freedom. Foucault's work evolved away from studying power that resembled the general understanding of cybernetic control as an instrumental, Cold War means of military governance. Instead he began to ask questions about how subjects have actively worked to constitute themselves. I argue that his late work on subjectivity takes up the concern of what makes up life in all its individual, social, and ethical facets. Foucault's is a holistic conception of life that intersects strongly with the vitalist tendency in physiology I have discussed. Fellow vitalist/machine theorist Deleuze defended his belief that vitalism was in the major understandings of his work explaining that there were two elements of vitalism in Foucault. Deleuze's first point was that in his work on power, "the play of forces operates along a line of life and death that is always folding and unfolding, tracing out the very limit of thought."[329] Secondly, Deleuze explained that later in his work,

> when Foucault finally introduces the theme of "subjectification," it amounts essentially to inventing new possibilities of life, as Nietzsche would say, to establishing what one may truly call styles of life: here it's a vitalism rooted in aesthetics.[330]

I choose to end with Michel Foucault, who was responsible for opening the eyes of many a critical scholar to the workings of biopolitical production. His late

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[328] Lafontaine, "Cybernetic Matrix," 36.
[329] Deleuze, *Negotiations*, 91.
[330] Ibid. 91.

work in particular, perceived to be his ethical period or at least his preoccupation with ethical practices—that I highlight as keying into an openness that resonates with an affirmative biopolitics, a sense of machine life, a different form of communication, as well as a theory of subject that resonates strongly with Cybernetics.

It is Foucault's post-1982 turn to the ancient techniques which marked a "care of the self" that is generally agreed as Foucault's shifting concern with Ethics.[331] It is generally taken that Foucault's late work was criticized in a reaction,

> now less prevalent with the more extensive publication of Foucault's writings…that his focus on the subject in his later work was a sudden and mysterious occurrence and marked a rejection of an earlier radical stance.[332]

To Foucault the task for an ethical philosophy, as Paul Rabinow noted, "is not to replace one certitude with another but to cultivate an attention to the conditions under which things become "evident," ceasing to be objects of our attention and therefore seemingly fixed, necessary, and unchangeable.[333] The task to which Foucault put his final research on the ancients was not to map the content of their knowledge but rather the forms/structure of their knowledge, which were primarily shaped in order to know one's self and one's relationship to the self. Very much in line with what I have argued as the century long history of

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[331] Clare O'Farrell, *Michel Foucault* (New York: Sage, 2005), 113.
[332] O'Farrell *Michel Foucault*, 2005, 111.
[333] Paul Rabinow, "Introduction: History of Systems of Thought", *Michel Foucault, and Paul Rainbow, Essential works of Foucault, 1954-1984. Vol 1., Ethics: subjectivity and truth* (New York: Penguin, 1997), xix

cybernetics as a theory of the subject, Rabinow showed that Foucault provided both context on why he might turn to the ancients as well as modernity's tendency to trap its perspective with presentism and the error of, "the new."

> Foucault approvingly invoked Maurice Merleau-Ponty's definition of the task of philosophy, "to never consent to be completely at ease with what seems evident to oneself." What seems so new, if we are attentive, often can be seen to have been around, at the back of our minds, at the corner of our vision, at the edge of things we almost, but never quite, saw or said. "The most fragile of passing moments has its antecedents. There is a whole ethics of an alert certitude [evidence] which doesn't exclude a rigorous economy of Truth and Falsity, far from it, but isn't summed up by that economy either."[334]

Judith Butler argued that the Final Foucault was determined to conceive of subjectivity as a non-identity that was simultaneously unrecognizable at the same time that it demanded our recognition.[335] In fact, Butler speculated that Foucault's turn to the subject resulted in two late breaking features in his work. His analysis of subject intimated a, "Spinozistic presumption that every being seeks to persist in its own being…to what will further the cause of its own self preservation and self-enhancement."[336] Crucially Butler saw "reflexivity" entering Foucault's account of the subject, as a recognition and attachment to one's self that becomes a, "desire or passion of some kind."[337]

On the one hand Foucault's subject exhibited this tendency to persist, what Spinoza called a conatus unique to each individual—a purpose. On the other hand reflexivity was key to subject formation as an attachment to one's self

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[334] ibid. xix.
[335] Judith Butler, "Bodies and Power Revisited," in Dianna Taylor, and Karen Vintges, eds, *Feminism and the final Foucault* (University of Illinois Press, 2004), 193.
[336] Buttler, "Bodies and Power Revisited," 190.
[337] ibid. 193.

required an observation and account of what that self was. Purpose and reflexivity, the basic tenets of cybernetics were entering Foucault's work at a moment when it began to perform the ancient qualities he unearthed. He wrote that an ethics of discomfort was a particular practice of self, both for the journalist and philosopher alike, which fought similarly against the "pressure of identity and the injunction to break things up" that were both abusive.[338] The act of constant response and change in the face of these pressures was both a feature of life generally but also an important part of observing and critiquing such power structures as one subjected to them. Foucault adopted the singular and individual act of ethics because while nothing was more arrogant than imposing one's laws on others, "my way of no longer being the same is, by definition, the most singular part of what I am."[339]

Buttler's analysis certainly affirms the above quote and Foucault's call for an "Ethics of Discomfort." Perhaps it is the case that his foregrounding of the ancient subject, despite or even because its political exclusions of women, slaves, and most identities that were not a virile masculinity—put both the modern subject and the Judeo-Christian subject in a particular discomfort. As Foucault admitted he wasn't holding up the Greeks as a model, perhaps the discomfort would lead to something completely new, leaving all three behind in history.

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[338] Michel Foucault, "For an Ethics of Discomfort," The Politics of Truth, ed. Sylvere Lotringer & Lysa Hochroth (New York: Semiotexte, 1997), 137.
[339] Foucault, "For an Ethics of Discomfort," 137.

In *On the Genealogy of Ethics: an overview of a work in progress* he discussed the analysis and possible appropriation of an ancient form of subjectivation for either political and/or ethical purposes.

> Among the cultural inventions of mankind there is a treasury of devices, techniques, ideas, procedures, and so on, that cannot exactly be reactivated but at least constitute, or help to constitute, a certain point of view which can be very useful as a tool for analyzing what's going on now—and to change it.[340]

Foucault worked to unearth a particular ethical practice, a "subjectivation" in the ancients that was distinct both from the religious or pastoral construction of self that would succeed it as well as the modern subjectivity that would seek to gaze upon the other as an object of knowledge. The fundamental ethical process for a Judeo-Christian subjectivity, known as asceticism, was/is a "renunciation of the self [a]s the essential moment of what enables us to gain access to the other life, to the light, to truth and salvation."[341] The Christian ethic of renunciation, which took hold of antiquity and Europe, was what Foucault understood as a "trans-subjectivation," a change from outside or even an evacuation of existing self in favor of a new subjectivity. Instead, the ancient subjectivation he was interested in exploring was a conversion as care for existing self.

> I would propose that the conversion of the philosophy of the first centuries of our era is not a trans-subjectivation. It is not a way of introducing or marking an essential caesura in the subject. Conversion is a long and continuous process that I will call a self-subjectivation rather than a trans-subjectivation.[342]

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[340] Michel Foucault, in *Essential Works of Foucault: Ethics*, 261.
[341] Michel Foucault. *The Hermeneutics of the Subject: lectures at the Collège de France 1981-1982*, Vol. 6 (New York: Macmillan, 2005), 250.
[342] ibid. 212.

On the other hand, the Cartesian subject that took hold after the 17th century, if it could be considered as an ethic of self in any sense, supplanted the care of the self as a maintenance and endeavor, with the certitude of "I think therefore I am." Foucault was well aware of Descartes' place in the pantheon of modernism and sought a way out of the taken-for-grantedness of modern consciousness. He recognized that,

> …by putting the self-evidence of the subject's own existence at the very source of access to being, this knowledge of oneself…made the "know yourself" into a fundamental means of access to truth.[343]

The Cartesian version of the self, or cogito or "gnothi seauton (know yourself),"[344] as I discussed earlier that chose mind over body and then the power of psychology over physiology, also rejected self-work in favor of a certitude of self that sought to work on the objects of the World outside.

> But if the Cartesian approach thus requalified the gnothi seauton, for reasons that are fairly easy to isolate, at the same…it played a major part in discrediting the principle of care of the self and in excluding it from the field of modern philosophical thought.[345]

In perhaps one of his most explicitly laid out descriptions of his work, which I quote at length here, Foucault produced a sentiment that this chapter has attempted to echo. Our modern vantage point on crises of power, the political, and ethics are nothing new, and the tools for possible solutions may be traced through perceived failures, anachronisms, and out of place ideas. This passage is, I believe, a testament to how his lectures are greatly informative of Foucault's

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[343] ibid. 14.
[344] Ibid. 14, (Foucault's translation).
[345] Ibid. 14.

struggle to explain his historical projects as ethical projects and as containing an inextricable though contradictory link between the ethical and political, referred to indirectly by the imperative for a history of the present.

> The theme of return to the self has never been dominant for us as it was possible for it to be in the Hellenistic and Roman antiquity. To be sure, there is an ethics and also an aesthetics of the self in the sixteenth century, which refers explicitly, moreover, to what is found in the Greek and Latin authors I am talking about…a whole section of nineteenth century thought can be reread as a difficult attempt…to reconstitute an ethics and an aesthetics of the self…what I would like to point out is that, after all, when today we see the meaning, or rather the almost total absence of meaning, given to some nonetheless very familiar expressions which continue to permeate our discourse—like getting back to oneself, freeing oneself, being oneself, being authentic, etcetera—when we see the absence of meaning and thought in all of these expressions we employ today, then I do not think we have anything to be proud of in our current efforts to reconstitute an ethic of the self…I think we may have to suspect that we find it impossible today to constitute an ethic of the self, even though it may be an urgent, fundamental, and politically indispensible task, if it is true after all that there is no first or final point of resistance to political power other than in the relationship one has to oneself.[346]

We see in the passage the trajectory that Foucault led himself by following the figure of the individual. Perhaps the figure most indicative of the modern era, the individual can organize itself as many things—a single organism, subject, consciousness, ego. Whatever the particular identity was, it was irrelevant to Foucault in terms of the ethical, which was why he declared that all of our quips and contrivances about “oneself” were meaningless. Instead what was true and good for the self was never identity but the choices surrounding a self. I suggest that it was what choices had been made and what choices a self would make available for the future—this was somehow how an individual could be evaluated

[346] Ibid. 251-252.

ethically to Foucault. It was similar motivation away from the modern individual that led Von Foerster to declare that the ethical imperative for cybernetics was to, "[a]ct always so as to increase the number of choices."

I have so far illustrated that the seeds for cybernetics as a theory of subject were present in 20th century via cybernetics as well as in 19th century political thought and 18th century physiology to varying degrees. They can also be found in Foucault's work on antiquity where the common problem is a theory of governance as a self-deployed technique. It is understandable why both cyberneticians' work and Foucault's have been regularly met with criticism over ethical concerns. On the one hand cybernetician's continued to explore the idea that one could design freedom through technology, environment, and policy. On the other, Foucault believed so strongly that any organized form of government was a disciplinary apparatus imposed on individuals from the outside, that his proposal for an ethics leveraged the criticism that he was amoral. There exist, "grave misunderstandings" that sees his work as either calling for a return to Greek Life, or at worst an ethics based on amoral aestheticism.[347] He did express his interest in a form of ethics so autonomous and divorced from modern governance that it left more questions than answers to how it would be a better way. Foucault wondered if there could be an ethics that was,

> a very strong structure of existence, without any relation with the juridical per se, with an authoritarian system, with a disciplinary structure . All that is very interesting.[348]

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[347] James W Bernauer, and Michael Mahon, "The Ethics of Michel Foucault," *The Cambridge Companion to Foucault* (Cambridge University Press, 1994), 153.
[348] Foucault, *Essential Works: Ethics*, 260.

In the sections of his work that most resonate with the cybernetic theory of subject, Foucault deemphasizes the metaphysical register of care of the self that cares for one's soul, and instead focuses on the care of the self as "a rule coextensive with life."[349] What Foucault unearthed in Marcus Aurelius' thought as a "biotic" or an "art of living" is tantamount to "both an open and oriented preparation of the individual for the events of life." It is also emphasized that the art of living as a set of techniques of caring for the self is not like the conquering, mastery, or the "triumph over others" in life.

Rather the maintenance of life is "nothing other than the set of necessary and sufficient moves, of necessary and sufficient practices, which will enable us to be stronger than anything that may happen in our life."[350] Foucault reiterated throughout his late work that he was interested in a subjectivation that neither renounced the self or what it knows, nor one that made itself (in the form of the mind principally) the object of its knowledge. I argue that in order to answer the question of substantially distinguished this ancient model of subject Foucault introduced two concepts shared by cybernetics. The first is familiar to those who have used Foucault as technique or technology of self and is a shift in perspective towards subjectivity that is active, that negotiates power in a continual process of self-making. The second concept he has in common with cybernetics is teleology or the acting by a subject through time with purpose.

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[349] Michel Foucault, *Hermeneutics*, 247.
[350] Ibid 320-322.

Foucault repeatedly stated in lecture the importance of conceiving of subjectivation as a journey, and turns to adopt the metaphor that has been most important to cybernetic thought, that of navigation, or steering oneself. The metaphor of navigation of the self had four components that made it a "complex, both theoretical and practical knowledge, as well as being a conjectural knowledge, which is very close, of course, to the knowledge of piloting."[351] These four components also resonate with the foundational concepts of Cybernetics and reflect well their deployment into a theory of subjectivity. First was the idea of the journey, that the movements of change to a subject were "a real movement from one point to another."[352] Second, there is the implication that movement itself is movement directed towards a particular aim or purpose. These two components reflect teleology, or the conception of purposeful action through time.

Third, within the metaphor is the idea that the purpose or point of movement of the self is its port, its place of origin or its homeland.[353] This movement from self to self, and one that Foucault repeatedly describes as a turn or return to the self, is in fact a precise understanding of what Hienz Von Foerster characterized as the, "partnership in the circularity of observing and communicating,"[354] the idea that to do the one is to do the other. Reflexivity in (2nd order) cybernetics was the including of the observer into observed systems,

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[351] Ibid. 249.
[352] Ibid. 248.
[353] Ibid. 249
[354] Hienz Von Foerster, "Ethics and Second-Order Cybernetics" in *Understanding Understanding: essays on understanding and cognition* (New York: Springer, 2003), 289.

or the critique of behaviorism by moving empirical focus from observation to the observer or subject. Just as Foucault was interested in an ancient self that eschewed the Cartesian, objectifying and psychologized modern subject, reflexivity of observation in 2nd order cybernetics moved to a powerful critique of objectivist epistemology, and the turning towards the self for Foucault will, as I discuss later, continue to drive the power of this particular subject.[355] Finally, within the idea of navigation is that there are external dangers and risks that alter your course or "lead you astray," and because of your experience of those dangers your navigation implies a knowledge (savoir), and technique, an art" necessary for the undertaking of your voyage.[356]

As Foucault concludes in his lectures on the hermeneutics of the subject, the care of the self which was within a practiced "tekhne tou biou" or art and craft of living, "became the correlate of a test, an experience, and an exercise.[357] That is to say that the function or purpose for a care of the self was always strictly speaking the maintenance of the human subject, physiologically and socially, in response to outside forces acting against that maintenance of subjectivity. Echoing Wiener's "the organism is the message" the continued expression or communication of subjectivity through space and time, and against adversity, which we can translate as dissolution of subject, or entropy, is the purpose of the endeavor to know oneself. Foucault moves even closer to the cybernetic theory

[355] Hayles, How We Became *Posthuman*, 134.
[356] Foucault, *Hermeneutics*, 249.
[357] Ibid. 487.

of subject when he further explains the process of care of the self as a "reversal of the gaze" onto oneself.

> You see then, and I strongly emphasize this, that this demand for a reversal of the gaze, as opposed to unhealthy curiosity about others, does not lead to the constitution of oneself as an object of analysis, decipherment, and reflection. It involves, rather, calling for a teleological concentration…[358]

Foucault characterizes this ancient production of (human) subject, one that he would show affinity for in his late work on Paeresia and Truth, as a teleological or purposeful. And it seems to me that it is a rather bizarre purpose, one distinctly without an End in itself: purpose, not end or finality. For, he continued:

> We must be aware, permanently aware as it were, of our effort… but being always acutely aware of this tension by which we advance towards our aim. What separates us from the aim, the distance between oneself and the aim, should be the object, once again, not of a deciphering knowledge (savoir), but of an awareness, vigilance, and attention.[359]

So the purpose of this subjectivation—in other words not the purpose of the subject but the purpose of the production of the subject—was not the aim but the distance between self and the aim. To imagine one's utmost concentration not on ends and not on identity (and how to maintain it) but rather on the distance between self and perceived end, was in some sense Foucault clamoring for a move in his late work, already beyond the machinations of power, beyond now the subject as we have known it.

It was, I believe, the inherent connections between purposefulness, ethics, and a conception of life (in general) unindividuated by knowledge, that compelled

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[358] Ibid. 222.
[359] ibid. 247.

both Foucault and Gilles Deleuze to end their scholarly lives, as Giorgio Agamben observed, concerned with Life. Although considering the utmost urgency he attributed to his teacher and historian of life sciences Georges Canguilhem's work[360], as well as his mission statement for his appointment at the College De France, it is not surprising that the physiological and biological components of life would influence his final work.

It is why Foucault, in finally reformulating life to be "that which is capable of error, was attempting, again as Agamben observed, to find another major axis, "distinct from both knowledge and power" or for that matter from Subject, at least as it has largely been theorized, as well.[361]

> At the center of these problems one finds that of error. For, at the most basic level of life, the processes of coding and decoding give way to a chance occurrence that, before becoming a disease, a deficiency, or a monstrosity, is something like a disturbance in the informative system, something like a "mistake."[362]

This definition dovetailed well into Foucault's understanding of the entire enterprise of Philosophy: the notion that Life continually belies, and short circuits, and persists in the face of Truth. Deleuze, who had detailed the plane of immanence as constituting what exists both actual and virtual, in somewhat of a

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[360] From Foucault, "Life: Experience and Science," Michel Foucault, *Aesthetics, Method, and Epistemology*. Vol. 1, ed. James D. Faubion, trans. Robert Hurley et al (New York: The New Press, 1998).
"But, take away Canguilhem, and you will no longer understand very much about a whole series of discussions that took place among French Marxists; nor will you grasp what is specific about sociologists such as Pierre Bourdieu, Robert Castel, Jean-Claude Passeron, what makes them so distinctive in the field of sociology; you will miss a whole aspect of the theoretical work done by psychoanalyists and, in particular, by the Lacanians." p. 466.
[361] Giorgio Agamben, "Absolute Immanence," *Potentialities: collected essays in philosophy* (Stanford University Press, 1999): 221.
[362] Michel Foucault, *Aesthetics, Method, and Epistemology*, 476.

reversal, claimed in his last writing that pure immanence is contained within Life, or more specifically a Life, that is as Agamben understands it, unattributable life.

> The plane of immanence thus functions as a principle of virtual indetermination, in which the vegetative and the animal, the inside and the outside and even the organic: and the inorganic, in passing through one another, cannot be told apart.[363]

Foucault not only surmised that the genetic function of life was to provide the possibility of erring, he believed this to be an ethical imperative for one's subjectivity. For what, as Paul Rabinow observed, was the quality of error if not simply the capability to *not* remain the same self, the capability of change?

> "One's way [facon] of no longer remaining the same," he wrote, "is, by definition, the most singular part of who I am." However, that singularity was never a blanket negation : if one knew in advance that everything, including one's self and the current state of affairs, was bad, what would there be to learn? What would be the sense of acting? Why think? A life without the possibility of error would not be conceivable. One might say, following Georges Canguilhem, such a life would not be alive.[364]

The strange coupling of the teleological navigation within Foucault's late work and his final understanding of the error of life, stands, I believe, as a fine beginning definition of the subjectivity of the machine, but a very particular machine. The "non-trivial machine" as Von Foerster defined it, is history dependent, analytically undeterminable, and unpredictable. Additionally, non-trivial machines are the only kind of machine that have ever been.

> I would even say that nothing is predictable. All systems that we isolate from the universe are non-trivial systems. Our hope that they are trivial is,

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[363] Agamben, *Absolute Immanence*, 233.
[364] Michel Foucault. *Ethics: Subjectivity and Truth. Vol. 1* (New York: New Press, 1997), xix.

looked at carefully, a naïve hope…[365]

The problem is that humans have always misrecognized the machines that exist, complicated and unpredictable, for the kind of machines we want—simple, predictable, and controllable. What results from such misrecognition is usually violence and loss along with a human response of suspicion to all machines. The ethical implication of Foucault's life as error, Deleuze's unattributable life, or Von Foerster's non-trivial machine, is seemingly that of mortal danger.

For at this moment the most readily available examples of unattributable life arise as traumatic anthropomorphisms. Unchecked, unmanageable growth goes viral, infects, is contagious, and metastasizes. It is the tendency within our own bodies for undifferentiated cellular growth, the cancer that, if not battled, produces the severe dissolution of what we know to be a good life. These tropes, too, of cancerous growth, or of viral contagion, inform our fearful understanding of our technologically connected lives and the prospect of unchecked connectivity among machines. Eugene Thacker and Alexander Galloway have attributed this danger to the confluence of "language, life, and code." It is software as computing machine language and our sustained attention to discourse that sees that language as a threat and "to see communication and contagion as inseparable processes.[366]

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[365] Heinz Von Foerster, *The Beginning of Heaven and Earth has no Name* (New York: Fordham University Press, 2014), 19.
[366] Alexander R. Galloway and Eugene Thacker. "Language, Life, Code." *Architectural Design* 76, no. 5 (2006): 26.

This is perhaps why Patricia Ticineto Clough speaks with senses of urgency and danger about the Affective turn in critical scholarship, all while continuing to push beyond language and ideology to those affective and social aspects of an agent, "which exceeds all efforts to contain it, even our efforts to contain its thought in the affective turn."[367] Her call consistently pushes us beyond perceived trauma to face ourselves up to what Gilles Deleuze theorized as "life" a,

> frightful non-organic life of things . . . oblivious to the limits and wisdom of the organism. . . pre-organic germinality, common to the animate and the inanimate, to a matter which raises itself to the point of life, and to a life which spreads itself through all matter. (1986: 50–1)[368]

Again, without being able at this moment to offer a less reductive anthropomorphism of good life in mortal conflict with its malignant other, I do suggest that, because of the inextricable link in biopower, between life and its other, we should persistently complicate the matter further, even at the cost of communicating a life form that is in our moment unrecognizable as such. To end with Agamben, perhaps the most urgent of biopolitical observers, "Today, blessed life is on the same terrain as the biological body of the West." I would add that our machine friend's body lies just below that.

The mortal danger is intensified greatly when our attention is turned to those situations where the error of human life and the error of machines are put together most intimately. The field of engineering that cybernetics birthed, bionics

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[367] Patricia Ticineto Clough, and Jean Halley, *The Affective Turn: theorizing the social* (Duke University Press, 2007), 28.
[368] Patricia Ticineto Clough, "Afterword: the future of affect studies," *Body & Society* 16, no. 1 (2010): 227.

(aka bionical creativity engineering), or the science of modeling technology based on the observation of biological life—materially grafts one to the other. Also, there has, since mid 20th century, been serious attention paid to technological systems where humans and machines mutually communicate, react, and adapt to one another. These dangerous scenarios of machine-human communication with its potential for error will be the chief concern of the science of "proper" interrelationship—Ergonomics, which is the subject of my next chapter.

Ergonomics or The Study of Human-Machine Affection

I have argued to this point that physiology and cybernetics shared a vitalist tendency towards both organisms and matter. In other words the principle present in a longstanding history of posthuman thought states that matter in general is self-organizing based on its relational interactions with other matter—systems tend to organize themselves. In what follows I demonstrate that ergonomics continues this principle of material agency, though with the additional express recognition of affect as the fundamental medium of communication between any agents.

The coverage of ergonomic design in popular media has recently taken on a deterministic character. In 2009 the London Museum of Design put together a yearlong exhibition celebrating Ergonomics, or as it describes, the "science of everyday life," which both the Guardian and BBC reported on as the essential

ways that ergonomics designs and shapes our "daily lives." Designers, advertisers, and manufacturers agree on a peculiar truism, that you can have too much a good thing insofar as ergonomic design. Even good ergonomic design, moreover, can be a bad thing for business. As Dick Powell, the designer that created the first "ergonomic" bra in the 90's, complained that

> there's more than enough ergonomics being applied. It's frustrating when the ergonomists tell you it's not enough. We usually design things to be produced in millions, and something has to give…[369]

The business side of the production of work machines has a naturally antagonistic relationship to ergonomics because ergonomics has generally appeared in the form of regulations and penalties levied on business practices and increased premiums based on workers' compensation. Ergonomics allegedly goes too far in its capacities to impinge on free market decisions, pitting the market against the well being of the worker. It took more than 40 years for the field to gain national recognition for its successful interventions into on the job trauma and its worker safety recommendations beginning in the 1990's. The passing of the Americans with Disabilities Act in 1990 was a key moment that opened up workspaces and machinery to evaluation and government authorized recommendation by ergonomists.

By 1992 the Occupational Safety and Health Administration (OSHA) had drafted its, "Ergonomics Program Management Recommendations for General

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[369] "How Ergonomics affects our Daily Lives" The Independent online, accessed May 1st 2014, http://www.independent.co.uk/life-style/gadgets-and-tech/features/how-ergonomics-affects-our-daily-lives-1822298.html.

Industry."[370] OSHA, itself put into legislation in 1970, was talked about by ergonomicists as both being a law for general well-being of workers that was ahead of its time and one that seemed likely to fail in its effectiveness.[371] In January of 2001, OSHA's, "Ergonomics Program Standard went into effect, with the aim of protecting approximately 27.3 million employees from musculoskeletal disorders (MSDs)."[372] It was the closest that government oversight had ever come to an ergonomic perspective on labor conditions, and it took less than 7 weeks for it to be repealed by congress under pressure from business leaders and the national insurance lobby.[373] More recently, Michigan became the first state to put a statewide ban on ergonomic regulations in order to help business and job growth.

There is an alarmist online story at Fastcodesign.com called, "How Everyday Ergonomics Shape Your Behavior." Fast Company is a magazine and web site that describes itself as

> the world's leading progressive business media brand, with a unique editorial focus on innovation in technology, ethonomics (ethical economics), leadership, and design.[374]

The story begins with another provocative insight provided by Charles Darwin over 100 years ago in, "The Expression of Emotions in Man and Animals," where he concludes that, "the free expression by outward signs of an emotion

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[370] Valerie J. Rice, "Ergonomics and Healthcare," Work, (1993, 4:3, 127).
[371] F.H. Bonjer, "Plenary Talk to International Ergonomics Association," *Ergonomics,* 19, 3 (1976).
[372] Rachel Michael, "Ergonomics: It's Here to Stay, Despite the OSHA Standard Repeal," Environmental Quality Management, Summer (2001), 57.
[373] Rachel Michael, "Ergonomics: Its Here to Stay," 57.
[374] "How Everyday Ergonomics Shapes Our Behavior," FastCompany online Magazine, accessed May 1st, 2014, http://www.fastcodesign.com/3020231/how-everyday-ergonomics-influence-your-behavior#comments

intensifies it."[375] This recurring theme of my study is echoed here in the power of external expression, namely the expressions of the body free or in excess of psychic control. The article explains this insight as one of physiology, that our physical and physiological actions to the outside environment influence and intensify what we think and feel "inside." It then goes on to argue that ergonomists have been designing many of our external environments for decades. Additionally, everyday or incidental ergonomics, those design elements we may not be conscious of, affect our behaviors in unintended and not necessarily good ways. Interviewing a psychologist whose recent work investigates ergonomics' relationship to unethical behavior in humans, the article concludes with a vague cautionary as an insight into the moral quandaries of design, highlighting the longstanding ergonomic hypothesis that humans not only have an ecological/symbiotic connection to things in their environment but also do not have the control over their psychology or behavior that they believe that they do.

What emerge from these and other headlines are two interrelated ideas about how ergonomics influences, shapes, and engenders human behavior. One, on a societal level its design principles can inhibit business interests and "impede job growth" as Michigan Governor Rick Snyder claimed after putting into law a ban against ergonomics rules in local companies.[376] Also on societal level

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[375] ibid.

[376] "Rick Snyder says ban against ergonomics rules will stimulate job growth in Michigan The Ann Arbor News, accessed May 1st, 2014, http://www.annarbor.com/news/rick-snyder-says-ban-against-ergonomics-rules-will-stimulate-job-growth-in-michigan/.

ergonomics influences workers' behavior and actions towards predesigned ideas about healthy, efficient, and economical labor. This results from machines and equipment designed with concerns for musculoskeletal effects from sedentary jobs, physiological stress caused by repetitive motions, as well as workers coming to a job who are differently enabled. As I discussed earlier, this notion of large-scale design to improve ethics, culture or the health of a population has serious consequences for American notions of freedom, creativity, and individuality.

The second idea now emerging about ergonomics is that, given that ergonomic design determines behavior through and with machines, ergonomics takes on a pedagogical role for individuals seeking to improve certain areas of their lives. Phrases such as "whole life ergonomics" and "everyday" ergonomics suggest a kind of ubiquity to the designed machines and spaces that affect us and also that the science of ergonomics can itself become a set of technologies by which we may negotiate and understand ourselves outside of official "work". It is this emerging notion that ergonomics, beyond an academic and industrial field that studies humans and machines, can be thought of as a set of technologies of self for individuals as they become more aware of the important ways that they interact with all sorts of machines.

Amy Cuddy, who coauthored, "The Ergonomics of Dishonesty: The Effect of Incidental Posture on Stealing, Cheating, and Traffic Violations," in the journal *Psychological Science*, has recently taken her knowledge of ergonomics' power

to the marketplace. At TED talks and other business organization events she has argued that an ergonomic understanding of your posture in public can bring you success in career and happiness in life. She has introduced “Power Poses” as a sort of ergonomic technique for asserting individuality through physical movement and posturing. Cuddy, as the creator of Power Posing claims, “I want to help people feel as powerful as they can feel.” This underscores well the precarious standing of ergonomics as a field of knowledge and practicable skill. Ergonomics is already being used on an individual level as a set of techniques to alter someone’s psychology and physiology. There is an intuitively felt power to ergonomics, to what it tells us about our behavior and to the ways we will change our actions based on that knowledge.

Ergonomics and Media Studies

I believe that my study of ergonomics will shed light on its role as both a theory of good design for the health of a population as well as its more recent status as a set of technologies of the self for individuals to direct their own lives. The idea of individuals actively involved in a set of ergonomic technologies is a continuation of my discussion of governmentality and technologies of self in the cybernetics chapter. Additionally, the lineage of thought informing ergonomics will illustrate just how long individuals have worked on the idea that humans coevolve with technologies and distribute both their cognition and affect with machines. Ergonomics provides an example of mediation on a bodily and

affective level showing what mediation through machines does to human beings rather than what it means or represents to them. For Grusin the study of affect led to an entirely different theory of media.

> Affectivity helps shift the focus from representation to mediation, deploying an ontological model that refuses the dualism built into the concept of representation. Affectivity …refuses what Bruno Latour has characterized as the modern divide, variously understood in terms of such fundamental oppositions as those between human and non-human, mind and the world, culture and nature, or civilization and savagery (Latour, 1993).[377]

Ergonomics followed the thread of affectivity through vitalism in physiology and through the open systems and ethics as aesthetic that cybernetics had to offer. It also follows a critical trend that I have discussed as a critic looking to non-modern solutions and ways of thinking through modern problems. In his latest book Alexander Galloway engages again in this sort of ancient parsing of modern conceptual problems.

Donna Haraway observed years ago that the modern First World had undergone an epistemological and political alteration to many previously fixed or naturalized categories—and she described this shift as an "informatics of domination."[378] Importantly she stated that where there existed before an "organic division of labour" there was now in its place an "ergonomics/cybernetics

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[377] Grusin, *Premediation*, 8.
[378] Donna Haraway*, Simians, Cyborgs, and Women: the reinvention of women*, (New York: Routledge, 1991), 161.

of labour" and where there had existed a notion of (human) labour there was now robotics.[379]

I bring Haraway's analysis to attention in order to first suggest that it was less a description of the moment in which she was writing and more a prognostication that inextricably links the future of machines to the history of the digital through the profusion of information or binary code. I also like to point out that neither cybernetics nor ergonomics need be limited to the their historical status as "coded by C3I, command-control-communication-intelligence"[380] and that just as I illustrated earlier with cybernetic theories of machine subject, so to with ergonomics there emerged a practice of human machine research that, unlike Haraway's prognostication, did not pit the organism against the machine in a "border war" and that, very much in the spirit that she suggests, ergonomics has to various extents taken "pleasure in the confusion of boundaries" between humans and machines and has also adopted a "responsibility" in their constructions.

Through the intellectual threads of physiology and cybernetics I have attempted to carefully reconsider the links between their machine-theories and their later integration into ergonomics as a posthuman complex. After reading dozens of attempts to systematically define the field, I believe that there is no strong contradiction or differing opinion on a basic guiding principle—that ergonomics aim is to fit technologies to human beings. This sensibility does not

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[379] Haraway, "Simians," 161.
[380] Ibid. 164.

base its use of machines on instrumental rationality nor an efficient process calculated by measuring profit margin to paid labor cost.

As such my analysis separates an integrated and holistic ergonomics from the very narrow conception of it as a form of technoscience. Haraway described it as on the one hand a historical change in biological science under the auspices of biocapital production. On the other hand it was an information/systems approach shift based on a communications technological revolution that

> changed the strategy of control from organism to system, from eugenics to population management, from personnel management to organization structures (sociotechnical systems and ergonomics) based on operations research (Lilienfeld, 1978, ch. 4).[381]

The problem with ergonomics from this perspective is exactly the same problem with cybernetics as members in a group of "bogeyman" theories. Through biocapitalist production, what Haraway calls the "biopolitics of postmodern bodies"[382] the epistemology and empirical methods of particular sciences reduce into simplistic programs for governing bodies and subjects. In order to disarticulate ergonomics from such a characterization this chapter makes two basic points regarding its development. 1) I complicate its history by showing that since its first use in the 1857 ergonomics has been highly influenced by a utopic thought that is reformist, progressive, and liberalist in character. 2) My chapter shows that this liberal humanist tendency in ergonomists' thought coexisted alongside the foundational use of cybernetics and system theories that at the same time fundamentally altered the idea of what humans were in relation to

[381] Ibid. 58.
[382] Ibid. 161.

machines. With these together ergonomics provides a powerful way of materially and empirically better understanding human and machine affect. From this point on when I refer to an "ergonomic" perspective I am referring to the above description.

Ergonomics Defined and seeds of Humanism

KHF Murrell coined Ergonomics in England as the science of "man in his working environment." It was a field that owed its emergence to WWII and the subsequent powerful belief in the West that an intricate relationship between Scientific thought and the technology it produced, if let to flourish, could prevent Fascism and fundamentally better humankind.[383] HFE research flourished during this high moment of techno-science in the West, or the conflation of science and technology based on the singular belief in their powers to alter reality (physical, political, ethical). Murrell was attempting to create a multidisciplinary group whose sole purpose was based on the most basic principles of "human research", "health" and "the good." What had been the "Human Research group" became the Ergonomics Society and quickly shifted its scope beyond merely conditions of the work environment and beyond as well designing machines of war and of the factory. To its earliest 20th century proponent Murrell, Ergonomics developed the first principle of the machine where it and the human operator were parts of a larger system,

[383] Chunglin Kwa, *Styles of Knowing*, (University of Pittsburgh Press, 2011).

> To achieve maximum efficiency a man-machine system must be designed as a whole, with the man being complementary to the machine and the machine being complementary to the abilities of man.[384]

From the inaugural issue of "Human Factors: the journal of human factors society of America" in 1958:

> In this study [of human factors] in which cross-fertilization between life sciences and engineering is encouraged, the human factor is considered in relation to the machines and environments in which man works and plays…the ultimate aim…is toward the optimal utilization of human and machine capabilities to archive the highest degree of effectiveness of the total system.[385] (Morehouse 1958, 1)

More recently, the 1989 preamble to the Human Factors and Ergonomics Society code of ethics defines its work thusly:

> The Human Factors and Ergonomics Society is dedicated to the betterment of humankind through the scientific inquiry into and application of those principles that relate to the interface of humans with their natural, residential, recreational, and vocational environments and the procedures, practices, and design considerations that increase a human's performance and safety at those interfaces.[386]

Between the end of the 1960's and the beginning of the 1970's developed an explicit liberal humanist philosophy, one that put ergonomists in a long lineage of scientists deploying radically anti-anthropocentric theories. This would lead to the problematization of many cold war uses of statistics and measurement for the control of closed systems of human beings and technology.

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[384] KF Hywel Murrell, *Ergonomics: man in his working environment* (London: Chapman and Hall, 1965), xv.
[385] Morehouse, "Introduction," *Human Factors: The Journal of the Human Factors and Ergonomics Society* 1, no. 1 (1959): 1.
[386] "Human Factors and Ergonomics Society Code of Ethics" accessed March 1, 2013. http://www.hfes.org/web/abouthfes/ethics.html.

> I am for the measurement, description, prediction, and control of human behavior. But I am concerned as to where that control will reside. Obviously, I want as much of that control as possible to reside with the individual.[387]

This concern illustrates the development of a philosophical view of ergonomics which sought, against statisticization of processes, to see the human being not as an error but as a creative problem solving component of an open and less uniform human machine system.[388] Thus, from the perspective of designing a system conducive to this human role, the ergonomist was called upon to be "empathetic" as an observer and as a decision maker. Crucially, in ergonomics this human centric philosophy was unproblematically put to work alongside systems and cybernetic theories, those that, as I go on to argue, provided very similar creative and reflexive qualities to nonhuman organisms.

After reading the above and dozens of other attempts to systematically define the field, I believe that there is no strong contradiction or differing opinion on a basic guiding principle—that ergonomics aim was and is to fit technologies to human beings. Like cybernetics, ergonomics and its radical conception of humans and machines provided the possibility for multiple, intense re-articulations of a humanist-human figure back into its technological systems. All of this produced, as I argued in chapter 2, a feedback mechanism whereby the radical nature of cybernetics and systems theories produced the humanist desire

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[387] Julien M. Christensen, "Individuals and Us," *Human Factors: The Journal of the Human Factors and Ergonomics Society* 8, no. 1 (1966): 6.
[388] D. J. Osbourne, F. Leal, R. Saran, Pat Shipley, and Tom Stewart, eds. *Person-Centred Ergonomics: a Brantonian view of human factors* (CRC Press, 2003).

for an ethical reframing of technologies towards increased freedom and quality of life for human beings.

Part 2: Ergonomics a Subjugated Knowledge of Work Science

In a sense ergonomics represents not an evolution in bio-techno-capital, but is rather an example of a subjugated knowledge based on its problematizations of Capitalist interests' bottom line. We can see this in the recent past of ergonomics and its embattled position between American Business and the Federal Government.

Just as physiologists had taken it up in the last decades of the 19th century, ergonomists were largely concerned with the idea of human fatigue both as a physical and psychological straining of the worker. And just as physiologists had assumed to build industrial machines that would adapt to the optimal function of human anatomy, ergonomists sought as a founding principle to "fit the job to the man." This philosophy of adapting work environments to the indulgences of laborer well being was not the answer that Frederick Taylor and American work science were satisfied with at the turn of the century, nor was it again after 1945 when Fordist accumulation had come to fruition.

As David Harvey pointed out, Ford's innovations did not lie in the technological and scientific processes of his factories, those he simply inherited from Frederick Taylor and the movement of science management from the turn

of the 20th century.[389] Harvey here built upon Antonio Gramsci's mechanistic linking of Fordism to its predecessor Taylorism, with no change in the "puritanical" sensibility toward the worker that from a technological sense reduced work to only its physical-physiological processes and from the human standpoint put the workers in an ascetic relationship to their labor. Ford thus continued the divestment of the "spirituality" of the worker, the worker's relationship to art, her role as "demiurge"—in a word, the humanism in labor.[390]

The break in this line from Taylor to Ford that ergonomics produced, worked beneath its explicit concerns with the "optimization" of workers and machines productivity, and despite its attribution of its methodology to the science of work before it. Implicit in the research principle to fit the job to the worker was the basic interest to empirically understand how, "technological development can produce effects on operatives which may not always be foreseen."[391] This marks the beginning of the philosophy of ergonomics in its literature that frames technology's influence on human's users in terms of registers unknown or even non-conscious to humans. It is a point I will return to at the conclusion of the chapter that ergonomics is a serious attempt at the empirical study of affection that technology is responsible for in humans, and the attempt to locate the human factor in the machine is an attempt to trace the reciprocity of affect that humans return in their design of machines. The

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[389] David Harvey, *The Condition of Postmodernity: An Inquiry into the Conditions of Cultural Change* (Oxford: Blackwell, 1989), 125.
[390] Antonio Gramsci, *Selections from the Prison Notebooks of Antonio Gramsci: Ed. and Transl. by Quintin Hoare and Geoffrey Nowell Smith* (New York: International, 1971), 303.
[391] Murrell, "Ergonomics," xi.

importance of affection and its reciprocal nature between them is what will lead the most contemporary ergonomics to study non-economical forms of labor/leisure practices like symbiosis, sensuality (Kansei) or happiness produced between humans and machines.

However, on a more concrete level ergonomics did not provide the change or answers sought by Fordist technological innovation to Taylorist work conditions. For example, managers and work experts both relied on any and all scientific findings pointing to psychological and physical pacification of workers and their acceptance of a production system in the assembly line that

> rested so heavily upon the socialization of the worker to long hours of purely routinized labour, demanding little in the way of traditional craft skills, and conceding almost negligible control to the worker over the design, pace, and scheduling of the production process.[392]

Along with the deskilling of labor, or as Gramsci argued, taking the intimate relation between art/craft and labor, the importance of this Fordist technology was in the dynamic it established whereby the industrial machine "trained" or led the direction and rapidity of movement of the human operator—this was the functional essence of what Ford had invented, the automated conveyor belt. Ergonomist Murrell called this "machine pacing," in his brief tome "Men and Machines."[393] In his concluding section, "Machines controlling Men," the pacing of the worker, or the inducing of the worker by mechanism to "work at a rate of his/her choosing," had results for productivity that were "difficult to interpret and

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[392] Harvey, Condition *Postmodernity*, 128.
[393] Hywel Murrell, *Men and Machines*, (London: Methuen& Co. Ltd., 1976).

compare."[394] Murrell discussed a general industrial philosophy that forcing a worker to work at the accelerated rate of a machine will cause the worker to adapt to its productivity over time. Two aspects of Murrell's philosophy are especially significant. 1) Murrell's analysis of this (managerial) practice is complicated, expressed largely through numbers, and provides answers by way of maintaining that context and individual characteristics matter. 2) His analysis began with the assertion that machine pacing does not lead to the desired productivity. Machine pacing, leading, or governing of the human worker was antithetical to the project of ergonomics as Murrell saw it. Not only was it an instance of the modernization of work that fit the man to his job. It also neglected one half of the entire man-machine system, it neglected to see the two as communicating with one another. Murrell would continue to stress the wholeness of the human-machine system as well as the necessity of a relation of equity within it. As in cybernetics,

> [f]or effective communication, perhaps there can be no master. Both sender and receiver must have arrived at a basic agreement on the meaning of the terms and their codes…[395]

Murrell designed ergonomics in order to, "advance the ability of men and machines to communicate with one another."[396]

Humanism, Progressivism in Ergonomics

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394 Murrell, *Men and Machines*, 109.

395 Martin H. Weik, *Standard Dictionary of Computers and Information Processing, Introduction* (New York: Hayden Book Company), 1969, 1.

396 Weik, Standard Dictionary, Introduction

It is not surprising that the first strong interest in Hywel Murrell's work came first from the Navigators of the British Royal Army, given that it was almost immediately apparent in his writings that he was trying to develop a theory of work based on humans and machines with the skills to self-navigate as they worked. The navigation of one's individual labor between an external environment of government and the internal necessity of comfort or health would be the driving problematic for his development of ergonomic theory, and his guiding principles would vacillate between progressive era humanism and the insights of cybernetics and systems theory. Murrell's suggested ergonomics stands first and foremost as a particular response to and shift away from the work of Frederick Taylor, whose scientific management I have previously discussed.

Interestingly Hywel Murrell identified not as an Ergonomist but a psychologist and took the study of humans and machines, seemingly on the surface to be largely the work of the psychology.[397] This also is not at all surprising, as it indicates the dominance of psychological study in industrial contexts since the turn of the 20th century and the rise of scientific management specifically as Friedrich Taylor envisioned it. As already discussed, Physiological theory dictated answers to problems of fatigue and efficiency that industrialists and factory owners had no use for in their bottom line of cheap, adaptable human labor. The psychologist rationalization was that physiological processes were at

[397] Murrell, Hywel. "Occupational Psychology through Autobiography." *Journal of Occupational Psychology* 53, no. 4 (1980): 281-290.

best partially accounting and at worst mere symptoms of mental "performance capacity." This new industrial buzzword arising from scientific management, "was primarily a psychological phenomenon and must be studied from the perspective of psychology…"[398]

The emphasis on psychology implied ultimate ergonomic interest in the "why" of human labor, which lead to certain of the key concepts of study like motivation, desire, annoyance, and attention. This is largely a matter of the enormous industrial interest and pressure exerted on ergonomics by owners, industrial investors, and other capitalist interests. In fact it is not an exaggeration to claim that the emergence of ergonomics depended almost entirely on two vested interests, the WWII British military and the continued interests in an efficient labor force in industry.

As Chunglin Kwa observed, 1945 marks a watershed in the development of sciences insofar as government support, particularly its military arm, of ostensibly "basic science" or discovery—jumped to unprecedented levels.[399]

> Those who recall the 1945-1970 period as the golden age of unfettered, pure research, or as the age of scholarship in the ivory tower, are overlooking the stunning extent to which academic science relied on defense contracts and fed into military programs.[400]

While psychology shared a much smaller piece of the WWII and post war pie than physics, its military and industrial support began much earlier in the form of

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[398] Anson Rabinbach, The Human Motor: Energy, fatigue, and the origins of modernity (University of California Press, 1992), 190
[399] Chunglin. Kwa, Styles of Knowing (University of Pittsburgh Pre, 2011), 260.
[400] Kwa, "Styles," 262.

the Galtonian paradigm of applied psychology, or statistical comparison of individual to population, throughout Europe and the U.S.[401]

Murrell did not come from the standpoint of pushing the necessity of psychological measurement of aptitude, intelligence, or skill. Rather, he as much as admitted that it was the industrial dynamic between workers and managers, not the processes of labor, that was the relationship necessitating the psychologist in his more social writings.

> The main problem between managers and workers is the division of the surplus accruing from their efforts, that is, how much goes in dividends and how much goes in increased pay. Both sides argue over this and gradually they come to look upon each other as antagonists and at times even as enemies.[402]

From the standpoint of psychology and its idealistic deployment in the work setting, Murrell shared the idea of the "mental revolution" that Fredrick Taylor espoused before a senate committee. This was at best the idealistic desire by managers and owners to change the hearts and minds of their labor, and at worst a disingenuous claim by Taylor and others to veil their base line desire for optimal profit from minimal investment in labor.

Though general consensus is that modern ergonomics emerged directly from the "work studies" of scientific management[403] and that Fredrick Taylor stands as a precursor to ergonomic study, Murrell provided a very different understanding of Taylor's discipline. In his placement of Taylor in the history of

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[401] Ibid. 217.
[402] Hywel Murrell, *Motivation at Work* (Methuen,1976), 7.
[403] David Meister, *The History of Human Factors and Ergonomics* (Mahwah, N.J. : Lawrence Erlbaum Associates Press), 1999.

the study of work, Murrell actually strongly defended Taylor's management science. In assessing the then fashionable act "to belittle Taylor's activities and to decry his psychology…" Murrell concluded that much of Taylor's ideas had been the victims of misapplication and that to some extent the man himself had been scapegoated.[404]

As unsightly as Murrell's apologism for Taylor may seem, it is however, productive to show the actual juxtaposition in Murrell's own ideas about labor, class, and worker manager relationships. For he inherited a sensibility opposed to Taylor's contribution to an efficiency movement void of a politics of quality of life. As Antonio Gramsci described,

> Taylor is in fact expressing with brutal cynicism the purpose of American society-developing in the worker to the highest degree automatic and mechanical attitudes, breaking up the old psycho-physical nexus of qualified professional work, which demands a certain active participation of intelligence, fantasy and initiative on the part of the worker, and reducing productive operations exclusively to the mechanical, physical aspect.[405]

Where Taylor depended wholly on strategies of motivation that governed workers both punitively and with incentives, what Murrell surmised was the entire history of the "carrot and the stick" of management, Murrell claimed to be seeking a third way.

> Whether or not there is scientific validity in Theory X or Theory Y, it is an inescapable fact that the carrot-and-stick type of management no longer works and that an alternative, whether you call it Theory Y or anything else, has got to be found.[406]

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[404] Ibid. 29.
[405] Antonio Gramsci, *Further Selections from the Prison Notebooks* (Minneapolis: University of Minnesota Press, 1995), 598.
[406] Murrell, *Motivation at Work*, 76.

There is quite a provocative discussion of individual versus group or "class" running through Murrell's work. In his book on "Motivation at Work," Murrell expressed an interesting opinion apropos the development of industrial psychology, Fredrick Taylor, and the "management" of human laborers. It bears a resemblance to Norbert Wiener's admission that part of his reasoning for working on cybernetics as a new paradigm was in order to produce a society "based on human values other than buying or selling."[407] Ultimately, it was not the validity of theories of psychology but rather, "the real determinates of managerial practice were the social, political, and economic climates of the period."[408] This is the first sense in which Murrell breaks away from Taylor's trajectory toward behaviorism, the efficiency movement, and the assumption that the worker was nothing but "'a perfectly adaptable machine,' whose only goal was to 'increase output.'"[409] His position is not one of belief in the access to industrial organization through science but a humanistic approach to better living through uses of science and technology.

Instead of "Taylor's most cherished claim, increased profitability," Murrell's history of motivation provided an account of diverse management strategies and manager-worker collaborations that emphasized incentives that were not limited to individual profit or promotion. Specifically he offered a consideration of the use of profit sharing—and also one with collective bargaining, or worker input built

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[407] Norbert Wiener, *Cybernetics or Control and Communication in the Animal and the Machine* (Cambridge: MIT Press, 1965), 28.
[408] Murrell, *Motivation*, 7.
[409] Gramsci, *Further* Selections from the *Prison Notebooks*, 250.

into it—or what Murrell calls a "co-partnership" between labor and managers, as an alternative to individual incentive management. To speak in terms of maximal profitability in profit sharing of this sort, was to miss the point of its motivation entirely.

> Alternatively, a profit sharing scheme devised and introduced with the collaboration of the work-force which includes arrangements which will enable the workers actively to promote the larger profits in which they will share, should achieve in some measure a breakdown of the "we-and-they" between management and workers and should motivate the workers to a greater productive effort. But this is not really a financial incentive, since the true motivating factor which can be achieved under this kind of regime can be a feeling of belonging to a firm and a pride in its commercial success.[410]

It is of crucial importance to note that the historical development of profit sharing, since at least the turn of the 18th century, can be conceived of as a troubled negotiation or third way between the ideologies of Capitalism and Socialism.[411] In 1896, Albert Trombert contended that it was a system that could only develop "between two mountains: the doctrine of pure individualism; and socialist doctrine."[412]

It should be recognized that the emergence of profit sharing as well was ideological in nature and could always be deployed disingenuously by employers or politicians. Charles De Gaulle prominently politicked for profit sharing as a "third way" to direct the French people between communism and capitalism.[413]

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[410] Murrell, "Motivation," 133.
[411] Christophe Estay, C. Lakshman, and Jacques-Olivier Pesme, "Profit sharing in the nineteenth century: history of a controversial remuneration system," *Social Responsibility Journal* 7, no. 1 (2011): 24.
[412] Christophe et al, "Profit Sharing," 27.
[413] Ibid. 24.

All the while, De Gaulle was implementing many other policies that "directed" (dirigisme[414]) capitalist interests and quelled socialist and pro-labor voices in service of a strong French state. It is worth noting also the critiques of profit sharing as a system that produces the movement of flexible wages for employees, thus recreating a tension between them and managers/employers, and potentially lowering any non-monetary motivation for labor.

However, in Murrell's assessment of profit sharing he connects the discussion to the work of Joseph N. Scanlon, whom he discusses further as another alternative to Taylor's efforts to "motivate" labor. The "Scanlon Plan" was an industrial management plan based upon the tenants that there "should be almost equal division of actual work at the establishment between the workmen on the one hand and the management on the other," that there be "a device for sharing any economic gains which may accrue from improvements in productivity-a unique kind of cost-reduction sharing," and finally the plan was itself a system by which "each individual in the firm with an opportunity to contribute his brains and ingenuity to the improvement of productivity." Created and Implemented by Joseph N. Scanlon, a "steelworker, cost accountant, professional boxer, local union president" Murrell notes that

> important characteristic of the Scanlon suggestion scheme is that it is collective, there is no individual pay off, each individual is expected to contribute his ideas for the benefit of everyone else.[415]

[414] Defined as, "directing" a doctrine promoting the productivity of state intervention in ownership, investment, and influencing of private investment.
[415] Murrell, *Motivation at Work*, 40.

And while Scanlon, an avid proponent of a united labor voice was skeptical at best, if not cynical about other managers/owners' intentions when implementing profit sharing, his plan mirrored a profit share between them, only in its inverse as a cost sharing system, "the only essential, for Scanlon, was labor-management cooperation in seeking cost savings and sharing these gains with the employees."[416]

The key similarity being that what employees and employers shared could increase in size both by sharing in increased profit or in reducing various costs in production. The key difference was that a cost-savings-share system did not rely, as Taylor's work did, on mere acceleration the speed of production or increase in output—but rather, to attention to detail, efficiency, and the overall quality of product, at every level by everyone within the organization.

On the system of profit-sharing Scanlon did not believe the system to be a non-solution in itself, only that the tendency by managers was to use profit share as a replacement for higher wages, but perhaps more dangerously, as a substitute for forethought and (nonhierarchical) participation in decisions on cost savings. Ultimately the concept of profit was not sufficient to understand all quantities of production, including a lack of surplus. The notion of cost-sharing-saving was.

> Whether or not a union is involved, if profit-sharing plans are to be successful, they must be a product of joint formulation, participation, and

[416] Daniel Wren, "Joseph N. Scanlon: the man and the plan." *Journal of Management History* 15, no. 1 (2009): 28.

> responsibility.[417]

Finally, if there is a single element that Murrell, Scanlon, and Frederick Taylor share in common, it is the necessity for the systematic accrual of knowledge on the working elements within an organization—though many of the vehement critiques of Taylor come from other work scientists, and claim that more rigorous study would have compelled Taylor to very different conclusions. Scanlon's, and by extension Murrell's in his affinity, demand for "co-operation and participation" as an alternative to individual motivation and profit, is matched by their call for systematic rigor in understanding the organization of humans at work. As the remaining tenants of the Scanlon plan illustrates,

> (1) All the traditional knowledge which in the past may have been in the hands of the workmen should be gathered together and recorded, tabulated, perhaps even reduced to mathematical formulae. (2) There should be scientific selection and progressive development of workmen. (3) Science and scientifically selected and trained workmen should be brought together

The desire for absolute rigor in the study of work processes was a wholly opposing view to Taylor's that human beings begin as laborers self-interested, unmotivated, and resistant.[418] This desire was also an expression of positive affect towards human labor, an alternative that treated labor holistically rather than a segmented reducible function of the factory.

> This "humanity and spirituality" cannot be realised except in the world of production and work and in productive "creation". They exist most in the artisan, in the "demiurge", when the worker's personality was reflected whole in the object created and when the link between art and labour was still very strong. But it is precisely against this

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[417] Joseph N Scanlon, "Profit Sharing Under Collective Bargaining: Three case studies," *Industrial and Labor Relations Review* (1948): 32.
[418] Murrell, *Motivation at Work*, 27.

"humanism" that the new industrialism is fighting.[419]

Murrell would construct a humanism very much in the spirit of Gramsci's passage, and articulated it in technical description as a holistic and integrative, rather than isolated, reductive, or mechanistic study—ergonomics stood as the "capacity of fitting the whole of the job to the man, not just the movements which he makes." It's arguable that this type of merging of a humanistic understanding of labor with a scientific approach to its processes was an integrative process itself. The science was deployed in order to achieve the ends of collectivity, participation, and better life, simultaneously as the humanistic love for work as creative endeavor informed the science against the dehumanizing effects of mere mechanism in human movement and energy output.

Murrell owed his humanist counter position to two main sources of humanist-scientist. The first is from the etymological source of the term ergonomics, Wojciech Jastrzębowski and the second was the work of Lillian Moller Gilbreth emerging from American Scientific Management.

Systems Theory, Cybernetics in Ergonomics

The story of the systems approach as taken up in ergonomics derives, again, from 19th century sciences. The systems approach is also an influence of international scientific theory that undergirds American ergonomics at mid 20th century. Though its century old, specifically Eastern European roots would be hard to recognize in reading American ergonomics accounts that by and large a-

[419] Gramsci, *Further Selections from the Prison Notebooks*, 599.

historically describe it and give little hint as to where systems thinking ever came from.

> The 'systems' approach…embodies systematic attention to both engineering and human factors considerations toward the objective of developing integrated systems that consist of optimum combinations of physical and human components.[420]

Hywel Murrell's work, additionally, has all the markings of systems theory especially when humans and machines are together and "man's role" is as a "system component" among others.[421] There was astonishingly little explanation of why the systems approach to engineering was either the best or the only approach to ergonomics of humans and machines. One strong factor was that the continual work on systems theories in the Soviet Union embroiled it in the larger ideological cold war and resulted in a turn away from systems approaches in the U.S. especially by the time of the Regan administration.[422]

However, the immediate context of Hywel Murrell's seminal introduction of ergonomics to a post-WWII audience of scientists and engineers was that he was compelled to speak about bodies and machines in terms of what cybernetics and systems theories had to say about them. Two fields of knowledge that had long since evacuated identities and inner states, as Arthur Ashby stated frankly that Cybernetics did not propose to ask '"what is this thing?" but, "what does it do?"'—and as Systems theorist Niklas Luhman commented that within systems theory

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[420] Ernest J. McCormick, *Human Factors Engineering* (McGraw Hill, Inc.: 1965), 420.
[421] Murrell, "Ergonomics," 115.
[422] David Waltner-Toews, James J. Kay, and Nina-Marie E. Lister, eds. *The Ecosystem Approach: complexity, uncertainty, and managing for sustainability* (New York: Columbia University Press, 2008), 8.

approach the "daily visibility of self-inspired actions by human beings…" was merely a superficial frame.[423] Ergonomics would shift decisively from a work environment to a human machine system, and this shift would emerge in no small part due to the intensification of scientific research in general towards fully automated machines, of which the digital computer is but one important component. Instead of the isolating of human labor to particular movements and durations through time and motion study, Murrell's ergonomics dictated a holistic and integrated vantage point of a worker in an environment.

As I demonstrate, it is crucial precisely where and when ergonomics picks up its systems approach, particularly from life scientists geographically and culturally influenced not by capitalist but communist thought. The link to the science fully acknowledged even while the link to a culture or ideology other than the American capitalist and military contexts of the 20th century is downplayed or disregarded all together by ergonomic histories.

Most importantly though, ergonomics borrows from General Systems theory the specific concept of an irreducible and open system which is then used to understand human machine interaction. This is important because Ergonomics owes a philosophy of systems most strongly to the physiological thought specifically of Pitor Anokhin and Ludvig Von Bertalanffy, and the recognition of this historical link further complicates the generally accepted narrative that a

[423] Niklas. Luhmann, *Social Systems* (Stanford University Press, 1995), xliv.

systems approach was developed during WWII and cold war eras only at the behest of military logistics and command control.[424]

In the following section I offer historical context setting up how the field of ergonomics is distinguished from psychology, scientific management, behaviorism, and generally reductionist science. David Meister had done some of the most extensive and most cited background on the formal, informal, and intellectual histories of ergonomics.[425] He described the "formal" history of Ergonomics as a story about the development of engineering and psychology between the two World Wars. War and its intimate relationship with the rise of ergonomics are largely, if not cynically and unproblematically understood by ergonomists as a causal relationship because, as Meister quipped, war always stimulates the "development of more sophisticated equipment" that must then be better understood.[426] Prior to WWII the designed fitting of a human operator to tool was more akin to the Darwinian selection process based on "trial and error."

Meister noted that in both American and European contexts the major precursors to Ergonomic thought remained a "machine domination in the human-machine equation" that lasted through WWI.[427] This was exhibited in the fitting of smaller men by militaries into cramped machines such as the Confederacy's

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[424] Waltner-Toews, David, James J. Kay, and Nina-Marie E. Lister, eds. The Ecosystem Approach: complexity, uncertainty, and managing for sustainability. Columbia University Press, 2008, 8.

[425]David Meister, "History and Characteristics of Human Factors Research," *In Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 40, no. 11, (1996); David Meister, "Human Factors—the early years." *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 39, no. 9 (1995); David Meister, *The History of Human Factors and Ergonomics* (Mahwah, N.J.: Lawrence Erlbaum Associates Press, 1999).

[426] Meister, *History of Human Factors*, 148.

[427] Ibid. 148.

submergible Hunley or the Soviet's small quarters of the T-34 tank, in which small men were immediately "promoted" to be operators. Interestingly Ergonomics' precursors are thought to be purely a branch of engineering, material, and machine sided, where the beginnings of the field itself is conceived of as a "behavioral" science.[428]

> In its 59-year history…it has been profoundly influenced by its predecessor discipline, psychology. Although human factors is practiced in an engineering context, its fundamental concepts are derived from psychology.[429]

WWII, its unprecedented tapping of resources and U.S. Nationalized participation actually provided the conditions of possibility for ergonomics to turn away from work science and the aptitude testing of psychology "Because this was total war, involving great masses of men and women, it was no longer possible to adopt the Tayloristic principle of selecting a few specialized individuals to match a preexisting job."[430]

Interestingly, Meister included an extended account of Russian Ergonomics (much more so than Britain where it first developed). Interesting insofar as it indicates a more general interest that U.S./western ergonomics has in Soviet era scientific theories. While Meister describes its auspices as severely influenced by the ideology of communism, his description highlights the translatability between the two. The strongest conceptual difference being that the Russian model is not influenced by behavioral approach like American

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[428] David Meister, *The History of Human Factors and Ergonomics*, 149.
[429] Gregory Bedny and David Meister. The Russian Theory of Activity: current applications to design and learning (New York: Psychology Press, 2014) xii.
[430] Meister, *History of Human Factors*, 151.

ergonomics is. It is rather a holistic approach that attempts to tie together inner states with external forces on human operators.

> The principal distinction between the Russian activity approach and the behavioral approach is the existence of the conscious goal, which determines the specificity of the selection of information and influences the strategy of its attainment. A person does not react to the stimulus or simply process information but actively performs in a given situation based on the goal and existing motives. [431]

Russian Ergonomics in practice is thus more integrated and exhaustive in the analysis of a work event, "in all its sensorimotor, perceptual, cognitive, motivational, and emotional aspects."[432] This ergonomic perspective was not limited to Soviet Cold War era scientific thought but was rather a product of 19th century Russian scientific philosophy of activity theory.

The openness of the systems approach in ergonomics owes not to a steady historical line of scientific thought but rather to a particular cluster of biologists working at roughly the same time period. In explicating this cluster made up of scientists regularly mentioned in ergonomic's history, I illustrate that ergonomics should be considered as a study of complex systems or a systems science. Ivan Pavlov was a mentor to Piotr Anokhin who is considered an important precursor to modern ergonomics.[433] While he is not mentioned with the following scientists as formative of systems science he is notable as a theoretical crossroads between open complex systems and behaviouristic conditioning of organisms. I believe it is important to point out that at the same time that Pavlov

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[431] Ibid. 167.
[432] Ibid. 163.
[433] Meister, *History of Human Factors*.

did much work to mechanize human reflex (through the reflex) and simplify sensuous encounters, or affect—his work was also a jumping off point for a more radical picture of human agency and affect.

Working at a time when mentalist psychology, the doctrine that the most valid means of studying psychological phenomena is by subjective data like introspection.[434] The foundation of this classical definition of psychology relies on the assumption that "whatever modern methods may have or will evolve, the classic assertion remains—the subject matter of psychology is mental activity itself and it can be studied.[435]

Pavlov instead developed psychological study based only on the empirical observation of physiological responses to outside stimulation. Through experiments with dogs and shifting their salivation response from food to the human who was associated as their "feeder" to a bell associated with feeding time—he deduced the principles of classical conditioning.[436] First, that the conditioned reflex was the most basic unit of behavior meant that when an organism first reacted or reflexed to its environment and was either rewarded or evaded unpleasantness because of that reflex, it became instrumental to expectation of the same outcome. Essentially this meant that if humans were anything like dogs then their most basic actions in the world were largely

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[434] Merrian Webster online, accessed may 1st, 2014, http://www.merriam-webster.com/dictionary/mentalistic.
[435] William R. Uttal, *The War Between Mentalism and Behaviorism: on the accessibility of mental processes* (New York: Psychology Press, 1999), 3.
[436] Ivan Petrovich Pavlov and Gleb Vasil'evich Anrep, *Conditioned Reflexes. An Investigation of the Physiological Activity of the Cerebral Cortex,* Trans. and Ed. GV Anrep. (London, 1927); Baars, B. "IP Pavlov and the freedom reflex." *Journal of Consciousness Studies* 10, no. 11 (2003).

involuntary and that to the extent that they learned it was through training the proper responses to stimuli.[437] We can recall here the aforementioned article on how ergonomics shapes our behavior and Darwin's insight that our (external) physiological expressions strengthen feelings we have.

> The simplicity Pavlov thought was in the brain resulted from manipulations so reductive that animals could learn only reflex associations. Humans thus confined might behave just as simply.[438]

The mention of a mechanistic or non-conscious component in human action is taboo in both popular and political contexts today that have been so driven by entrepreneurial and individualistic rhetoric. Jodi Dean identified this as a world divided simplistically into freedom and oppression, as presented to the American public starting at mid 20th century through presidential address.[439] This binarism developed and entrenched itself in American culture alongside the development of neoliberalism, or what Dean calls communicative capitalism. The imperative of freedom as expressed merely through individual choice and economic mobility is to such an extent that today the Right and Left in America share this language rooted in the individual and it is increasingly difficult to think beyond Democracy.[440] Just as Leftist scholars continue to quip, "it is easier to imagine the end of the world than the end of capitalism"[441] similarly it seems

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[437] Bernard Baars, "IP Pavlov and the Freedom Reflex," *Journal of Consciousness Studies* 10, no. 11, (2003): 19-40.
[438] Baars, "Pavlov and The Freedom Reflex," 30.
[439] Dean, Jodi. *Democracy and other Neoliberal Fantasies: communicative capitalism and left politics* (Durham: Duke University Press, 2009), 103.
[440] Dean, *Democracy*, 18.
[441] This statement has been attributed to Fredric Jameson although he has only ever mentioned it as attributed to someone else.

impossible to imagine that individuals are governed by anything other than deep and complex conscious behavior.

This is due in part to Pavlov's legacy; that of a scientist whose findings were quite easily problematized from the start but whose "messianic enthusiasm" allowed him to use "extremely limited evidence to make utopian promises of human perfectibility."[442] Again, as with the cyberneticians and others I have mentioned a "design" becomes problematic when it is closed off to change or variability and outcomes are limited to predictable, binary outcomes. Pavlov remains an important touchstone for ergonomic thought because he is another figure of machinic thought that had to be left behind once again so that an open system of human machine interaction might be reached. In the man's own words about the trailblazer for physiology:

> Three hundred years ago Descartes evolved the idea of the reflex. Starting from the assumption that animals behaved simply as machines, he regarded every activity of the organism as a necessary reaction to some external stimulus, the connection between the stimulus and the response being made through a definite nervous path: and this connection, he stated, was the fundamental purpose of the nervous structures in the animal body.[443]

Pavlov stands as a powerful re-instantiation of Cartesian physiology and mechanistic science for the modern era. Interestingly his thought did allow for an external environment, "so infinitely complex, so continuously in flux" in "the world around" the animal/human organism.[444] It was just that he could not conceive of the individual, the psyche, or the consciousness as complex entities participating

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[442] Baars, "IP Pavlov and the Freedom Reflex," 20.
[443] Pavlov, *Conditioned Reflexes*, 137.
[444] Ibid. 141.

productively in that world. Instead they could only react and wait for a positive outcome.

Pyotr Anokhin's work diverged from Pavlov, John B. Watson, and B.F. Skinner's reductionist behaviorism, and bridged physiology to systems theory of Bertalanffy. In 1935 he introduced the notion of biological feedback, which significantly altered the concept of a reflex. Pavlov serves as a reminder of a transitive or reciprocal philosophical relationship. First and foremost, those moments when science, theory, and thought are reduced for simplicity or for the sake of their universalization across all phenomena, are moments where ideological or political interest can reduce life and social processes, to stimulus-response for example, for the purpose of designing better human beings. Such was the case in the conclusions Pavlov reached for his salivating dogs as the prominence of "conditioned reflex" as the basic unit of behavior that were extrapolated and built into the idea that human pathology could be trained through negative conditioning like electroconvulsive shock treatment.[445]

Ergonomics owes its capacity to make sense of "human as system component" to the integration of cybernetics with biological science. The reason for this is that ergonomics is fundamentally concerned with the empirical study of both physical and social phenomena. Just as Warren McCulloch admitted that science had nothing to say on matters of "good and evil" so too in ergonomics there emerge objects of the social that the formal languages of logic and

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[445] Edward Shorter and David Healy. *Shock Therapy: a history of electroconvulsive treatment in mental illness* (Rutgers University Press, 2007), 211.

mathematics fail to make sense of. Jacob Von Euxkull concluded that the study of biological environments illustrated on a basic level "the inconstancy of objects" within them down to their constituent matter.

> No single property of matter remains constant as we course through the series of environments…In this human environment, matter is the rocher de bronze on which the universe seems to rest, yet
> This very matter volatilizes from one environment to another.
> No, the constancy of matter on which the materialists insist is
> no solid basis for an encompassing worldview.[446]

It was this perspectival shift in reconfiguring object identity, and even its constitution, that led Uexkull to include that in any environment there was only subjective, not objective reality.[447] To say that environments change in relation to objects was to claim that the "sensory spectrum" of a particular subject made a particular environment, to which those objects depend for their meaning. The thrust of this move was not at all to introduce a "relativist science" but rather to provide a third way between the "too strict objectivity of physical mechanism and the too random planlessness of Darwinism."[448] All this was to say that if all objects changed based on a shift in perspective then all objects in an environment, even the environment itself, had the potential to have a perspective and a subject.

Part 2: Ergonomics is Radically Human

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[446] Jakob Von Uexküll, *A Foray into the Worlds of Animals and Humans: with a theory of meaning* (Minneapolis: University of Minnesota Press, 2010), 198.
[447] Uexkull, "Foray," 125.
[448] Brett Buchanan, "Onto-Ethologies: the animal environments of Uexküll, Heidegger, Merleau-Ponty, and Deleuze (Albany: SUNY Press, 2008), 16.

In *The Posthuman*, Rosi Braidotti treats Leonardo's Vitruvian Man as

> the emblem of Humanism as a doctrine that combines the biological, discursive and moral expansion of human capabilities into an idea of teleological ordained, rational progress.[449]

Images of the Vitruvian Man are scattered throughout ergonomics literature and it is a centerpiece for the field's humanistic philosophy of perfectibility and beauty of the human form. However, contained within this figure in no small part because of the theories of machine subjectivity inherited from cybernetics, the Vitruvian man becomes transformed into its other, the nonhuman.

Figure 1: Human Factors and Ergonomics Society Emblem

[449] Rosi Braidotti, *The Posthuman*, 20.

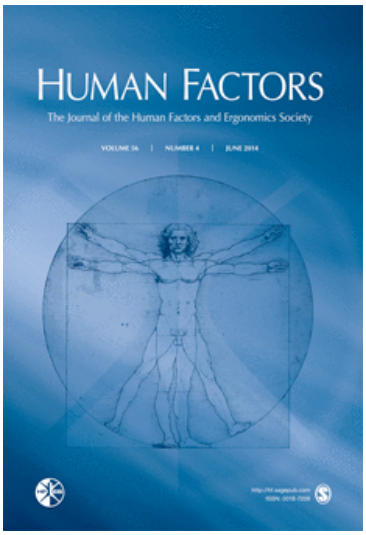

Figure 2: Cover of Human Factors Journal.

Interestingly, the way in which she continued invoking "updated" Vitruvian Men throughout her book indicates a sort of repetition, or, as I have been using, a recursion as a returning to a particular subject, as well as a self-updating image of humanity through the image of man. Or at least, this is partially correct. The image for the cover art of the book is of "The New Vitruvian Woman," and is the first mutated iteration of Vitruvian Man. Along with donning an additional set of arms that give the sense of multiple bodies or individuals, woman's face, hair, skin, and eyes have been darkened in the update, evoking a multicultural feminism with striking aesthetic similarity to Time Magazine's 1993 "The New Face of America,"[450] which utilized computer graphics modeling to show a new multicultural population. As Braidotti noted, New Vitruvian Woman strongly expressed the "universal humanism" and "social constuctivism" of second wave

[450] "The New Face of America, Nov. 18th 1993, Time Magazine online web site, accessed April 30th 2014, http://content.time.com/time/covers/0,16641,19931118,00.html.

feminism, and "forged a bond of solidarity between one and the many…to grow into the principle of political sisterhood."[451]

The Vitruvian Machine

The second update to Vitruvian Man is a digital art piece called "Robot in the style of Leonardo's Vitruvian Man." Its image evokes both the current significance of the digital and particularly computer modeling of "real" world objects, as well as the context of biochemical technologies and engineering whose works on human bodies are demanding new definitions of human. These examples of updated and mutated Man can be talked about in two ways that are productive to a new understanding of Posthuman. As this dissertation has continued to stress, the Posthuman or Nonhuman subject should be conceived of without either agonistic or eschatological implications for the human subject.

First, we may think of them as expressing not what Foucault observed as the effacement of the figure of man, but rather positively as a progression or accretion where more and more previously marginal identity positions are "let in" to the sphere which humanism originally allowed for man. In this sense it is the modern project of democracy that has allowed for a less androcentric and more global or cosmopolitan view while maintaining humanistic ideals. The idea of a non-male or nonhuman Vitruvian subject brings to mind ---- proposition of a "democracy of objects" except still within the sociopolitical realm of humanistic equality.

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[451] Braidotti, *The Posthuman*, 21.

Further, we can begin to think of Vitruvian Man as what is called conceptually a skeuomorph. A skeuomorph is "a derivative object that retains ornamental design cues from structures that were necessary in the original.[452] Or as N. Katherine Hayle explained, a skeuomorph "is a design feature that is no longer functional in itself but that refers back to a feature that was functional at an earlier time."[453] We can describe skeuomorph design in terms of both mimesis and anachronism. Hayles uses the example of a vinyl dashboard of a car with ornamental stitching of the same material that refers back to when leather and thread had been used. Either non -functioning or revised functioning elements are ubiquitous in the technologies we use, and persist in the shift to virtual, digital interfaces. Apple has long been described as a heavy user of skeuomorphic design, and users are familiar with many visual representations of a button, gauge, or knob that indicates an illusory hardware interface from the past—and beyond the visual is the "shutter" click of smart phone cameras that lack physical shutters.

Hayles explained that in the context of "the new" and particularly new technologies that humans come into contact with, the skeuomorph is an essential component of design. As a design element the skeuomorph's main function is to be familiar and recognizable to a user. She made two important insights regarding the working of skeuomorphism in technological/material design. One is

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[452] Basalla, George (1988). The Evolution of Technology. Cambridge, UK: Cambridge University Press. p. 107.

[453] N. Katherine Hayles, How We Became Posthuman: Virtual bodies in cybernetics, literature, and informatics. University of Chicago Press, 2008, 17.

that a material artifact, in this case a skeuomorph, "materially expresses the concept it embodies."[454] Second is that epistemological fields develop similarly to the evolution of material culture. In this sense, Hayles observed cybernetics as a field of knowledge neither evolved according to Kuhnian paradigmatic incommensurability nor like a Foucauldian sharp epistemic rupture. It moved, instead, in a seriated pattern. "Rarely is a constellation discarded wholesale. Rather, some of the ideas composing it are discarded, others are modified, and new ones are introduced."[455]

Hayles concluded by describing the singular power of the skeuomorph in our perception of change:

> Like a Janus figure, the skeuomorph looks to past and future, simultaneously reinforcing and undermining both. It calls into a play a psychodynamic that finds the new more acceptable when it recalls the old that it is in the process of displacing and finds the tr4aditional more comfortable when it is presented in a context that reminds us we can escape from it into the new.[456]

I'd like to suggest that the necessity of skeuomorphs need not only apply to the design of vinyl car interiors and specific scientific concepts, but to the possibility/capabilities of human understanding in general. The Vitruvian image is an example of the fact that concepts, thoughts, and entire systems of thought become skeuomorphs and persist that way, providing crucial recognizability to what succeeds it. Judith Butler stressed this idea in her discussion of radical subjectivity that stands at the edge of unrecognizability even as it demands to be

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[454] Hayles, *How We Became Posthuman*, 15.
[455] ibid. 15
[456] ibid 15.

recognized. In this sense not only humanistic thought but the humanity, the culture and human beings it has developed, have become skeuomorphs. These skeuomorphs simultaneously help understanding and possibly transformation into nonhumanity, while at the same time continually reasserting themselves and their meaning.

The skeuomorph is essential to Ergonomics as a field that designs new interactive possibilities between humans and machines, as well as redesigning of preexisting and accepted ones. I suggest that the “human factor” constituted by human life, culture, and Humanistic thought, is precisely the skeuomorph at work, as Ergonomics is faced with deciding which elements of the human are acceptable to revise, discard, and create anew. What is essential to my understanding of Ergonomics is that the human-skeuomorph works not only in this way as a conceptual design element (epistemological change) but also as a design element for subjectivity (ethical change) as well as the design of actual systems of life (embodiment, affection, or materiality). I suggest that Ergonomics is, as constituted by both Physiological thought and a Cybernetic ethic, exemplary of a new recognition of what may be called Nonhuman subjectivity where subjectivity is thought of as matter poised to be life. As I have already discussed in previous chapters, though my dissertation analyzes key moments leading to what various authors describe as a posthuman subjectity, I prefer to focus on the recognition of a nonhuman agent in machine bodies.

More importantly, Ergonomics puts into practice certain kinds of nonhumanity that allow for the conditions of possibility for their embodiment or materialization. It is my belief that, again, it is not in the agonistic repudiation of the human or the dissolution of its identity where the burgeoning nonhuman subject is to be found. Rather, it is in the continual articulation of what is human, the innervation of thought, experience, and sensation with the idea of humanity—where its limit and other will emerge again and again.

Throughout the dissertation I have touched on historically significant and heterdox attempts to both distinguish and connect organic life to inorganic matter—particularly those that resist a method of simple mechanistic reduction. Taking ergonomics as an object and in a sense culmination of the earlier attempts in physiology and cybernetics, this chapter connects these theoretical understandings with their politico-ethical ramifications or how these ideas can affect a biopolitical register of governance in science, research, and design. My guiding claim is that the machine, both as an abstract mimetic concept, as well as a material service provider/tool, has been inextricably linked to our modern conceptions of life—but further, that we must understand all that we can about the figure of the human that continues to mutate and persist in the face of (perceived) besiegement by technology.

There is an interesting epistemological foundation in Ergonomic research and writing that bears emphasizing. As mentioned before Cybernetics largely defined itself not as a particular branch of science, mathematics, or engineering,

but rather as a theory of machines suis generis and thus as a meta-science in which many other fields existed. Likewise, ergonomics describes its work as multi-disciplinary approaches to the problem of human machine interaction. As such, there exist many scientists and engineers engaging in ergonomic design whether they claim it as such or are conscious of the human factor at work in what they do. This is also the reason for much revisionist history that is done in the field resulting in the grandfathering in of prevalent scientist-inventors as progenitors or latent ergonomists. This kind of historicizing is also very much in line with a liberal humanist edification of ideas and progress narrative construction. As a recent article in the official bulletin for "The Human Factors and Ergonomics Association" proposes that the first American ergonomist was none other than Benjamin Franklin.[457]

In fact, the founding principle that Hywel Murrell wrote into his treatise on ergonomics, the study of human beings specifically in their industrial working environment,[458] has largely been dispensed with. In another sense, the study of how we labor with machines has dispersed into all areas of life and in this sense corresponds quite well to the shift to a neoliberal economy and an intensified attention paid to the labor we do outside of our official workspaces. In addition, take an example like the recent buzz over the ergonomics of standing at work in one's office, and the socio-economic imperative to produce new standing desk

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[457] John W Senders, "Benjamin Franklin, The First American Ergonomist?" in *Bulletin Human Factors and Ergonomics Association* 54, no. 5 (2011): 10.
[458] Murrell, *Ergonomics.*

contraptions, articulates well a general biopolitical regime of health that has likewise dispersed through our daily lives.

There is an additional motivation for the general ergonomization of any machine in any context, in other words there is a very specific motivation for ergonomics to conceive of itself as a meta-science as well. The result of which illustrates ergonomics as the inverse of cybernetic observation. Cybernetics generally held that whether the object was a chemical reaction, a frog, a family interpersonal dynamic, or human culture[459]—it always acted in a sense as a machine. Or as my earlier analysis showed more accurately what was common to humans, organisms, and machines was that they all acted as governors. On the other hand, ergonomics begins from the supposition that whether one is designing an operating system, a phone bot, or an automated industrial welder, there will always be a human factor influencing it. Even in completely automated machines and systems (if such a thing could ever exist) the emergence of such systems from human thought, design, and handwork is paramount.

It is in this sense that I mean ergonomics to be an inverse of cybernetics, that where cybernetics is a theory of machines (subjectivities) real, virtual, or imaginary—ergonomics acts as a theory of the human qua human. Though, as I will later demonstrate, cybernetics and systems theories are the very backbone

[459] These were all actual research objects of cyberneticians. The frog was the subject of the seminal paper introducing cybernetic purpose, the “Palo Alto Group” introduced cybernetics into psychology and interpersonal communication fields, and both Margaret Mead and Gregory Bateson deployed cybernetic principle into their anthropological theories.

of ergonomics, the machines that result cannot help but be rearticulated through the “divine proportion” of the human being.

Ergonomics utilizes the human being as a skeuomorph in order to redefine the basic ways that we communicate with machines. The outmoded communicative forms include type, touch, and text as the physical processes of inscription that have persisted from print media to new media machines. The interface as we know it provides the other component of the skeuomorph, the visual-representational hermeneutic, and includes screen, image, window, and luminescence as the persistence of visual culture. Ergonomics is at work on redefining human machine communication without the reliance on inscription and the visual hermeneutic—replacing them instead with the production and transmission of affect. The new human who interacts with new machines will do so through her cognition, emotion, and body. The new elements of mediation that ergonomics study include heart rate, blood pressure, respiration, temperature, voice modulation, and facial expression. The frontiers of experimentation whereby the human skeuomorph ushers in the new affective human include physiological or affective computing and human-robot interaction. The new Vitruvian human will not be significant for its proportions or representational beauty but will be important as a body that feels and perceives and moves and manages its self and body in the world.

To return to Braidotti’s example of the Vitruvian Model that frames in its image the human as “the rational animal endowed with language,” the closer the

investigation into the minutia of what physiologists refer to as the rhythms of life the more collisions are felt with the nonhuman. As Art Historian Paul Valery noted, Leonardo Da Vinci was in a sense so committed in his science, art, and invention to the discovery of the processes of the human body that defined human life that his inundation led to some very "inhuman" conclusions on the touchstones of humanity life, love, and death.[460] The Vitruvian Man was, in fact, a product of Da Vinci's obsessive love with the human body—with physiology over the mind, the body over the soul—and his inundation with it resulted in observations that Valery observed were alien to renaissance and moderns alike.

> So detached an intelligence is bound to arrive at curious attitudes in the course of its movement—as a ballerina will astonish us by achieving and sustaining for several moments poses of utter instability. His detachment is a shock to our instincts and a mockery of our preconceived ideas. Nothing could be more free, that is to say nothing could be less human, than his judgments on love, on death.[461]

Importantly it is from the great intensity with which Da Vinci, and, as I have shown all of the scientists in this dissertation, have focused on the minutia of life and organism, coupled with an underlying "belief" in the figure of the human—that the machine emerges again and again. It was the reason that Da Vinci chose the human body over the soul in absolute beauty—proportion, motion, and mass above thought or Love. This is also why He describes himself, his ultimate role in his art and invention, as "O speculator on this machine of ours…"[462]

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[460] Paul Valery, *Introduction to the Method of Leonardo da Vinci*, trans. Thomas McGreevy (New York: John Rodker, 1929), 18.
[461] Valery, 11.
[462] Richard A Turner, *Inventing Leonardo* (Berkeley: University of California Press, 1994), 197.

A cursory viewing of his sketches reveals Da Vinci's focus on human musculature and movement, and, on the other hand of new and imagined machines. References abound in Ergonomic literature not only to the image of Vitruvian Man and its similarity to current ergonomic graphic image, but to Da Vinci himself as either a precursor to ergonomic design or as "the first ergonomist." Much of ergonomic research, like physiology, utilizes biomechanics[463], which, based on his extensive sketch work on anatomy, Da Vinci is credited as a foundation.[464] In this way, we see the strong current of humanist aesthetic and ethic that informs modern ergonomic research from a pre-modern tradition. Again, much like mid 20th century cybernetics, ergonomics has been an empirical study in continual interaction with its perceived cultural, political, and ethical implications. This is exemplified in the immense legacy that Vitruvian Man and his divine proportion.

> The classical tradition was prescriptive. It dealt with idealized human beings as they ought to be according to some pre-existing aesthetic or metaphysical principle, rather than real human beings as they actually are.[465]

The first component of ergonomics is thus aesthetic and influenced in part by humanism and its own ancient history. Protagoras' "Man is the measure of all things," or the idea of man as microcosm in Mediaeval scholar Isadore of Seville's though stipulates that, "all things are contained in man, and in him exists

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[463] W. Jastrzebowski, "Outline of Ergonomics or The Systematic Study of the Human body as Governed by the Laws of Physics," International Encyclopedia of Ergonomics vol. 1, ed. Waldemar Karwowsky (Boca Raton, FL: CRC Press, 2006),104
[464] Ibid. 104.
[465] Ibid. 107.

the nature of all things" so as "to place man in communion with the fabric of the universe.[466]

Ergonomics will be a productive mode of knowledge for understanding both the humanism and nonhumanism to come. Put another way, observing the practice of ergonomy as an ethical philosophy put into methodology may get to Rosi Braidotti's chief concerns of,

> how to find adequate theoretical and imaginary representations for our lived conditions and experiment together with alternative forms of posthuman subjectivity.[467]

Ergonomics will also most certainly continue to be exploited by the biotechnological economy and in so doing will continue to reproduce on physical and cultural levels many forms of exploitative designs built into our everyday lives. Further, it is certainly a field whose influence on our everyday lives functions largely beyond our conscious understandings of our relationships to machines. In what follows I discuss those individuals (Ergonomists and precursors), experiments, and machines that most strongly magnify this innervation of human and recursion between human and nonhuman factors.

Wojeiech Jastrzebowski, Divine Labor, and Spinoza

This labor-science-humanism complex had already culminated in the thought of "Polish scientist, naturalist and inventor, professor of botany, physics, zoology and horticulture." Wojciech Jastrzębowski, who is the first person known to use

[466] Isadore of Seville, *Encyclopedia of the Dark Ages*, (Indiana University Press 1912).
[467] Braidotti, *The Posthuman*, 196.

and define the word ergonomics. His astonishing document, “An Outline of Ergonomics, or the Science of Work Based upon the Truths Drawn from the Science of Nature,” is less a scientific text and more a manifesto, “He who complains against his work knoweth not life: work is an uplifting force by which all things may be moved. Repose is death. And work is life!”[468]

Besides creating a metaphysical register to which human labor contributes, “work enriches or divitiates us, bringing us closer to the divine”[469] Jastrzebowski’s outline provides an account of labor and human life reminiscent of the 18th century physiologists who had discovered self-regulating organisms and processes. Form, identity, or organization is never born or given. Labor is the fundamental mechanism by which form is maintained. Intertwined with the outline’s metaphysical divination is an austere mechanics of labor that resonates with Karl Marx’s assertion that labor was a uniquely human activity and that through labor man, “realises a purpose of his own that gives the law to his modus operandi…”[470] Jastrzebowski’s outline also in proclaiming that the “exercise of our forces…is the principle and essence of our lives” is strongly evocative of the naturalistic physics in Baruch Spinoza’s Ethics, and in particular, Jastrzebowski had described in labor a uniquely human conatus, or as Spinoza put it in strikingly similar fashion centuries before,

> the power of any thing, or the conatus with which it acts or endeavors to act, alone or in conjunction with other things, that is (Pr. 6, 1II), the power

[468] Jastrzebowski, “An Outline of Ergonomics,” 161.
[469] Ibid. 161.
[470] Ibid. 163.

> or conatus by which it endeavors to persist in its own being, is nothing but the given, or actual, essence of the thing.[471]

Crucially, like many naturalists with affinity for "natural philosophie" Jastrzebowski's outline expressed an integrated and holistic perspective in the face of the increased instrumentalization and extraction of science from philosophy. He asserted that,

> Lest this Science of Work understood as Work in the comprehensive and integral sense, not merely its part that is physical labor or toil. But physical, aesthetic, rational, and moral work. That is Labor, Entertainment. Reasoning. And Dedication. That is Work to be performed by all the forces assigned to us by our Maker and to relate to all the purposes of our existence as intimated by pure religion and an untarnished sense of personal dignity…[472]

When humans do labor, as the exercise of vital forces, or as a tendency of humans to persist and to be active, they exercise four vital forces at their disposal. First is the physical vital force that he takes to be the weakest. The aesthetic or creative, he also calls the feeling vital force, and our intellect or reason makes up the third. Finally, Jastrzebowski concludes, again, that labor is an integrative process of the three forces, and that a when a final moral or spiritual force is added to the prior three our labor

> induces us to work not only for our own und the common good (which entails the glory of God, the welfare of our neighbors, of our fellow creatures and or ourselves)[473]

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[471] Spinoza, Baruch. Spinoza: Complete works," Trans. Samuel Shirley, et. al. Ed. Michael Morgan. (Indianapolis: Hackett 2002) 283.
[472] Jastrzebowski, Outline of Ergonomics, 163.
[473] Ibid. 162.

With the foundations of his ergonomics—To labor in common or for the common good, to produce abundance, and to engage our vital forces with "other forces appertaining to both the living and inanimate in Nature," Jastrzebowski is an integral first step towards modern ergonomic theory and practice. His outline stands as an inherited model, which is at once holistic, ethical, and crucially, one gesturing to a modern notion of affection.

Lilian Gilbreth and the Feminizing of Work Science

The second major influence informing Murrell's humanist-scientist complex is Lillian Moller Gilbreth. The magnitude of Lillian Gilbreth's work and thought on management science, domesticity, and the relationship of the feminine to technology is so great that it necessitates, I believe, an entirely new radical history that is beyond the scope of this chapter. Beyond her recognition in the field as a "pioneer in ergonomics,"[474] many historians are now documenting her role in reconfiguring the kitchen and household of American homemakers. Immortalized in the book and film "Cheaper by the Dozen," she also stands as a very early female celebrity, famous by virtue of being a career scientist/lecturer, a mother, wife, and homemaker—which is also significant to her science, which I discuss later.

[474] "Her Story: Then Lillian Gilbreth", Women in Science, Technology, Engineering, and Mathematics Web Site, accessed March 3rd 2014, http://www.womeninscience.org/story.php?storyID=106, http://www.newworldencyclopedia.org/entry/Frank_and_Lillian_Gilbreth

While there is little doubt that Gilbreth's work significantly transformed home and work life for women after the depression, she is also a divisive figure in terms of whether the changes in domesticity were good for women. Based on more liberalist historical accounts she championed equality for women through both her writings and as a role model for motherhood and professional women, particularly in the sciences.[475] On the other hand, from a more materialist feminist position she stood as one of the "key ideologues of the antifeminist, pro-consumption, suburban home." According to Architect and Historian Dolores Hayden it was the commitments to a consumer life, the privacy of the home, and reliance on technologies and not people, that made Lillian and other women's "experts" of that era the antithesis of materialist feminism and its utopian visions of women's lived spaces. While her treatments of both Gilbreth and scientific management are cursory, Hayden's assessment rings true insofar as Lillian's career and persona gravitated towards consulting for manufacturers who produced women's consumption products, and she did not seek to radicalize the home or alter the Nuclear picture that was developing.

On the other hand, Lillian was one of the earliest if not the first to uniquely combine psychological study and management science to provide a gender analysis of work inequality and began, after the death of her husband, to champion the study of little addressed laboring subjects, the handicapped and women in the emerging suburban home. In this sense "antifeminist" is a severely

[475] Jane Lancaster, *Making Time: Lillian Moller Gilbreth, a Life Beyond* "Cheaper by the Dozen" (Northeastern University Press, 2004); Julie Des Jardins, *Lillian Gilbreth: Redefining Domesticity,* (Westview Press, 2013).

deficient description of the complexity of her work as a scientist, public intellectual, and celebrity. For the purposes of this chapter it was precisely Lillian's turn to scientific observation and technological innovation as a means of self-management or government for the two marginalized laboring subjects, the handicapped to some extent, but especially women.

For the ergonomic science that was to come Gilbreth needed to alter management science/work science with its specific application to women's labor and the home, and with enabling of bodies in mind. It was then that practitioners could move the study of human labor and energy beyond the factory floor and office, and extend their objects to include human affect and happiness. We may consider her work in its contradictory relations to progressivism and capitalism of her era, as a problematic not unlike Margaret Mead who years later would create (cybernetic) social theory as a tool for the "engineering" of idealic human culture. Gilbreth proselytized the social ill to be remedied only after she had become a widow and single, female scientist.

> Even more does it consider human resources and we try to look (and I hope it is internationally all over the world,) to see where these human resources can be found and developed. It is not only the physically handicapped who are our responsibility, but the mentally handicapped, the emotionally handicapped. And we try also to think in terms of the benefit of mankind. Who really knows what that benefit is? None of us is exactly sure, but we do know, if our code brings it to our attention, that we are to think in these terms: it should stimulate us.[476]

My argument is that Gilbreth's work stands, again, as both an articulation of humanism and simultaneously something more than or beyond human

[476] William Robert Spriegel, Clark E. Myers, Frank Bunker Gilbreth, and Lillian Moller Gilbreth, eds. *The Writings of the Gilbreths* (RD Irwin, 1953).

recognition. What emerged is what I argue as a queer image of the working-man and his (according to Frank's work) "one best way" to work. Thanks to Gilbreth, this worker had been transmuted, on the one hand into the equalized handicapped worker who, under Taylor's and Frank's systems was dealt with in a very different way. On the other hand the working man was transmuted to the working women, who Gilbreth knew from personal experience to be productive of many essential practices of labor all while to varying extents "managing" her bread winner. In this particular case it was her feminine subjectivity itself that produced both these tendencies and propelled work science in a new direction. Her relationship to her husband, like many husband wife professional teams, was one of professional sacrifice and relative lack of credit given her. This no doubt along with her progressive political viewpoints would spur her work on "the best way" to provide comfort and health to women in their homes.

The work that Gilbreth would come to be known for after her husband's death—as bringing better working conditions to the handicapped and to women, was implicit while they worked together. For the scientists, psychologists, and Frank as well, "her professional reputation was always secondary to his. She understood this implicitly…"[477] That more and more histories are now being written about Ms. Gilbreth than her husband is due to the increasing recognition that his work was inextricably her work.

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[477] Julie Des Jardins, (2012-09-25). Lillian Gilbreth: Redefining Domesticity (Lives of American Women) (Kindle Locations 1219-1223). Westview Press. Kindle Edition.

> [I]t's why she took time out from her research to index a new edition of Field System (1908) and why she quietly did the lion's share of the preparation of manuscripts and papers for Frank's academic and professional meetings. The books Concrete System (1908), Bricklaying System (1909), and Motion Study (1911) were published in Frank's name only, but in truth, Lillian had worked so closely with Frank on these texts that even he could not tease out his contributions from hers. [478]

The work that was directly attributed to her was of a different character. Where Frank's singular function in creating motion studies was to combat an ecological evil of "this waste going on in the whole civilized world." Of the resources squandered Frank felt that, [t]here is no waste of any kind in the world that equals the waste from needless, ill-directed, and ineffective motions.[479] While this in itself was more of a philosophical and progressive view that Taylor's science of labor, Gilbreth shifted the aim away from efficiency and towards the well-being of the worker. She argued

> that the aim of motion study was to eliminate unnecessary fatigue by designing convenient workbenches and chairs, providing regular rest periods, and introducing other salutary measures.[480]

And if Frank and Lillian together had indicted Taylor's stopwatch, Lillian Gilbreth had also convicted the manager himself. In fact she too believed similarly that the worst sin was to "discard" or waste "human potential."[481] However, what Lillian actually saw as waste and worked to eliminate in her research, was the

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[478] Des Jardins, *Lillian Gilbreth*.
[479] Frank Bunker Gilbreth, "Description and General Outline of Motion Study," in *Motion study: A method for increasing the efficiency of the workman.* (D. Van Nostrand Company, 1911).
[480] Brian Price, "Frank and Lillian Gilbreth and the Motion Study Controversy, 1907-1930," *Frank and Lillian Gilbreth: Critical Evaluations in Business and Management*, eds. Michael C. Wood and John C. Wood (New York: Routledge, 2003), 63.
[481] Lancaster, *Making Time*, 293.

discrimination against and firing of older women and people with injuries or disabilities for faster, cheaper labor. This practice would

> not only increase the number of non-productive, unhappy people in the community, but would commit what is sure the greatest of industrial wastes—human waste.[482]

As a result, Lillian initiated a research study on the discrimination of older women at the workplace, and became more publicly outspoken on this as an issue of labor and of resource waste, and reiterated her unpopular argument that men needed to learn to manage a "50/50 marriage" and share in a woman's "24 hour work day."[483]

Gilbreth certainly put her efforts towards devoting resources to women's work day through the innovative design of her environment and tools. Among the credits to her reconfigured kitchen Gilbreth designed the "door closet," composed of a thin cabinet fastened to a door to more easily access mops, cleansers, etc.[484] She also designed the foot pedaled trash can which, besides a more efficient means of opening the trash can, was also a substituted foot motion for what was "normally" a hand motion, reflected her thought towards the differently enables. Then there was the "management desk" designed with the post-depression era woman who both worked at home and at a job. This official desk, Gilbreth claimed, was designed for the homemaker to better organize both manual and managerial work.[485]

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[482] Ibid. 293.
[483] Ibid 294.
[484] Des Chardins, *Lillian Gilbreth,* 136.
[485] Ibid. 136.

> At the Chicago World's Fair in 1933, she unveiled the Gilbreth Management Desk, promoted as the "Business Headquarters of the Household Manager." Intended for the kitchen, the desk had a clock and, within easy reach, a radio, telephone, adding machine, typewriter, household files, reference books, schedules, and a series of pull-out charts with tips on organizing and planning household tasks.[486]

Her transforming of the homemaker into a "household manager" was very much like women's activist Catherine Beecher's earlier "home minister" in that it worked to legitimize the labor within the house while it gave women opportunity to consciously recognize that part of their work was in managing their "bread winners," "[w]oman as "home managers" would study the best ways to keep the "homeowners" functioning as stable, conscientious workers, husbands, and fathers.[487] Key to Gilbreth's understanding of women's identity/subjectivity as laborers was of course her own performance in her various social roles. Beneath her public persona as one of the first women to "have it all"[488] was a very different idea about women's integral role in connecting home and work life—and this idea began forming after her husband's death. It was at this point that Gilbreth both undertook her more political research on discriminatory practices by employers, but that she also increased her research, teaching, and commercial work in general as a new head of household. Whether in order to curb her grief, to increase her public persona, or to foot the bills, it was a turn to labor, and an active expansion of all of her work that was her answer. It was during her

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[486] Ibid. 136.
[487] Dolores Hayden, *The Grand Domestic Revolution: A history of feminist designs for American homes, neighborhoods, and cities* (Cambridge MIT Press, 1982), 284.
[488] Psychology's Feminist Voices web site, accessed on April 30th, 2013, http://www.feministvoices.com/lillian-gilbreth/.

increased participation as a product design consultant that Gilbreth formed a very powerful and prescient idea.

Whether women were contained within the nuclear family dynamic or were less conventionally the head of their own household, their labor was distinguished from the masculine, factory and office paradigms that had developed into Fordism and Taylorism. In the formal economy men had foremen, experts, and managers, and in the informal economy they had, as Frank had in Lillian, a manager at home that was to varying degrees working unrecognized.

> Woman as "home managers" would study the best ways to keep the "homeowners" functioning as stable, conscientious workers, husbands, and fathers.[489]

It was this simple truth, that where working men had external authorities, working women had themselves, were self-managers, that Gilbreth designed an entire environment to surround women in order not only to expedite and render safer their work, but also to enable their continued self-managing practices.[490] This was the less obvious upshot to the more sweeping and detrimental effects of her work such as social control, industrialized disciplinary techniques and domestic isolation of a population of women. It was the notion of self-management, self-government, and self-regulation through labor. It was one that she formed by way of experience, performativity, and her own recognition. Beyond its liberal context, self-regulation was not freedom/autonomy, and beyond the implication of a future neoliberal context, self-regulation was not a

[489] Hayden, *The Grand Domestic Revolution*, 284.
[490] Wood and Wood, "Frank and Lillian Gilbreth," 299.

conscious and active participation in a field of rules established by a juridical and economic system to optimize self. Though of course the principle of self-regulation could easily be subsumed by both.

Gilbreth hit upon a simultaneous metaphysical and scientific principle that identity or subject is maintained through its continual renewal by labor. It was a rule that Jaezrbrowski hit upon in 1857 just before the "question of labor" would be asked, and from Gilbreth, motion studies, and the imperative to design for a marginal yet self-governing subject, Murrell would inherit the principle into his system of ergonomics. No, Gilbreth's work never attained a political register that could be considered radically feminist—she was too ingrained in the developments of normative masculinist and capitalist forces. No, Gilbreth's science was nowhere close to suggesting a posthuman work science—that was yet to come in general systems theory, cybernetics, and then together with ergonomics. But I believe her work was an embodied, performative gesture to both of those possibilities and because of the interaction or perhaps collision of her humanism with her belief in technoscience, Gilbreth expressed a latent radical otherness key to both conceptions of machines and of women that general domination suppresses or irradiates as a "failure."

> Technology in some way is always implicated in the feminine. It is young; it is thingly. Thus every instrument of war is given a feminine name. The feminine, in whose way we are, does not arrive. She is what is missing. Constituted like a rifle, she is made up of removable parts. She hinges on the other, like the allegorical symbolics of which Heidegger speaks. The woman has gotten in the way of things…[491]

[491] Avital Ronell, The telephone book: technology--schizophrenia--electric speech. U of Nebraska Press, 1989.

Her system of studying human beings and the welfare of their labor, while certainly a “failure” in the sense of a more radical feminist and anti-capitalist study, both kept vital a sense of self-regulation in a coming Fordist regime of labor organization, as well as gesturing towards the scientific foregrounding of technological bodies so that marginal human bodies may be recognized.

Elizabeth Duffy, Affect, Energy

Elizabeth Duffy was one of the first scientists that not only sought the serious study of human emotion but also the reconfiguration of emotion beyond literary, descriptive, and cultural meanings. Duffy proposed a psychology that questioned the “common assumption” that emotions were unique categories distinct from other kinds of responses and the use of categories such as anger, fear, or joy, as unproblematically empirical states. Instead Duffy argued that emotions be seen as similar to both cognitive as well as physiological processes. She thus importantly exploded the age-old binary between emotion and intellect/rational thought and reintegrated the two as interdependent phenomena related and interacting by “the total organization or pattern as determined by the various dimensions in their relation to each other.”[492] As a psychologist she informed a kind of thinking that would later emerge in ergonomics as the study of human-machine affect. In integrating previously distinct psychological elements like emotion, cognition, and consciousness, to name a few, she shifted the

[492] Elizabeth Duffy, "Emotion: an example of the need for reorientation in psychology." Psychological Review 41, no. 2 (1934): 184. 196.

theorization of affect away from psychology's "the emotions" to the physical, physiological, and embodied form of affect that has developed in continental thought and cultural studies. Duffy emphasized this shift in affect when she called for the description of emotional and other responses in humans as a range of energy mobilizations. The energy of affect would play a huge role in giving psychologists and ergonomists the vocabulary to describe material systems of embodied encounters. In the section that follows, I explore how breakthroughs in thought like Duffy's could be extrapolated into ergonomics and coupled with attempts to humanize machines.

Ergonomic "Human Factor" and Anthropomorphism

To the extent that radical theories of machinic life and machine subjects remain vital(ist) and holistic in ergonomic theory, it will continue in its co-constitutive humanism and non-humanism, to temper the reductive and mechanistic effects that capitalism and rationality have wrought on the social through biotechnological control. This chapter has attempted to offer a "retrospective by way of an alternative" in the form of the emergence of ergonomics at points in history where much more reductive and dominating controls or governing mechanisms were deployed on humans and machines at work. My claim has been that ergonomics, as a complex constituted by the epistemology of physiology and the theory of subjectivity driven by cybernetics, produces the embodiment or materialization of those theories.

The notion of anthropomorphism is central to this line of thought. Heinz Von Foerster defined anthropomorphization as "[p]rojecting the image of ourselves into things or functions of things in the outside world."[493] He agreed that anthropomorphism in general was not only a standard human practice but that it was not in itself bad, stating, "in principle there is nothing wrong with anthropomorphizations; in most cases they serve as useful algorithms for determining behavior."[494] The problem was that such project tended to lead to a delusion that dismissed or destroyed the difference of the nonhuman thing by fitting it to the common name it shared with humans. To the extent that an animal or machine "remembers," "feels," or "communicates," how were those phenomena unique to them? An attempt needed to be made so that a human observer could make projections that both she and other humans might understand as meaningful while maintaining the differences among species of subjects. Keeping with Uexkull's perspective that observation was a foray into another subject's world, Von Foerster did feel it necessary to push back against rampant anthropomorphization.

There are two major research issues or problems that have led ergonomicists into ongoing discussion about the benefits and drawbacks to anthropomorphic design. The first is a research technology and field called Human Modeling or Digital Human Modeling that has, since digital computers became a design tool within ergonomics, been used to create accurate

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[493] Heinz Von Foerster, "Thoughts and Notes on Cognition," in *Understanding Understanding: essays on cybernetics and cognition* (New York: Springer, 2003), 169.
[494] Von Foerster, "Thoughts and Notes on Cognition," 170.

simulations of human processes that can be applied to the "real" world. Simply put in modeling, "a digital representation of the human [is] inserted into a simulation or virtual environment to facilitate prediction of safety and/or performance."[495] The emergence and development of human modeling with the digital computer was for the express purpose of aiding with the, "the manipulation of a simulated human figure easy for a particular user population human factors design engineers or ergonomics analysts."[496] From an ergonomic perspective the earliest modeling techniques were physical models or simulations, machines that surrounded the human in order to mimic a particular mechanical process. In this sense the grounded flight (cockpit) simulators were an example. However, as Manuel DeLanda observed, it was at the end of WWII that Los Alamos scientists began to experiment with the "virtual worlds" that the new computers were able to create.[497] From that point time would need to pass in order for the processing power and graphical display of modern computers to increase such that adequately complex and realistic representations of human bodies could be produced. It was in the 1980's when the microprocessor led to the development of the personal desktop computers that human modeling became a viable and well-resourced research problem.[498] The most famous example would come out of the University of Pennsylvania's Center for Human Modeling and Simulation

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[495] Vincent G Duffy ed., *Handbook of Digital Human Modeling: research for applied ergonomics and human factors engineering*, (Boca Raton, FL: CRC press, 2008), 1-1.
[496] Bonnie L Webber, Cary B. Phillips, and Norman I. Badler, *Simulating Humans: computer graphics, animation, and control* (Oxford University Press, 1999), 4.
[497] Manuel DeLanda, "Virtual Environments and the Emergence of Synthetic Reason," accessed June 1st 2014 http://www.t0.or.at/delanda/delanda.htm.
[498] Bonnie L Webber et al., *Simulating Humans*, viii.

(HMS). The "Silicon Graphics workstation based Jack TM,"[499] a registered trademark of the university, was compact enough to fit into small laboratories or classrooms, where one ergonomist would sit and view, replicate, and manipulate a human model within a designed work environment.

> One can think of Jack as an experimental environment in which a number of useful general variables may be readily created, adjusted, or controlled the workplace the task the human agents and some responses of the workplace to internally or externally controlled actions.[500]

As digital modeling software and processing power continue to advance the power to create artificial worlds has moved beyond human modeling into the contexts of simulating populations and virtual societal infrastructures such as traffic flows and population movements. It is a deployment of the virtual for purposes of general risk management that, as a subset of computer research, owes to John Von Neuman's war-time development of Game Theory. On the other hand, in the realm of human modeling outside of an ergonomic perspective neuroscience uses the technology for the purposes of modeling brain function to discover and map its constituent parts. While computational genomics has made use of the smallest units of life in order to create a "complete computational model" of a simple organism.[501] Both are examples of a sort of reverse engineering of the processes of life by way of reductionism and informationalization through reliance on the Human Genome Project database. It

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[499] Bonnie L. Webber et al., *Simulating Humans*, 10.
[500] Ibid. 11.
[501] "Stanford Researchers Produce First Complete Computer Model of an Organism," *Stanford University News Web Site*, accessed June 1st 2014, http://news.stanford.edu/news/2012/july/computer-model-organism-071812.html

is not surprising that like the Human Genome Project before them the U.S. BRAIN initiative and Europe's Human Brain Project are both massive government initiatives to produce complete, all encompassing virtual models or databases of the human brain. Both are encouraged and partially funded by government militaries and subsequently are seen as non-transparent, dubious scientific endeavors by scientists across the globe.[502]

However, when Delanda argued that computer modeling had the promise to, "track the machinic phylum in search of a better destiny for humanity,"[503] he was neither referring to computer modeling's checkered past as a simulacra for war nor its present state in military-market driven state of the art research. Rather the promise for virtual modeling lay precisely in how the technology has yet to be deployed, or in its radical experimentation on the margins. There is evidence to suggest that ergonomics is deploying virtual modeling, anthropomorphism in order to design and study of robots as human companions.

To give context, the first initiative for an industrial robot modeled on humans came from Honda in 1986 and continued through the 1990's in a development that coincided with computer modeling technologies.[504] "The Honda Humanoid Robot ASIMO" was the result. The emergence of humanoid-robots or androids should be emphasized because, as I discussed in the introduction, it

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[502] "Obama's BRAIN initiative and the alleged $140-to-$1 return on the human genome project," *Knight Science Journalism at MIT* web site, accessed June 5th 2014, https://ksj.mit.edu/tracker/2013/04/obamas-brain-initiative-and-alleged-140/

[503] Manuel DeLanda, "Virtual Environments and the Emergence of Synthetic Reason."

[504] "ASIMO Development Story," *The Honda World Wide ASIMO* site, accessed May 1st 2014, http://world.honda.com/WalkingTogether/.

marks the beginning of a shift in tandem with the shift of the affective turn. It characterizes a de-emphasis on software and code and a foregrounding of hardware and bodies as well as a shift away from a hermeneutic of the visual screen interface to that of an embodied encounter. Additionally, the continuing imperative for automation in industry that led to the robot's emergence brought the crucial concept of anthropomorphism into the lexicon of ergonomics in this period of the 1990's. For example, Anthropomorphism appeared sixty six times in the major U.S. journal *Ergonomics*, with its first appearance in 1993, one more in 1995, and a marked increase after 2000. In place of an older paradigm that framed human users in terms of fatigue, distraction, and error, was the design imperative to study terms like familiarity, comfort, and trust in the human user towards a robot other. Human modeling became one instructive technological tool for this purpose. One ergonomics experiment utilized the modeling of a virtual industrial work-space, a technical system that consisted of robots and humans. The function of the experiment was to test the hypothesis that, "[a]nthropomorphism is a promising approach to improve the acceptance of a robotic system as a team-partner."[505]

With Anthropomorphism's inclusion into its literature ergonomic design provides a unique opportunity to work through a fundamental problematic at the heart of many forms of critical scholarship—posthumanism, new materialism, environmentalism, species studies, and affect studies—who are in solidarity

[505] "Using Anthropomorphism to Improve the Human-Machine Interaction in Industrial Environments (Part I)," *Digital Human Modeling and Applications in Health, Safety, Ergonomics, and Risk Management Human Body Modeling and Ergonomics*, (New York: Springer, 2013) 76.

through their attention to the nonhuman. That critical problematic is a matter of how we may access epistemologically (or more strictly discursively) to our experiences of nonhuman bodies or agencies. This has led recently to different alternatives among materialists like Alain Badiou or Quentin Meillasoux to turn to mathematics as a formal language that is capable of thinking the thing in itself.[506] Closer to home, new materialism in the U.S. media studies context has turned to the historical and particularly Foucauldian archaeology in order to trace its nonhuman objects. Meanwhile, the emergence of Object Oriented Ontology has seen the turn to such a strict anti-anthropocentric epistemology that its conclusion is that all individual objects (including humans) withdraw from the attempts to know or understand them. The response is not "how can we know these objects," but "can we recognize that we can never know these objects?"

Ticineto-Clough has recently called for a turn to science and technology, specifically for feminist theories of affection, in order to face this problem of accessing or understanding the nonhuman.

> The feminist theorists I have engaged are focused on bodies other than human bodies but not only to revise accounts of relations between human bodies and technologies, especially those technologies which are presently bringing into human experience what only technology can enable, the experience below human conscious and cognition, outside the current understanding of life itself.[507]

The power in Anthropomorphism lies first in its reminder that no radical system of thought or theory of subject oriented to the nonhuman can circumvent the

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[506] Justin Clemens, "Vomit Apocalypse; or, Quentin Meillassoux's After Finitude," *Parrhesia* 13 (2013).
[507] Patricia Ticineto Clough, "Bodies, Science and Technology," *The Routledge Handbook of the Body*, ed. Bryan S. Turner (New York: Routledge, 2013), 104.

materiality and situatedness of our humanity. This is precisely why this project has stressed the continual recursive dynamic between a pervasive articulation of the human in scientific thought and the emergence of a nonhuman subject as a result. Jane Bennett believes that

> maybe it is worth running the risks associated with anthropomorphizing (superstition, the divinization of nature, romanticism) because it, oddly enough, works against anthropocentrism…too often the philosophical rejection of anthropomorphism is bound up with a hubristic demand that only humans and God can bear any traces of creative agency.[508]

To go a bit further with Bennett's thought, a "careful course of anthropomorphism" will illustrate that, as per affection, it is in fact the only course available to our capacity to inquire. All of our experience of the world must (for now) mediate our bodies, sensoriums, and intellects. To say that those experiences move beyond or below our scales of discourse and representation is true, but it is also the case that in order to conceive of them for the purposes of philosophy, politics, or ethics—and especially if we desire to communicate them to other human beings—they must mediate anthropomorphism. In this sense our humanity is just as much a medium as any machine or image that we put ourselves in relation to, and to think or hope for an unmediated access to nonhuman entities is fallacious.

Ergonomics, the study of affection

The anthropomorphism of Human Modeling and Computer design have been of major importance to opening up Ergonomics to the affective well being

[508] Bennett, *Vibrant matter*.

resulting from human machine interaction. In 1995 Rosalind Picard, who would later form and head the Affective Computing Group within the MIT Media Lab wrote the article "Affective Computing," which laid out some foundational thoughts on the general benefits of bringing emotion into computing for "learning, human-computer interaction…creative arts and entertainment, human health, and machine intelligence."[509] Picard discusses in philosophical terms the taboo of bringing emotions into science because of the negative description of human emotion based on rationalist positions in science. It is a taboo she would comment on further in her book of the same title:

> Being a woman in a field containing mostly men has provided extra incentive to cast off the stereotype of "emotional female" in favor of the logical behavior of a scholar. For most of my life my thinking on emotions could have been summarized as: "Emotions are fine for art, entertainment, and certain social interactions, but keep them out of science and computing." Clearly some kind of conversion has happened; this is a book about emotions and computing. Moreover, it is not about how people feel about computers, but about something of more questionable cause: giving emotional abilities to computers.[510]

Picard's work explores a range of issues for the founding of affective computing. For example, she brings up the ethical concern of emotional manipulation in humans which is another reason against bringing the study of emotion into science. The key issue being that in designing computers that perceive, adapt to, and simulate human emotion, inevitably two issues arise. 1) Are affective computers merely adding to the exploitative tools at the disposal of

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[509] Rosalind Wright Picard, "Affective Computing," *MIT Media Laboratory Perceptual Computing Section Technical Report* No 321, MIT Medialab web site, accessed May 1st 2013, Submitted for publication, (1995): 1, http://hd.media.mit.edu/tech-reports/TR-321.pdf.
[510] Rosalind W Picard, *Affective Computing* (Cambridge: MIT Press, 2000), xi.

parties interested in particular emotional responses out of human beings? 2) If we are able to, through affective computing, design a computer with human-like free will, can we build that machine and "give up control over it?"[511] Picard argues that attempting to understand emotion scientifically is a necessity for "greatly improving the interactions between humans and machines."[512] Additionally, Picard insists that "a quantum leap will occur" in communication when computers "become able to recognize and express affect."

A final note on Picard's essay is that she illustrates an understanding shared in this dissertation of the importance of physiology to the communication of affective states of human beings. Affect is both "physical and cognitive" and the indication of her work is that affective computing research will lead to a new theory of "affective communication" that will change the direction of the study of communication. The major reason affective computing machines would harken such a change is in the shift away from a computing interface that is representational, linguistic (semantic), and visual in nature—namely as the figure of a screen. The new interface, exemplified by what Picard calls affective "wearables" would communicate based on

> affective information, such as facial expressions, gaze, tone of voice, gestures, and physiology; (ii) creating new techniques to infer a person's affective or cognitive state (e.g., confusion, frustration, stress, interest, and boredom); (iii) developing machines that respond affectively and adaptively to a person's state; and (iv) inventing personal technologies for improving awareness of affective states.[513]

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[511] Picard, "Affective computing," 15.
[512] Ibid. 1.
[513] Rana El Kaliouby, Rosalind Picard, and Simon Baron-Cohen, "Affective Computing and Autism," *Annals of the New York Academy of Sciences 1093*, no. 1 (2006): 18.

The resulting wearable machine would have access to all of an individual's bodily (and cognitive) processes, and its functions resemble more a hybrid between a smart mobile device and a personal medical diagnosis machine rather than a tablet or laptop. The affective wearable would not only communicate "awareness" to an individual about her affective state, it could, given the user's permission, communicate her affective information to other individuals in proximity to her.

> One of the distinguishing features of wearable computers, as opposed to merely portable computers, is that they can be in physical contact with you in a long-term intimate way.[514]

Picard speculates that in general these wearables could augment your memory similarly to contemporary smart devices, as well as the reality of your perception (it might have a camera that could magnify your view from the back of a large room). However the most radical changes remain the social aspects of being able to enhance and communicate one's affect.

> With willing participants and successful affective computing the possibilities are limited only by our imagination Affective wearables would be communication boosters clarifying feelings, amplifying them when appropriate, and leading to imaginative new interactions and games…it might recognize your emotional state could be improved by striking up a conversation with someone with common interests right now and it might let you know who's available that would enjoy this opportunity.[515]

Picard expressed the establishment of a fundamentally new design, aesthetic, and most importantly a mode of communication between human beings and machines. It was not just a move away from the design principles of the visual

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[514] Rosalind W Picard and Jennifer Healey, "Affective Wearables," *Personal Technologies* 1, no. 4 (1997): 231.
[515] Picard, "Affective Computing," 23.

interface and representational communication but also a move toward “a computer that takes the initiative to communicate with you, and to tune itself to your preferences, instead of expecting you to program it.”[516]

Another feature of traditional computing removed from affective computing was the idea of the human user as a “maker” or “hacker” that actively fought against the predetermined design of her machine. The human-computer relationship was no longer about humans acquiring the “language” of computing, code, in order to unlock the power of customization or to possess higher levels of freedom in the virtual world. Instead the theoretical relationship was defined by the presence of a self-adapting machine that worked to fit itself to an individual.

Picard realized even when affective computing was more a hypothetical than a field that the fitting of a machine to human raised “many new human factors problems.”[517] With the focus on the physiological, or the confluence of the physical, cognitive, and affective aspects of life, took affective computing out of ordinary programming or computer engineering fields and into the expertise of Ergonomics. Additionally, the conception of wearable affective machines that were intimately connected to humans highlighted the benefit of the cybernetic thread within it.

As Ergonomics sought the study of beneficial human-machine relationships across all aspects of life, the entrance of affective computing as a research problem meant that the purpose of these machines became expansive.

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[516] Ibid. 241.
[517] Ibid. 139.

This sense of purpose would include not only new social practices and the management and promotion of personal medical health but also education, happiness and well being studies, and disability studies. In 1999, two years after Picard's book on Affective Computing was published the first ergonomics studies on affective computing started to be published in its major journals and studies on affection between machines and humans would steadily increase for the next decade.

Particularly in the application of affective computing to educational and disability contexts, the ergonomics perspective produced radical conceptions of machines and their ontological relationship to humans. This conception that involved theories of affect and empathy would have serious implications for learning, socialization, and ethical communication as learned, lived practices for machines and humans alike.

For example, Rosalind Picard and her colleagues discussed affective computing in relationship to people with Autism. They focused on the ability to empathize with others as the central problem for Autistics given that intelligence, memory, and language acquisition were major areas in which there was no difference. The set of cognitive-affective skills in empathy

> involves setting aside one's own current perspective, attributing mental states to the other person, and then making sense and predicting that person's behavior, given his or her experience.[518]

[518] Rana el Kaliouby, Rosalind Picard, and Simon Baron Cohen, "Affective Computing and Autism," 229.

This part of social learning in human beings resulted in our ability to be an empathic observer and acquire “people intuition” and the proper affects to an observed state, such as showing compassion for someone in distress.[519] The authors that there were mutually beneficial outcomes for a collaboration between affective computing and autism research in the form of computing machines that could affectively support autistics but also that looking to the processes of autistic life could help the development of socio-emotionally intelligent machines. The basis of this argument was an astonishing comparison:

> Computers, like most people with autism, do not naturally have the ability to interpret socioaffective cues, such as tone of voice or facial expression. Similarly, computers do not naturally have common sense about people and the way they operate. When people or machines fail to perceive, understand, and act upon socioemotional cues, they are hindered in their ability to decide when to approach someone, when to interrupt, or when to wind down an interaction, reducing their ability to interact with others.

By way of ergonomic perspective this comparison both drew a pattern that connected computing machines and humans in cognition and affect as well as anthropomorphized what are seemingly cold, emotionless machines. Both people and machines fail perceptually and affectively and both can also fruitfully be educated in these areas to increase their abilities to succeed.

Conclusion Ergonomics the study of Affection

The majority DeLanda’s case studies or examples used to explicate either Deleuze’s or his own views on history and philosophy are subjects beyond the scale of human bodies, history, or culture. Thus the scale of history that he often

[519] Ibid. 229.

deploys is prehistorical, geological, and cosmic in nature.[520] In order to explain expressivity beyond language he foregoes the range of human affect, instead citing the expressivity of crystalline objects before the Earth was even populated with humans![521] Human language is the target of DeLanda's second foundational assumption and following his call to always start with the nonhuman his account of affect posits that all phenomena including linguistic ones have nonlinguistic or semantic meaning that may be observed.[522]

Communication is key for DeLanda's theory of affect in the form of "expressivity" that he takes from Deleuze, a communicative form in which "language should be moved away from the core of the matter, a place that it has wrongly occupied for many decades now."[523] Though he begins with nonhuman case studies and eschews the primacy of semantic language but Delanda is still centrally concerned with a theory communication. And his sense of affect comes closest to reconfiguring the problem of machines' communicative abilities. He describes all objects as having the capacity to affect and be affected and also that affects are "constructive capacities." DeLanda offers another contribution to how we communicate with machines and other nonorganic life forms with the simple provocation, "that humans did not really invent machines."[524] In order to illustrate that machines communicate DeLanda understands that they must be

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[520] Manuel DeLanda, *A Thousand Years of Nonlinear History* (New York: Zone Books, 1997).
[521] DeLanda, "Expressivity of Space,"103.
[522] Manuel Delanda, "A New Ontology for the Social Sciences," *New Ontologies: Transdisciplinary Objects, (University of Illinois*, 2002)
[523] DeLanda, Manuel. A New Philosophy of Society: Assemblage theory and social complexity. Continuum, 2006, 16.
[524] "Out of Control," *Interview Survival Research Labs*, accessed May 5th, 2014, http://www.srl.org/interviews/out.of.control.html.

given their own history or evolutionary story outside of the domain of human history.

Perhaps the most important part of DeLanda's theory of affect is the concept of emergence. When Manuel DeLanda advocates for the study of emergence he begins to speak strongly as an ergonomist. Further, his argument for a creative practice of (social) science and a realist philosophy of affection and social complexity is a touchstone for the machine theories I have laid out in the previous chapters. DeLanda offers another contribution to how we communicate with machines and other nonorganic life forms with the simple provocation, "that humans did not really invent machines."[525] In order to illustrate that machines communicate, DeLanda understands that they must be given their own history or evolutionary story outside of the domain of human history.[526]

As I have discussed above, DeLanda's theory of affect offers the most radical possibilities for studying the affect produced between humans and nonhumans. DeLanda's reliance on the concept of emergence is the key to understanding these radical possibilities. As I have outlined in previous chapters, emergence is an important philosophical concept in both physiology and cybernetics. It is the key to a new understanding of freedom of action in both organisms and machines alike. DeLanda describes emergence as the result of a process where unique organizations or assemblages spontaneously form out of matter and energy. Importantly, DeLanda uses emergence to visualize and

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[525] "Out of Control," *Interview Survival Research Labs*, accessed May 5th, 2014, http://www.srl.org/interviews/out.of.control.html

[526] Manuel Delanda, War in the Age of Intelligent Machines (*New York: Swerve Editions,* 1991).

understand these formations across all fields of life. An Emergent form can be expressed through a crystalline structure, as well as a constructed computer, a political infrastructure, or even an entire society. Or as he describes it, emergence can be studied as overlapping layers of complexity from, prebiotic soup, bacterial ecosystems, insect intelligence, mammalian memory, primate social strategies, and the emergence of trade, language, and institutional organizations in human communities.[527]

DeLanda is fully aware that the emergence of a unique material or social formation cannot be predicted, managed, controlled, or produced solely based on human intentions. However, he feels strongly that emergence can be modeled or virtually simulated in order to better understand under what sorts of conditions certain emergences are possible. As discussed earlier, DeLanda takes the virtual to be just as real as things that exist materially in the world. So by virtually simulating, or modeling the affect that emerges alongside new formations we are being equally productive of emergence as participants in that very simulation. Like in ergonomics, where the simulation is the foundational method of experiment and insight, for DeLanda the simulation of emergence is key to understanding biological, material or social change.

The benefit of DeLanda's emergence framework is an empiricism and methodology that augments Ticento Clough's call in her introduction to accept, and not fear, new social formations. Emergence goes a step beyond the critical awareness of affect and how it moves us. With it and the practice of simulation

[527] DeLanda, *Philosophy and Simulation,* 6.

we can begin to actively participate in simulations of affect for the purposes of its novel and ethical use. We can see this framework of emergence at work in the ergonomic perspective. Whether dealing with standing desks, affective computers, or robots; ergonomics continually puts together humans and machines, charting the affects produced and changing particular variables for more “humane,” or desirable outcomes.

The ergonomic study or experiment is the site of emergence where machines are concerned. It is where machines that continue to resemble humans more and more, both physically and behaviorally, end up seeming more alien to us than ever. And, just as with simulation and the modeling, the power of ergonomics as a study of human-machine affection lies in the ways that various individuals can make imaginative frameworks and creative experiments—whether they identify academically as an ergonomist or not. Ergonomics is both a virtual space of communication and a set of technologies we may be able to use individually and collectively towards novel arrangements of affects and bodies.

Ergonomics is where the human of sight, inscription, and representation is giving way as skeuomorph to a new figure, a new life form of affect. Whether intentional or not, ergonomists have now built in the reflexivity of 2nd order observation into intelligent machines, affective computers and companion robots. These machines study human physiology and recognize the production and transmission of affect therein—a practice that human scientists in ergonomics have been empirically studying for over 50 years. It may soon be entirely

possible for a population of citizens to begin to live ergonomically, to engage in an ergonomics-of-the-self through these machines. They will then be aware for the first time of an entire universe of communication below/beyond the discursive and representational register where humans purport to exist.

Chapter 5 Conclusion: Robots Today or Beyond the Bare Life of Machines

This dissertation attempted to show that through its historical relationships to physiological thought and to cybernetics, ergonomics has become a productive way to empirically study the production of affect between humans and machines. All three fields stand on a foundation of radical theories that decenter and problematize hundreds of years humanistic thought. However, physiology also provides a thread of what I have discussed as a critical vitalism, particularly with the implicit assumption that there is an immanent power of vitality or life-like behavior that all matter share. From cybernetics there is the overarching theoretical assumption that machines, real, abstract, or fantastical, are not radically distinct from organisms and specifically what we are capable of experiencing as human machine/organisms.

I have discussed how these two tenets, which have been adopted in ergonomic study of the most “beneficial” human-machine relationships, push back against much modernist tendencies in both science and philosophy. As sort of anti-modernist inquiries, physiology and cybernetics constructed languages meant for integration not reduction, and for universal communication and

common knowledge not endless specialization of disciplines. These approaches were susceptible to two strong critiques from the scientific ideologies that encouraged the reduction of life processes on the one hand and the fragmentation of scientific expertise. One, as I discussed the physiologist experimenters who had interests in all forms of natural as well as social and philosophical phenomena would by contemporary standards be seen as unorthodox scientists at the very least and dilettantish at worst. Likewise the strongest proponents of cybernetics would be harshly criticized for defending "sloppy" metaphors between machines and organisms, physics and psychology, mathematics and human language.

However, when Norbert Wiener stressed that the "organism is the message" or Gregory Bateson looked to the most general patterns in the universe that connect all life, or Hienz Von Foerster implored that all machines existing in the world are nontrivial and unpredictable—they each were continuing a kind of thinking that not only compares and reconnects matter and life but also opens up the possibility for communication about those processes across disciplinary divides. To add the viewpoint of another provocative scholar of media machines, Marshall McLuhan also seemed to be seeking a way for articulating universal problems of communication without regard for disciplinary battle lines.

> The study of communication theory and practice has recently been fostered by numerous separate approaches to the common problems of our present world. Yet there has been no spectacular sponsor of such study, no doctrinaire approach to distort the flexibility and sensitive awareness of its complexity. But such study seems inevitably to hold the

> key to the unification of the proliferating specialisms of modern knowledge…[to the] harmonizing of the arts and sciences.[528]

The belief that all organizations of matter and energy have the power of self-expression or communication binds the 3 fields I have discussed. The communication of self as both form and function, what is on the surface is taken to be reproduction or propagation, has long been a distinguishing characteristic between life and matter. It is a generality that, as I have mentioned before, is shared by philosophy and the life sciences:

> One of the most pregnant insights into the uniqueness of living beings was Aristotle's observation that living matter possesses a special form, or organization, which is uniquely able to communicate itself to other suitable matter.[529]

It is in this sense that ergonomics contains, if in an non-programmatic way, the history of this train of thought as well as the possibility for a sort of balance of the new and the old, of the modern and anti-modern and a holistic approach that can include the scientific, artistic, and philosophical. These characteristics make it a crucial inroad to the empirical, measured, and non-anthropocentric study of the most contemporary machines—those that are highly intelligent, affective, and anthropomorphic—these are the coming generations of industrial and service robots.

Robots have become even hotter commodities not only in the U.S. military industrial complex, but also in industry and of course in popular culture. Robots continue to trend high in online and print news, and in every story they are

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[528] Marshall McLuhan, "The Later Innis," *Queen\'s Quarterly* 60, no. 3,(1953): 393-394.
[529] Thomas S. Hall, *Ideas of Life and Matter*,381.

framed as harbingers, either of revolution, insecurity, or death. The United States Drone program has had the limelight for a while, but slowly the drone is being understood for what it is, a subset within a class of intelligent machines with a long complicated history. As reported in Forbes there is a class of "killer" robots that the United Nations agreed to take steps to ban from conventional warfare in the next 3 years.

The Federal Aviation Association has just recently allowed the commercial flight of domestic drones in U.S. airspace. Google has recently been buying up many robotics technologies/patents and are in the process of developing a robot ethics board of experts who ostensibly will be influencing their operationalization of new robots.

Now it would seem that an even larger context is being produced for robots as people are recognizing a general "rise" of intelligent machines outside of the auspices of war.

Within this context you have commentators like MIT scientist Illah Nourbaksh who writes that "Its time to Talk about the Burgeoning Robot Middle Class."[530] Nourbaksh also writes, in his blog of the same name as his book RobotFutures, that this decade is very much an "engineers revenge" which will see the speedy catching up of hardware ie material machines in everyday life to

[530] Illah Nourbaksh, "Its time to Talk about the Burgeoning Robot Middle Class," *MIT Technology Review*, accessed on April 30th 2013, http://www.technologyreview.com/view/514861/its-time-to-talk-about-the-burgeoning-robot-middle-class/

the innovation of software and memory in computing.[531] In Politico Magazine's "The Robots are Here" predicts at least 3 major events from the rise of working robots: 1) a digital social Darwinism where those who ostensibly can design, program, or work well with robots become the new elites. 2) A new digital meritocracy, and 3) a new digital libertarian age where control over intelligent machines equals new economic freedom.[532]

This machine driven dystopic future is reflected perfectly in the commercially and critically successful Elysium, where militarized robots are the bloody boot heels/immigration police for the ultimate gated community floating above an impoverished Earth.[533] The 2014 Robocop remake of the 1980's comic and film has dropped the political satire of Reagan age popular culture and corporate and government bureaucracy, in favor of a heavy handed allegory about futuristic military drones used domestically as police. In the film we find Samuel L. Jackson's character, described vaguely as a powerful TV magnate who advocates any and all of the robotics market, shouting to us the audience, "Why is America so Robo-phobic?"[534] This perhaps disingenuous conflation of robots with the LGBT movement expresses well Rosi Braidotti's observation that those aligned with neoliberal, global economic forces tend to be more open to some of the characteristics of posthumanist condition than either liberal

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[531] Illah Nourbakhsh, *Robotfuturesbook: A companion blog for the book Robot Futures by Illah Nourbakhsh,* accessed April 30th 2013, http://robotfuturesbook.wordpress.com
[532] Tyler Cowen, "The Robots are Here," *Politico Magazine* online, accessed April 30th 2013, http://www.politico.com/magazine/story/2013/11/the-robots-are-here-98995.html#.U6MAAl60Zg
[533] *Elysium*, dir. Neil Blomkamp, Hollywood California, Sony Pictures, 2013.
[534] *Robocop*, dir. Jose Padilha, Hollywood California, MGM Studios, 2014.

progressives and/or critical scholars. This immanent arrival of machines in industrial and popular contexts is reflected in the significant increase in ergonomics publications studying human robot interactions since the middle of the 1990's.

Finally, a piece in the Atlantic "All Can Be Lost: the risk of putting our knowledge in machines" adds yet another element to our economic insecurities, the fear that intelligent machines makes for lazy, unintelligent human citizens.[535] This is a framing or enframing around machines that has been repeated historically for centuries, and derives in part from Plato's Phaedrus, where the machine like quality of writing (i.e. its artificial supplement to the purity of memory) is, as Jacques Derrida observed, both curative and poisonous to human memory. As he explained, the thing itself, writing, or what could be called an ancient media-machine, was always more complicated, more ambivalent than the cure/poison binary that enframed it.[536] Yet, the machine would always carry with it this framing of itself as dangerous. The event of the "pharmakos" was the ceremonial scapegoating/killing of a Greek citizen chosen to represent an evil outside presence.[537] For Derrida it served as an example of the uneasiness of the original thing or machine (pharmakon) that was not human, that was then over determined, overlaid by Greek culture with another function.[538] That new

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[535] Nicolas Carr, "All Can Be Lost: The Risk of Putting Our Knowledge in the Hands of Machines," *The Atlantic* online, accessed April 30th 2013, http://www.theatlantic.com/magazine/archive/2013/11/the-great-forgetting/309516/

[536] Jacques Derrida, *Dissemination*, trans. Barbara Johnson, (London: The Athlone Press 1981).

[537] Derrida, *Dissemination*, 130.

[538] Ibid. 130.

function was actually the process of turning the uncertainty and non-meaning of what was not human but in constant interaction with humanity into the certainty and comfort of determining it as evil—as what must be expelled from the body and the polis.[539]

What is most important about Derrida's analysis of pharmakon is that he translates the discussion of the medium of writing, the physical object and technology, into a discussion about human vs. nonhuman life, as well as the maintenance and security of an organism both literally in the individual and figuratively in society or the body politic. He thus opens up the possibility to talk about machines within the framework of the human and the animal (beast) what many biopolitical theorists have continued to work on as the distinction between political citizenship or fully realized humanity and bare life. I wish to continue my own research into the development of a biopolitics of machines in order to further understand how humans enframe them for the purposes of defining, producing, and managing modern forms of life.

I borrow "frame" or "enframing" from Literary Theorist Cary Wolfe, who takes framing as a particularly violent production of knowledge.

> the question of framing is not simply a logical or epistemological problem but a social and material one, with consequences. Framing decides what we recognize and what we don't, what counts and what doesn't; and it also determines the consequences of falling outside the frame (in the case at hand, outside the frame as "animal," as "zoe" as "bare life").[540]

From Gestell in Heidegger's "Question Concerning Technology" we get a

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[539] Ibid. 132.
[540] Wolfe, *Before The Law*, 6.

humanist's definitional senses of machines as something that is both rigid and lacking of content—an armature, skeleton, rack. In Heidegger's cautionary against modern technology he frames technology is neither human nor natural in essence, nor is technology important in and of itself, but rather for how it calls forth the world to our perception. As a third term between humans and nature a machine is thus a medium, one that in modernity calls forth an improper relationship between humans and technology (as in an utter reliance on calculation and rationality) and thus an improper relationship between humans and themselves.

The way then, Wolfe argues, that Heidegger's humanism can be the cure to technology, (to quote Heidegger from letter on Humanism "for this is humanism: meditating and caring, that man be human and not inhumane, 'inhuman,' that is, outside his essence."—is precisely to continually draw and redraw the line between who are "fully human and less than human."[541] While much has been said on Heidegger's question and its violent relationship to humans and the environment, in post-structuralist thought and in biopolitical theory, a common feature seems to be that in political and ethical contexts where machines are concerned, the machine as a subject is erased from a particular context of trauma or loss save for what it "brings forth" into a human world. This is what led Bernard Stiegler to determine that the technological has been immemorially repressed from Western Thought.

In my dissertation I have argued that this repression can be thought of

[541] Wolfe, *Before the Law*, 5.

fundamentally as a problem of communication. If a machine is merely a medium, or some substance intervening in two or more subjects, then it is both rejected as a subject with intention or capability to communicate itself. As mentioned before, if technology is not important per se, if it has neither intention or purpose, but rather merely frames the world for us, then it is lacking in its powers of communication.

To state it another way, in the relation between human, technology, and nature, none of these figures (subjects integral to biopolitical studies), the slave, the musselman of the Nazi Internment camp, the colonial subject, or the machine, have a fully realized capacity to communicate—whether that means the ability to literally enter the polis or give voice to indignity—or on a basic ontological level they cannot fully express what they are, the fact of their existence independent of the fully realized human life opposed them. Again, from my introduction and above, the idea of self-communication of form as the defining characteristic of life (as opposed to matter) is ancient and still thrives. This ability to communicate organization has impinged on the modern robot as a machine that while continually increasing in complexity is conceived of as fundamentally dependent on human creators for its existence. But Wolfe's examination brings up a problem of the machine in my dissertation that relates directly to biopolitical theory. My guiding claim moving forward in research is that the machine, both as an abstract mimetic concept, as well as a material tool and service provider, has been inextricably linked to our modern conceptions of life—

conceptions to which my study of physiology/cybernetics/ergonomics provide less fearful, exclusionary, and violent alternatives.

Key to our anxiety over robot lives is also the continual problematizations and destruction of the hierarchical limits we feel compelled to continually construct between them and us. With robots this comes to mind as a very long list of humanness that we continue to cross off as they continue to evolve. In the general scheme from simplicity to complexity, machines seem to be acting equivalences in mobility, reflex, and memory. Though it has generally been held that the human mind, and its mysterious relationship to membrane and electro-chemical reactions that has been the pinnacle of human consciousness is the difference by which robot intelligence comes up short and will never be like human intelligence. Very recently a "social bot," was claimed to have been the first to pass the "Turing Test" and fool at least 30 percent of a panel of human judges into believing they were communicating with a 14 year old boy. Though less than a week later this feat was quickly dismissed as a failure and the AI computer deemed unimpressive. This backlash against the Chatbot, "Eugene Gustman," did not dissuade CNN's opinion page from echoing the sentiment from above that "The Robot Age is Here," because of such a milestone.[542] I believe that all this discourse over "robots to come" represents the longstanding problem of making machines an object that is both allowed and prevented from the sociality of human affairs, what I have touched upon as part of the bare

[542] Mark Goldfeder, The Robot Age is Here, *CNN* online, accessed on June 5th 2014, http://www.cnn.com/2014/06/10/opinion/goldfeder-age-of-robots-turing-test/

life/political existence distinction of modern biopolitics, and what Giorgio Agamben calls an "inclusive exclusion" of the biopolitical other.[543]

Very recently Cary Wolfe put his thoughts together on the future of posthuman studies.[544] One future, he claimed, was a biopolitical framework that is both Zoological and Ecological insofar as we can see through the regulation of our living environments and the animals surrounding us just how powerful our biopolitical production has become. The marriage of biopolitics and species and ecological philosophies is doubly productive in that it reveals to both sides that an ethics committed to ending the production of bare life (zoe) for the sake of the existence of the good life (bios) must not end at the disposability of human beings alone.

> as many philosophers have emphasized, that "dehumanization" is a fundamental mechanism for producing a "Western" idea of the "man" over and against populations considered "dubiously human." But as I have argued in detail elsewhere, as long as the automatic exclusion of animals from standing remains intact simply because of their species, such a dehumanization by means of the discursive mechanism of " animalization" will be readily available for deployment against whatever body happens to fall outside the ethnocentric "we."[545]

A nonhuman biopolitical framework thus lays bare the common problematic for both radical theories of otherness as well as biopolitical theory—the particularly humanist valuation of life. It is not that valuing life is itself a negative political proposition, it is rather that humanistic thought has long constituted its evaluation based on the absolute of the negative other to life.

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[543] Giorgio Agamben, trans. Daniel Heller-Rosen, *Homo Sacer: Sovereign power and bare life* (Meridian, 1998), 7.
[544] Carey Wolfe, *Plenary Speech of Society for Literature Science and Art 2012 Convention*.
[545] Wolfe, *Before the Law*, 21.

Wolfe's call for a zoological or cross species biopolitical theory might be construed as a less radical Cosmopolitan ethic based on liberal humanism—whereby the sphere of political rights and inalienable dignity is pushed or expanded continually to include this and that subject. In this case at some point in time both fauna and flora will have their rights bestowed at the very least de jure. However, I believe that there is a more radical openness to his proposition, one that reflects a growing gesture to an affirmative biopolitics. This is the idea in general that the apparatus which regulates particular forms of life does not have to be based on the particular principles or valuation of life that currently exist. In this sense, if we recognize that our external management through technological and institutional infrastructure could indeed promote life more ethically, then it may occur to us that the only trauma we suffer is the loss of our engrained myth of a freely choosing, self-sustaining life form. Affirmative biopolitics also indicates that regardless of the apparatus in which life is regulated, in our case one that places a schism between life and matter, and then dictates lives' values based on its proximity to a fully realized humanity—life persists in excess, life errs in the face of human life, and exists in spite of its regulation—as anomalous life. I have attempted, in particular in my discussion of the cybernetics of Michel Foucault, to show the confluence and inseparability between machine and organism that encourages a biopolitics of machines. What I believe is necessary for those of us interested in claiming that nonhuman and nonorganic bodies are caught up within

biopolitical regimes of production, is to start to find ways of translating such a radical notion into more familiar terms.

Jane Bennett, who I have mentioned throughout and has already written a political ontology of the agency of nonorganic objects in the world, claims that our anthropomormism may begin with anthropocentrism, hierarchical judgment, and "narcissism" but can go much further: "We at first may see only a world in our own image, but what appears next is a swarm of "talented" and vibrant materialities (including the seeing self)."[546] She believes that there are ethical and political benefits to allowing ourselves to anthropomorphize because,

> We need to cultivate a bit of anthropomorphism-the idea that human agency has some echoes in nonhuman nature - to counter the narcissism of humans in charge of the world.[547]

What Bennett suggests is that instead of avoiding anthropomorphism, our human scope of sensation and understanding, what is necessary are new images and new modes of anthropomorphizing. Perhaps we might project or imagine a Robot's mimetic abilities, or equivalency—(recognizing all the while that mimesis is not the purpose of the robot but the necessary way we relate to it as other) not of human life per se but of life in general. But what might a non-reductive, non-hierarchical anthropomorphism look like?

The latest in computing and robotics have timely examples that might aid our imaginative anthropomorphism. DNA computing, which designs computing machines from living proteins and DNA, moves away from a human brain/mind

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[546] Bennett, *Vibrant Matter*, 99.
[547] Ibid. xvi.

design aesthetic in favor of the molecular generation of life forms writ large. Programmable matter, which has received much buzz in robotics, is based on the idea that a robot is no longer of any particular shape with specialized parts or appendages, but rather can construct itself differently based on context-based problems. While DNA computing may easily be represented as Frankenstein's post-industrial monster, and, as programmable matter has already popularly been likened to Terminator II, T-1000 liquid metal man—the conception of a non-reductive machine life that does not threaten our own human identity, perhaps can lead our imaginations elsewhere.

In conclusion, I plan to continue following the inroads into human machine interactions that my work on ergonomics has provided. I am interested in pursuing both ergonomics' longstanding intellectual history as well as the sociopolitical implications of the most contemporary work in ergonomics. For example, I wish to continue studying ergonomics' strong relationships to systems theory and cybernetics on the one hand, and its antagonistic relationship to capitalism on the other. I will build on my existing research to show that through ergonomics both the machine and the human being are theorized in fundamentally different, more ethical ways than they are when captured by both industrial and global capitalist frameworks.

To give an example of contemporary research, I have begun research for one or two journal publications on a recent trend in "popular" ergonomics. Ergonomics is currently being deployed in business and self help contexts in

order to help individuals feel more powerful and to increase their levels of professional success and mental well being. Deemed “power poses” this new enterprise teaches individuals to control not only their body movements and postures but also their conscious sense of space and the objects of their lived environments. Power poses combines the sciences of biomechanics, anthropometry, and kinematics—all derived from a larger history of ergonomic science—with neoliberal practices of citizenship that render all forms of knowledge and all practices of everyday life as functions of entrepreneurship. This enterprise is gaining traction at the same time that psychologists are taking seriously the relationship between ergonomics or designed spaces and individuals’ capacities to be ethical.

Finally, as a more long term and ambitious book length project, I would like to draw on my training in anthropology and secure funding for an ethnography on humans and robots in robotics and engineering cultures. There are numerous sites across the globe, for example, “Robot University” in affiliation with the “Arts and Queensland University of Technology” where researchers put humans and robots in constant interaction in order to “to transform negative attitudes towards robots.” I believe this project would serve two unique and productive ends. One, it would illuminate this burgeoning culture of robotics production, both in the institutional, aspirational, as well as creative productivities of human participants. Two, I believe it could contribute to the cutting edge methodology of ethnography by including machines as producers of culture. This

of course, resonates with the whole of my research imperative to push the theoretical conception of our being ethical through and with machines.

Coda American Machine:

I would be remiss if I did not mention lastly that the most recent bit of writing I added to the dissertation is based on Jacques Derrida's late work on the figures of the Beast and the Sovereign in early modern Europe, and American Sovereignty today. My new interest in this work of his has absolutely nothing to do with the present study on ergonomics, and everything to do with the events surrounding the killings of young black men in America—particularly the killings of Eric Garner in New York and Mike Brown, who lived in Fergusson, Missouri, about 2 hours away from my home town. This is particularly important to note because admittedly there is a profound lack of a political valence or description of the political stakes within my project. It has taken these abominable events perpetrated by U.S. law enforcement agents, characteristic of a history of such acts that has accompanied the history of the Nation from its beginnings—to offer me a shift in vantage point of the philosophical concepts of otherness that I have deployed. The following few fragments I leave as a documentation of what I am reconsidering and as a promise to myself and to others that I will work harder to connect the possibility of ethical subject to the hope for a just political arrangement where I live.

In one of his last publications Jacques Derrida wrote, as an admission of sorts,

> I had to cite Tocqueville, and particularly Democracy in America, without letting too much more time go by, in order to announce from afar that, at the end of a long detour, right near the end, it will perhaps become clear that democracy in America or, more precisely, democracy and America will have been my theme.[548]

Derrida had acknowledged America's thematic importance to his work years before when he declared that,

> I would risk, with a smile, the following hypothesis: America is deconstruction (l' Amerique, mais c'est la deconstruction). In this hypothesis, America would be the proper name of deconstruction in progress, its family name, its toponymy, its language and its place, its principal residence.[549]

This is a hypothesis he would retract just as soon as he posited it, as was the ambivalent character of deconstruction. However, it was also because of the great ambivalence Derrida felt toward America as a rhetorical figure of international sovereignty and perceived rule of the people domestically. The problem was inherent in the "representational" character of America's signs, of both its State and its People, both, as it were, independent.

> It is the "good people" who declare themselves free and independent by the relay of their representatives and of their representatives of representatives. One cannot decide-and that's the interesting thing, the force and the coup' of force of such a declarative act-whether independence is stated or produced by this utterance.[550]

The problem emerges from the double declaration, the two separate (but equal?) declarations of independence. On the one hand the sovereign people, represented in as unadulterated a manner as possible by the pen of the

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[548] Jacques Derrida, *Rogues: two essays on reason*, trans. Pascale Ann-Brault and Michael Nass (Stanford University Press, 2005), 14.
[549] Jacques Derrida, *Memoires for Paul de Man*, trans. Cecile Lindsay, Jonathan Culler, Eduardo Cadava, and Peggy Kamuf (New York: Columbia University Press, 1989).
[550] Jacques Derrida, "Declarations of Independence," *New Political Science 15* (1986): 9.

representatives of government. On the other, the representatives of government, being wholly different from any form of sovereignty that came before, represent their own independence—the independence of a State founded on and embodying individual sovereignty. Derrida astutely noted the “force and the coup of force,” within this double declarative act. And to answer my own question above, they are definitely not equally powerful declarations in political context as a citizens representational independence becomes, as Derrida might say, difference—or a deferral of right in the face of the immediacy of the power and independence of his governor. Derrida offered two interrelated concepts that might describe the violence that would spring forth from the coup of force in American independence, Autoimmunity and Rogue. In mentioning autoimmunity I only wish to say that it integrates nicely with both Roberto Esposito’s Immunitary Paradigm as well as with Giorgio Agamben’s State of Exception. A particular kind or class of citizen, particularly in America, must become forfeit so that other classes may feel re-secured in their representational independence that had already been subject to deferral. For Derrida this had historical precedent in Europe in the figures of the beast and the sovereign. In America, the beast has been proven, through time and blood, to without a doubt be of color.

Another result of this force is violence, and the violence can be seen in the figure of the Rogue as Derrida discussed late in his career. Of the rogue I will only add that Derrida gave us insight again into America in presenting a notion of a rogue that was in part playful, ironic, and endearing. It is this playfulness that

leads America on in defending their rogues. Whether it be a rogue citizen (shooter), a rogue political administration pushing U.S. exceptionalism, or now a rogue police office. Citizens find comfort in the possibility of becoming rogue in order to re-represent a lost power, one that Derrida noted was inherent within our radically representational system of governance.

Finally, to put a finer point on it, Derrida's late work on biopolitics and the American State is useful in understanding the technologies of policing black Americans as well as those protesting in solidarity with racial and class struggles in the U.S. I have found one more of his concepts, "animal-machine," as an arresting description of the dark political repercussions of a mechanistic, instrumentalist epistemology. I leave the following passage at length as a guiding element towards understanding the connection between the epistemological and ethico-political contexts of the kind of mechanism I have discussed. Derrida rightly notes that the animal-machine is a construct of Cartesian tradition[551], and reads that tradition through a thinker in Thomas Hobbes, who took scientific instrumentalism into the social, but also, and in a reductive fashion, took animalistic fear into the legitimacy of policy.

> And there we should find. as close as can be to sovereignty-which is, as it were, its correlate-fear: fear as It is defined by the Leviathan, for example. Leviathan is the name of an animal-machine designed to cause fear or of a prosthetic and state organon, a state as prosthesis. The organ of contempt, and then exert terror (Hobbes's word: "Terrour"} by "private revenge; this terror I exert is a crime. So that everything comes down to fear: I can commit a crime and exert terror by fear, but it is the same fear that makes me obey the law. Fear is "sometimes cause of Crime, as when

[551] Jacques Derrida, *The Beast and the Sovereign Vol. 1*, eds. Michel Lisse, Marie-Louise Mallet, and Ginette Michaud, trans. Geoffrey Bennington (University of Chicago Press, 2009) 111.

> the danger is neither present, nor corporeal (p. 150). This is an important precision: Hobbes privileges "Bodily Fear" and the "present" of the body, but there is in all fear something that refers, essentially, to non-body and nonpresent, if only the future of a threat: what causes fear is never fully present nor fully corporeal, 111 the sense that the purely corporeal is supposed to be saturated with presence.[552]

The, “republic, state, commonwealth, civitas,”[553] only ever come into existence based on the fear driven animal-machine sovereignty. The fear that the beast instills is also the fear of the machine, the combined power of the animal-machine is the power,

> to amplify the power of the living, the living man that it protects, that it serves, but like a dead machine, or even a machine of death, a machine which is only the mask of the living, like a machine of death can serve the living.[554]

I have seen all to clearly the power of the animal-machine encounter between police officer and black male. The amalgam emerges from the various machines of arrest that the officer deploys—handcuffs, night sticks, tasers, handguns, riot gear, shields—in contact with the animalistic responses the civilian is left with. One either takes flight or freezes in the face of a machine of death with arms risen. I have also seen the representational power of wearable policing technologies as documenting or witnessing eyes and their effects on the status quo of American authority. Wearable video cameras have, in the light of recent civilian killings, gotten much publicity as a means of visual documentation and for police to “self-police,” and to curb excessive force. However, police forces are also poised to use a battery of other wearable technologies including smart

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[552] Derrida, The Beast and the Sovereign, 44.
[553] Ibid. 28
[554] ibid. 28.

watches and tactical headset computers—all functional because they are hands free tech used in the heat of an altercation when police hands are occupied with other low-tech wearables, namely tasers, pepper spray, or handguns. I will pursue further the analysis of this wearable-police officer as a subject of prosthetics, as an animal-machine designed to symbolically legitimate a form of sovereignty that, as Derrida describes it, is a machine of death meant to protect the living. While police literally perform incapacitating and lethal violence to certain bodies wearable technologies identify, document, and informationalize citizen lives that are racially and ideologically marked as improper.

The wearable-police officer subject is rearticulating the early modern political theory Derrida discussed while updating it with the power of new technological devices. What separates Men from beasts is the artifice of his invention, these machines. Men rule over beasts through their machines. Finally, there is no possibility of the good of justice in Man without (righteous) force over beasts and the production of their fear. This has important implications today not just for racial tensions or the militarization of law enforcement. It also works to explain the legal system's inclusion of certain violent acts by rogue males and rogue police forces as part of the public service and good, as well as the increasingly violent nature, and inherent danger involved in a citizen resisting or speaking out against the status quo. A popular phrase has emerged out of police brutality against Brown, Garner, and others—black lives matter—has circulated powerfully through images and social media, and attests to a new declaration (of

independence?) by a particular citizenry, those who would be advocates for the recuperation of the black body into the polis, into the envelope of the sacred and outside of its beastly opposition, that Americans with the “good life” enjoy. However, police killings of black citizens constitute an entire system of authority and administration—what Agamben describes in biopolitical terms as an apparatus—and this apparatus is founded on a logic that is more complicated than the disposability of black Americans. Black American lives matter a great deal in our moment, first, in representing the latest iteration of the kind of life that must be produced, then recognized and circulated to the public—in order for U.S. sovereignty to legitimate a particularly roguish form of democratic agency. Second, judging by the continued killings, the organization of protest, and the obstinacy of police departments and some white citizens—black lives matter crucially by showing that traditional responses of resistance that deploy concepts like equality, civil rights, and especially freedom, may be unequal to the task of transforming this animal-machine apparatus. It is, in fact, a system where authoritarian declaration of right and citizen declaration of right to fully realized political life share the same philosophical basis for defining justice. The tyrannical rule of authority to maintain the American status quo and the urgent outcry of American citizens in support of black citizens both hinge upon a “right to life.” Agamben may be correct in asserting that only a biopolitical reflection,

"will be able to bring the political out of its concealment and, at the same time, return thought to its practical calling,"[555] where its practical calling is an institutional transformation out of an apparatus that kills some so that many Americans may live particular lives.

In the end, I resist saying definitively that my project has always been or is now primarily concerned with otherness or even more specifically with racial inequality and violence in America. I do recognize that the machine continues to be a productive philosophical figure for understanding otherness, and the strict way that it is excluded from life and poised against it. This melded relationship between animal and machine can be enlightening if not horrifying when seen alongside the extreme exclusions, not just to citizen status but to life itself, for the actual citizens we live with. I will follow this biopolitical line that merges machine with animal, epistemology with governing practices, ethics with politics. I will continue to say that my object is the machine, and…

[555] Giorgio Agamben, Homo Sacer: sovereign power and bare life, ed. Werner Hamacher and David E. Wellbery, trans. Daniel Heller-Rosen (Stanford University Press, 1998), 4-5.

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