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At the Intersection of Human Agency and Technology: Genetically Modified Organisms

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by

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Dedication

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Abstract

Since the Neolithic period and the rise of agriculture along Mesopotamia's "Fertile Crescent," greater societies have formed thus requiring laws and governance to ensure their continued preservation. The Babylonian Code of Hammurabi is one such example of how agricultural technologies directly created new social and institutional structures in codifying slavery into law, or how mercantile transactions are to be conducted. Similarly, GMOs are the result of modern agricultural technologies that are altering laws and society as a result of their implementation. This transformation informs the central inquiries of my research question: Why are GMOs necessary, and what influences do they have on the project of human rights? As our age is defined by the products of bioluminescent – or glow-in-the-dark – cats and goats that can excrete spider silk proteins from their mammary glands, these questions become essential. I conclude that the technology does not, at least conceptually, conflict with or undermine human rights. Instrumental reason has firm limitations in biological applications as well as conflict with its inherent anarchical nature. We are now compelled to question the utility of genetic engineering and if it merely places humanity into another precarious "arms race" with weeds and pests, in addition to the pressure of maintaining current dependencies of petrochemicals, fertilizers, and continued observations of ecological homeostasis.

Chapter One: The Controversy in Context - Synthetic Syntheses and Life

The tree which moves some to tears of joy is in the Eyes of others only a Green thing that stands in the way. Some see Nature all Ridicule and Deformity, and by these I shall not regulate my proportions; and some scarce see Nature at all. But to the Eyes of the Man of Imagination, Nature is Imagination itself. As a man is, So he Sees. As the eye is formed, such are its Powers.

William Blake, In a Letter to Reverend Dr. Trusler, 1799

In an early-2001 Microsoft PowerPoint presentation titled "Future Strategic Issues/Future Warfare [Circa 2025]," Dennis M. Bushnell, Chief Scientist of NASA's Langley Research Center, examined a number of not-so-hypothetical threats that the United States then had to consider. Based "upon existing data/trends/analyses/technologies (e.g., NO PIXIE DUST)," Bushnell wrote emphatic and frighteningly marvelous "bullets" detailing scenarios of "Rampant Recombinant Bio" and, referencing "dust" in a more serious context, a "Smart Dust." This "Smart Dust" Bushnell envisioned in 2001 had the potential of being used as "Micro Dust Weaponry," a "Mechanical Analog to Bio, Micron sized mechanized 'dust' which is distributed as an aerosol and inhaled into the lungs. Dust mechanically bores into lung tissue and executes various 'Pathological Missions,' that was in his view, 'A Wholly 'New' class of Weaponry which is legal'" (Bushnell 2001).

Observing that this was an extension of a "WORLD [in] the throes of triple/exponential (IT/Bio/Nano) Technological Revolutions)," Bushnell's presentation should cause us now, eleven years away from the fruition of the predictions, to consider what we have thus far made of these three revolutions, and what we have done to life itself. And that is without the interest of organizations such as DARPA, the Department of Defense's Defense Advanced Research Projects Agency.

As fantastical as the orientation of Bushnell's presentation was, he wrote that in 2001 "Humans Have 'Taken Over' and Vastly Shortened 'Evolution'" and in regard to "Products/Life Forms" that a "Cross Species Molecular Breeding" and "Directed Evolution" were possible, and companies such as Maxygen and Nexia Biotechnologies converted these possibilities into realities. Through the use of recombinant DNA (rDNA) or "chimeric" molecules of DNA from divergent, parallel, or entirely separate evolutionary backgrounds and synthesizing them together as "directed evolution," the nascent industry of biotechnology could overcome long-perceived limitations of biology. Products such as "BioSteel" and "Arctic Apples" are two examples of this technology's use, as they are, respectively, transgenic (formed from chimeric rDNA) spider silk proteins produced from the mammary of goats, and apples that do not tarnish or oxidize as traditional apples would when sliced. Both examples marvelously solve and remedy what have been industrial obstacles whether from the inefficiencies of producing spider silk, or the costs and efforts that catering companies would accept in preparing food that could remain visually appealing hours into an event. Further and even more important to consider, the application of rDNA technology carries with it the potential of alleviating world hunger, the first of eight Millennium Development Goals established by the United Nations. At the present time of this writing, projects like NERICA or the "New Rice for Africa" (an isogenic cultivar and not a genetically modified organism) and "golden rice" (a genetically modified organism proper) are seeking this prospect.

Poised to ameliorate world hunger, exponentially rising food prices (one factor among many that helped to trigger the Arab Spring in Egypt), and the problem of heavily depleted, overworked, and stressed farmlands from soil erosion and the effects of climate change, GMOs, or the technology to genetically modify organisms would appear to be humanity's "way out." However, as I will argue, this "GMO Revolution," just as the revolutions which preceded it, has its own consequences: Human law, society, and our environment will also change in tandem with the revolution. Where the Neolithic Revolution required the organization of society through law as an extension of its success, Rachel Carson's 1962 *Silent Spring* and the implementation of the Environmental Protection Agency and similar regulatory responses were necessary following the pesticide and herbicide propelled Green Revolution. In considering this inextricable caveat of progress, the question developed can be stated as such:

Why are GMOs necessary, and what influences do they have on the project of human rights?

Methodological Approach:

The methodological approach and subsequent analysis utilized here is properly forked between critical theory, insofar as the technology's aspects of an "instrumental rationality," and their current implementation. Oxford University Press' dictionary defines critical theory as a "philosophical approach to culture" that "seeks to confront the social, historical, and ideological forces and structures that produce and constrain it" (oxforddictionaries.com). As such, critical theory is an indispensable asset for analyses that hinge upon technological issues as a function of its unique ability to underscore the social, political, and economic consequences of technology on humanity. Instrumental rationality, stated roughly, is a means, and means merely, of how humans achieve a set of desired ends using the world and entities contained within it as a tool. For example, a rock is not simply a rock; it can serve as a hammer, a heated surface, a "deadfall" trap, or an innumerable number of other things though its instrumentality exists above its status as a rock. Though humans are not alone in this instrumental execution (chimpanzees are well known users of tools such as stems to extract termites from termite mounds), humans exist as the only species with the capacity to terraform or transform vast landscapes in accordance with intent.

As major professor and advisor to this thesis, Steven C. Roach aptly illuminates this aspect of critical theory and its prominence in his *Critical Theory of International Politics, Complementarity, Justice, and Governance* (2010) as a foundational ground to attempts of exposing "hidden sources of social reification" (Roach 2010). Integrated within this project, I will shift the reader's consciousness towards the oppressive arms of technology stemming from (in my view) scientific reductionism in genetic engineering, and how this strict instrumentality alters and "reifies" itself socially. Placed in a more direct purpose within the scope of this work, I am to mean when a crop is no longer a crop in a basic utilitarian scheme, but when its genetic code (both proprietary and altered through recombinant processes) becomes its own identity in law, as through patents, and in society. Substantiated by what Steven Roach identified as the first generation critical theorist Theodore Adorno's "strain of radical Hegelian idealism," social and historical progress never occurs through mediating "a middle element between extremes," but "through the extremes, in the extremes themselves" as a result of the inherent subjectivity of experience (Adorno 1993). I elected to add inclusions of post-left anarchist thought to serve as such an "extreme" on the matter of scientific progress as a way to underline thought posed by the cynics of progress. Exemplified by another extreme, I selected the most far-reaching and conceptually radical ends of genetic and molecular research as underscored in the introduction. From these two extremes, and an examination of the raw effects of GMOs, I am able to answer why the science is both necessary and from that vantage point, to demonstrate how technology shapes human rights.

I have elected an equally unorthodox methodology, interpretivism, as the tradition is well aligned to critical theorists, who were among the early opponents of the Vienna Circle and late nineteenth-century positivist thought. Interpretivism owes its advantage as a research method to a raw connection of ideas and concepts to world developments and their historical significance. For instance, Oswald Spengler's 1918 work *The Decline of the West* and its production cannot be owed to an algorithmic decoding of stochastic phenomena; rather, it was Spengler's assessment of the stages of civilization and technology as holistic and inseparable processes that built his conclusion. Conversely, positivists and statisticians promote a truth that exists within filtered, verified, and numerical representations of phenomena, and thereby contend for a single, universal, firm, fixed, and irrefragable reality that any observer who executes logic to a proper end can apprehend said truth. While interpretivists also submit that there is a wide profundity of hermeneutic and phenomenological conduits to such a unified reality as proposed by positivists, these conduits are grounded in social constructions, language, and even limitations in consciousness. Interpretivism then, I believe, is the best candidate to examine some underlying stand-in for a Kantian *noumenon* or a realized yet fully inaccessible universal truth. Methodologically framed, interpretivist analyses of history and society directly inform the larger structures present within organized humanity.

With regard to spotlighting the issue of human rights internationally, my investigation is undertaken through asking whether the right to know, a right of privacy, and a right of choice (or choice *from*) is preserved and / or protected in the adoption of GMO technology. It is my hope that this procedure of analysis does not present itself as merely presenting a strawman of GMO technology, or to simply deploy some level of a "naturalistic fallacy" or appeal to nature in assuming that what can be associated with nature (apart from human science and thought) should be privileged above the "unnatural." I shall seek to show that GMO technology does not, at least conceptually, conflict with or undermine these above human rights. To address this aim, the paper will be broken up into two separate segments. The first segment is constructed of its own subtopics, being instrumental rationality, technological progress, and the twentieth-century advancements in agriculture; the second segment has its own respective subtopics, being the matter of human rights and consequences of technology.

<u>Framework and Overlay of Analysis</u>:

This section will seek to resolve and clarify the multiple threads of reasoning present in the following chapters. Until this point, I have briefly hinted toward how the structure of this paper is organized. I determined that a necessary component is an explicit overlay of the arguments. In reading this subheading alone, one will be better adapted in understanding a thorough perspective of why, and a preview of where, my arguments detour.

Chapter Two, titled "The Convergence of Agriculture, Society, and Technology," problematizes the tripartite arrangement of – as might be readily guessed – agriculture, society, and technology. Together, these elements are found to be neither separate nor discrete as a consequence of human history. As such, these elements together form a sharp point of a precarious "Sword of Damocles" scenario in which humanity either adopts the ideology of continued progress, or suffers collapse. As a focus of the chapter, agriculture's reliance on development and technology is found to have ideological trappings that set it on this course as found in Hardeman and Jochemsen's analysis of the Treaty of Rome and CIGAR, or the Consortium of International Agricultural Research Centers. While critical theorists were apt in identifying the creation of artificial needs through technology, they did not encompass an even more provocative idea that the origination of technology itself (before there was ever a project of Wilsonian liberalism) led to our enslavement and effective domestication. I use this chapter to underline ideological forces present in agricultural technology and their deployment with the added thoughts of post-left anarchists John Zerzan and Terrence McKenna. Wholly combined, the chapter summarizes the political and social factors which spurred on the Green Revolution across the developing world and, from that vantage, decouples and examines ideological commitments involved in agriculture and technology. Poised in an even more problematic sense, I address a refusal of technology in the wakening of neo-Luddism. Overall, the chapter identifies a functional (anarchism and critical theory) and epistemic (what historical factors led to implementation) account of ideology in agricultural processes.

Chapter Three carries the critiques offered by neo-Luddites of the second chapter into contemporary skepticism of GMOs. Titled "The Seeds of Control and Disenchantment," I begin to establish how a

Heideggerian “instrumental reason” took the Green Revolution to further heights that largely fail as a consequence of hubris and from evolutionary principles. Summarily defined through an example provided by Heidegger himself, “instrumental reason” is a point at which a river adjoining a nuclear power plant ceases to be simply a river – it is now “coolant” for that power plant rather than a river merely. It is the redefinition of essence in bridging the “instrumental” capacities of the natural world into a strictly purpose-driven means. To illustrate the effect of instrumental reason’s application in the biological realm, I examine Biosphere 2 – an enclosed ecosystem inhabited by scientists – and the reasons for its failure. As a way of introducing costs and drawbacks to GM technology, Biosphere 2 serves to help disarm ideologically-charged reasons for genetic modification’s status as a panacea. Biosphere 2 embodies a crux of how evolution and biology inhabit an anarchical world that is unyielding to control and domestication, and does so in a way that is not too dissimilar to the post-left anarchists and their refusal of technology.

Chapter Four then amplifies an unease of imposing technology onto biological organisms further in asking how human rights are altered in the adoption of GMOs. In the fulfillment of answering my research question, *Diamond v. Chakrabarty,* 447 U.S. 303 (1980), helps in introducing English common law and the convention that biological organisms are able to be patented. Intellectual property, the right of disclosure or a right to know, the right of security or self-preservation (in lieu of ecological concerns), and a right to question ethics all serve as a sort of tritium to the sight of addressing human rights within the GMO question. Absurd scenarios are considered in this section. Particularly considered are the societal and institutional transformations under GMOs, including what clonal crops could tell us regarding widespread use of GMOs, and how nanomachines can emulate wayward genetic hybridization into indigenous plant and animal populations. In the end of this chapter, I reaffirm the earlier conclusions of Chapter Three, that biology is anarchical and, though GMO technology indeed restructures the planet's ecosystem, it contains within it its own end as a contradiction.

As the last chapter, Chapter Five employs a parallax or optical fixture between the disparate Chapters Two and Three, and presents an ultimate conclusion. GMOs do not, at least conceptually, threaten the project of human rights, however ecological projects do need to consider the allure and resulting thrall of genetic engineering and that the costs, in the author's view, are simply not worth enduring. In this chapter, I reintroduce Terence McKenna and his conceptualization of a "plant based model of social organization" as a way to proceed with the twenty-first century and include Slavoj Žižek's fair yet well-reasoned point that true ecologists should reside in garbage before answering how humanity must directly engage with environmental and biological problems.

In sum, one is correct to identify hubris of "instrumental reason" and ideology in the science of GMOs, and the institutions that favor their adoption. Likewise, one should at this departure know with certainty that, engineered or otherwise, biological entities are an "is" and not an "ought." Life adapts to environmental and ecological constraints regardless of its particular engineering. To fully remedy this problem, an entire ecosystem would require genetic engineering; at this point, that nears the level of a fool's errand, evidenced by the simple failings of Biosphere 2. Overall, I divided this work into two separate sections. The first section examines a historical and social raison d'etre for GMOs, while the second underscores costs and effects of GMOs at a conceptual level. In turn, it is agreeable that no particular entity – be it science, technology, humanity, or non-human biological entities – has full reign to act independently of the others. Oddly enough, this constitutes a kind of rarely-mentioned freedom.

Literature Review:

Mirroring the project as a whole, the literature review conducted will also be separated into two segments with one crossover. The first part of this literature review will focus on what is entailed by instrumental reason as well as the basis of instrumental reason in addition to its critics and criticism of instrumental reason. The second segment, as one may predict, will focus on human rights and GMO technologies as the overlap is currently understood: the crossover mentioned will address GMO technology itself to bridge both segments together. Through this organization of literature, will be able to easily grasp and interface with the discrete components afoot in the admixture of the work so as that everyone has an albeit limited though still comprehensive understanding of GMO technology, the technological process, technology itself, and finally, the current problems of human rights as through the lens of GMO technologies in their current instantiations.

Of the various definitions for technology, this work simply refers to technology as the human capacity to use implements or knowledge toward a particular goal. As a foundation, in *The Question Concerning Technology* (1977), the German philosopher Martin Heidegger parallels the above definition of technology and what it is to address its effects in the following section:

> "We ask the question concerning technology when we ask what it is. Everyone knows the two statements that answer our question. One says: Technology is a means to an end. The other says: Technology is a human activity. The two definitions of technology belong together. For to posit ends and procure and utilize the means to them is a human activity. The manufacture and utilization of equipment, tools, and machines, the manufactured and used things themselves, and the needs and ends that they serve, all belong to what technology is. The whole complex of these contrivances is technology. Technology itself is a contrivance, or, in Latin, an *instrumentum*" (Heidegger 1977, pp. 1-2).

Essentially, and truly by essence here explicitly, technology is the human activity of determining ends and realizing the means necessary to reach those desired ends. The reason why Heidegger "questions" technology in this essay conveniently overlaps with the question concerning human rights in that Heidegger's views and Bushnell's civil-military perspective would equally both admit, as Heidegger writes, "we shall never experience our relationship to the essence of technology so long as we merely conceive and push forward the technological, put up with it, or evade it. Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it" (Heidegger 1977). Contra to the conspiracy theorists who first discovered the PowerPoint presentation of Bushnell on NASA's servers, the reason why the presentation was held and of importance to the Federal program was not to suggest a solution to the problem of overpopulation and devise novel ways to eliminate people, but rather as a necessary extension of the inescapable quality of the "technological" direction of warfare and the strategic pillars new technologies would structure. Drawing this into the focus of GMO and rDNA technologies, one ought to recognize that our intellectual and even pre-intellectual history has influenced the genetics of other species for our own purposes, in virtue to proving Heidegger's assessment of our "chain" with the process, and that these technologies exist as a different form of the activity.

But "'What is modern technology?' It too is revealing. Only when we allow our attention to rest on this fundamental characteristic does that which is new in modern technology show itself to us" (Heidegger 1977, p. 6). What, then, is fundamentally new in rDNA and GMO technology? Let us consider the geneticists and methods of artificial selection on the evolutionary process to assess what truly is novel. Two examples are that of the domestication of maize by the Mesoamericans and the nineteenth-century friar Gregor Mendel's hybridization and inheritance experiments of peas as a baseline of what the origins of GMO technology resembled. In a thoroughly comprehensive book on the subject of maize by Duccio Bonavia, we are privy to an account of how early humans technologically altered nature towards their own desired agricultural end. Concerning this point, he states:

> "Galinate discussed the possibility that there have been several domestications that followed different paths. He believes that teosinte Chalco may have been domesticated by a combination of a reduction in the cupules [base of the husk] and an elongation of the kernels, which led to such varied modern derivates as the Palomero Toluqueño, the Confite Morocho, and the Gourd Seed Dent. The majority of the maizes may predominantly come from another independent domestication, which apparently entails the tunicate locus and the Guerrero teosinte. . . Human selection, undertaken to attain recessive alleles to obtain a thick cob in the string cob loci, increased the vascular supply required for the more productive development of the ear. The long rachillae, plus wider pith, enabled the attainment of the enormous cobs of contemporary maize" (Bonavia 2013, p. 62).

Bonavia writes that a 1980s DNA study on isozymes and chloroplastic DNA showed that "teosinte is the species most closely related with maize, and which assumed a phylogenetic ascent of species with the biggest number of shared genes" (Bonavia 2013, p. 62). These models all account for maize, an entirely new plant corn, engineered and developed from native teosintes (formally the genius of *Zea*) through a process of “human selection.” From the teosintes to maize-teosintes hybrids and to maize, one can see a greater specialization and emphasis on the size and length of the husk in addition to the presence and development of larger kernels. The vast geographical distribution of teosintes from Mexico to Peru and the relatively “quick” emergence of an identifiable husk to the structure of corn did not occur as an accident; the Mesoamericans of 5500 to 4500 BC cultivated the crop through selective breeding. This would indicate that humans have tailored the genetics of a natural world to their desired ends, though the matter of what is “new” in the modern technology is left unaddressed.

Aside from the Mesoamericans’ domestication of maize, and the earlier domestication of canines, equines, and other farm animals, the “technology” remained the process of selecting a set of traits over others. Plato and *The Republic* in this sense was not the first case of viewing inheritance (genes) as an instrumental mechanism, but instead, among one of the earlier recognitions of this effect. The concept of inheritance was there by proxy, though it had yet to be formalized; this discovery would form the studies of a Silesian friar, Gregor Mendel. Mendel selected among thirty-four varieties of peas and defined an experiment in hybridization whereby the plants would be constrained to have constant differentiating characteristics over generations, protection from foreign pollens, and a “generation time” that would be “short enough to make it possible to perform the experiment for generations” (Tateno 2013, p. 4). Conducting the experiment at his monastery, the friar cultivated an impressive catalog of 29,000 plants under the scientific species designation of *Pisum sativum* to "deduce by law" the characteristics which appear in successive generations through the criteria of fifteen characteristics and then further winnowed them down to seven once hybridization occurred – "form of the seed, color of the seed albumen, color of the seed coat, form of the ripe pods, color of unripe coat, positions of the flowers, and length of the stem" (Tateno, 2013: 5). Like the Mesoamericans before him, Mendel was not aware of genes or chromosomes, and, just as the Mesoamericans, only of plant characteristics (Tateno 2013, p. 5). From these seven plant characteristics Mendel would predict the patterns of inheritance allowing future geneticists a foundation on which to base their analysis; he was the preeminent scientist in that a theory was required prior to there being an established field with prior theories. Between a dominant trait (A) and a recessive trait (a), Mendel calculated that the hybridized offspring could be expressed as $(A+a)(A+a) = A2+ 2Aa+a2$ (Tateno 2013, p. 7). This much is clear: further research on what causes rDNA and GMO technology to be revolutionary, and in the ways that is revolutionary, must become a dedicated portion of research so as to understand the question as structured by Heidegger's question on technology.

A litany of critics rallying against "instrumental reason," or what Heidegger means by writing that "the essence of technology is by no means anything technological" (instead, as an ongoing process defined not by its products, but by an impulse) also have a place in this preliminary discussion on genetic modification and technology as the crossover into the issue of human rights. Clearly stated, though Heidegger opposed technology for its absence of perspective, others oppose technological progress itself on foundational grounds.

John Zerzan, an American anarcho-primitivist philosopher associated with the 1996 Ted Kaczynski / "Unabomber" trial concludes in *Elements of Refusal* (1988) that, as far as how human agriculture relates to technology, the "land itself becomes an instrument of production and the planet's species its objects" (Zerzan 1988, p. 73). Part to my earlier concern of avoiding an argument from nature or naturalistic fallacy however, Zerzan asserts that agriculture "is the birth of production, complete with its essential features" forming in his view, the ultimate "deformation of life and consciousness" (Zerzan 1988, p. 73). As critique, Zerzan unifies the crop as a synthesis of our domestication of nature with the domestication of our freedom in lamenting that, "[w]ild or tame, weeds or crops speak of that duality that cripples the soul of our being" (Zerzan 1988, p. 73). As an outcome of this effect, he asserts that "despotism, war and impoverishment [present in] high civilization" are product to separation of an earlier oneness with nature. It should be apparent from these points why Zerzan spoke for the actions of Ted Kaczynski whose bombings targeted advanced artificial intelligence researchers. The forced march of civilization, which Adorno recognized in the 'assumption of an irrational catastrophe at the beginning of history,' which Freud felt as 'something imposed on a resisting majority,' of which Stanley Diamond found only 'conscripts, not volunteers," were dictated, and products of by agriculture" (Zerzan 1988, p. 73).

With agriculture being identified by Zerzan as the locus of all technology, and thereby further specialization, which propelled human civilization into “despotism” and did so with the help of Diamond’s “conscripts, not volunteers,” some examination of anarchist and critical thought is necessary. His inclusion within this analysis is essential as Zerzan is an advocate of a future that is primitive rather than technological. A common theme present throughout his works such as *Twilight of the Machines* (2008) and *Running On Emptiness* (2002) orbits a notion that technology, rather than unifying the world and allowing wider human flourishment, is the very force that alienates, stratifies, and removes us from our humanity. Understanding how human rights and its expansive array of issues and literature synergize and converge with GMO technology and the function of technology itself to “domesticate” on an agricultural basis seems the right investigation to undertake in the process of research on this issue. Though let us stay on such an analysis of agriculture and technology for now and refocus on how technology itself and its “essence” can bring about “despotism.”

American popularizer of science and public intellectual, Bill Nye (also known as “Bill Nye the Science Guy”) has written on the matter of GMOs specifically. Nye writes in his 2014 publication *Undeniable: Evolution and the Science of Creation* that, while producing a “sufficient supply of food is an urgent need,” we cannot “know what will happen to other species in [a] modified organism’s ecosystem” (Nye 2014). To illuminate this principle, Nye uses the example of the Monarch butterfly and its seasonal migration of North America. As corn fields resistant to Roundup (a product of Monsanto) become more common, and as the pesticide is more widely used, fields dotted with milkweed, a staple of the Monarch, will become less common. The result, of course, would result in the reduction of available food for Monarch caterpillars, thereby affecting their numbers. Theorizing further, and in parallel with the governing primary principle of this paper, Nye postulates the possibility that Bt corn (a GMO variant of corn that carries a resilience against pests) could have its Bt, a protein harmful to insects and produced by a microorganism, spread via pollen dispersal onto fields of milkweed, thereby reducing Monarch communities through pollen pollution. If both are true, laments Nye, "then the genetically modified plants are coming after the Monarchs in two ways at once" (Nye 2014). Though Nye, in an "AMA" or "Ask Me Anything" thread on the news and discussion aggregator Reddit later recanted these concerns (for reasons that have yet to be explained by Nye) after "visiting the scientists of Monsanto," I will later explore what Nye may have possibly overlooked with regard to ecosystems and their full totalities (Kloor 2015).

In referencing Theodore Adorno's "assumption of an irrational catastrophe at the beginning of history," Zerzan's owes some of his anarcho-primitivist views to the German Frankfurt School of the twentieth century. Among the early Frankfurt School theorists who would eventually represent "critical theory" were Max Horkheimer, Theodor Adorno, Herbert Marcuse, and Erich Fromm. Marcuse considered how society is altered by technology's separate nature from the technological. Marcuse serves this project well through encapsulating how a technology carries political and sociological change, and not necessarily positive change, with its adoption.

In *One-Dimensional Man* (1964) Marcuse, in a part titled the "One-Dimensional Society" developed the problem into a brash declaration on the state of affairs: "If the worker and his boss enjoy the same television program and visit the same resort places. If the typist is an attractively made up as the daughter of her employer, if the Negro owns a Cadillac, if they all read the same newspaper, then this assimilation indicates not the disappearance of classes…" (Marcuse 1964, p. 17). By "disappearance of classes," Marcuse means that technology and the continued creation of needs eventually removes the idea of class from society, as he asked: "Can one really distinguish between the mass media as instruments of information and entertainment, and as agents of manipulations and indoctrination? Between the automobile as nuisance and as convenience? Between the horrors and the comforts of functional architecture? Between the work for national defense and the work for corporate gain? Between the private pleasure and the commercial and political utility involved in increasing the birth rate?" (Marcuse 1964, p. 17).

The picture that is rendered by Marcuse is one in which "resisting majority" of Freud and "conscripts" of Diamond have been, to borrow Zerzan's use of the word, "domesticated" by technology to the point of dissolution of identity – a transformation towards "one dimensionality." Could this domestication or one dimensionality extend to the species and crops that have undergone rDNA modification? To answer this, I must now address the preliminaries of how rDNA and contemporary methods in artificial selection differentiate from the Mesoamericans' cultivation of maize and Mendel's systemized inheritance.

Second to the analysis of how rDNA and genetically modifying plants in the modern context differs from domestication and artificial selection, I must also examine how this technology and the application of instrumental reason have altered the scope of human rights and the greater environment. Though biosecurity and biosafety often merge the environment with human rights, here my approach is in partitioning the issue such that when clearly defined as one issue or another, the effects are known. At this point I will admit that this distinction is purely arbitrary. One's environment directly influences the possibilities and overall quality of life. Such an idea was the established basis for United Nations Resolution 64/292 that "explicitly recognized the human right to water and sanitation" and "acknowledged that clean drinking water and sanitation are essential to the realization of all human rights" and many similar laws and resolutions throughout the mid-twentieth century into today (UN.org).

Chapter Two: The Convergence of Agriculture, Society, and Technology

Everything that was directly lived has moved away into a representation.

Guy Debord, *Society of the Spectacle,* 1967

The aim of this chapter is to outline as well as problematize an interwoven and complex system of dependencies. This system is structured at a "convergence" of agriculture, technology, and society in so far as they can be separately delineated. Agriculture is itself a technological feat and is vastly improved as a consequence of technological progress. Similarly, human civilization depends on the sustained growth and management of agriculture and technology to flourish. Does any "break" or disunity in this tripartite arrangement result in inevitable collapse? Is humanity inextricably bound, even beyond its own will or through the promise of technology, to fate?

On the outset of this project it is of critical and fundamental importance to understand that technology, agriculture, and human society are vitally intertwined. All three within this "trinity" of sorts function as an ecosystem in their own right: neither component exists as a wholly discrete entity. The character and form of human society is fundamentally shaped and determined by its environment. Conversely, human culture, language, and knowledge all limit and produce what is technologically realizable, as well as how nature itself is conceived. Lastly, agriculture, or a domesticated nature, is limited and defined by ecological and environmental constraints – weather patterns, properties of the soil, *et cetera*. A classical rendition of these relations would likely depict humans gradually developing more efficient technologies to subdue the chaos of an unpredictable environment thereby allowing a larger and more prosperous human society to further develop. The cycle then begins anew, and it continues *ad infinitum* with the addition that humans introduce more order in counter-acting disorder. Would it be a fair characterization to suggest that this rudimentary sketch remains true and relevant in the context of today, some twelve thousand years after the advent of agriculture?

A preliminary answer to this question stemming from reflection alone would be a definite "no." While technology has delivered on the promise of domesticating and pacifying the earth to sufficiently fit our needs, the impulse and want for these very needs has set us precariously underneath a "Sword of Damocles." Whereas in the *classical* depiction of the relationship among human society, agriculture, and technology, all function within a clearly defined instrumental synergy, and the three are now bound by an anergy. Climate change, population growth, and unsustainable resource management practices have all made brittle what links the components of the trinity. The interdependence among the three should not be mistaken as a strength and instead viewed as a weakness. Any break or catastrophe affecting one or all of the components would spell equal disaster for the others in a cascade effect. Failure to develop technology to counter-act climate change, overuse of resources or pesticides, overproduction and under-consumption, and poorly-adapting crops to their environment would all, for different reasons, come with the same consequence, overpopulation notwithstanding.

Such a predicament was the *raison d'être* for the international organization CGIAR. CGIAR or the Consultative Group on International Agricultural Research, owes its origin to the period of decolonization following World War II when "serious food shortages occurred in South Asia" during a time when many were "predicting a worldwide impending famine" (D.J. Greenland 1997, p. 460). CGIAR's role was then to ameliorate this tenuous interdependence of technology, human society and agriculture through choosing to focus on technology as the fulcrum. Its stated mission, summarized by its chairman, is to use a strategic, science-based focus on increasing "the pile of rice on the plates of food-short consumers" (Consultative Group on International Agriculture 2004, p. 1). In sum, CGIAR is the international version of Franklin Delano Roosevelt's vision of a "chicken in every pot." Funded by the World Bank and its sixty-two member states, CGIAR wrote of this contemporary problem in agricultural production: "According to the CGIAR's own analysis, the decline in the number of food-insecure people in the developing world slowed considerably in the 1980s and 1990s relative to the 1970s, the period of the Green Revolution. Indeed, if China is excluded, the number of food insecurity *increased* in the rest of the developing world in the 1990s, while the annual rate of growth in cereal yields decelerated from 2.9 percent during 1967-82 to 1.9 percent during 1982-97. The rate of growth in cereal yields is projected to decline further" (Consultative Group on International Agriculture 2004, p. 4).

CGIAR claims itself as a "non-political" institution in the context of researching the means to further increase crop yields. Though could this be true in accordance with the reason for CGIAR's existence? In a 2012 article "Are There Ideological Aspects to the Modernization of Agriculture" appearing in the *Journal of Agricultural & Environmental Ethics*, Danish authors Egbert Hardeman and Henk Jochemsen contrasted the vision of CGIAR in that they observed "a blinkered quest for efficiency in the industrialization of agriculture since the Second World War" (Hardeman and Jochemsen 2012, p. 657). They noted that the "key factor is the cultural mindset at the foundation of our modern society, originating from the ideas of the enlightenment" and concluded that it was what made "people vulnerable to ideologies, causing them to focus on a certain goal without considering the consequences" (Hardeman and Jochemsen 2012, p. 657).

In returning to this subsection's theme, Hardeman and Jochemsen do not agree with the fixed and static rendition of humans, technology, and agriculture working in harmony. Instead the results of their study concluded that "due to the overemphasis on efficiency, modern industrial agriculture has never been comfortably embedded in its ecological and social context, and as a result displays the characteristics of an ideology" (Hardeman and Jochemsen 2012, p. 658). Their analysis was threefold in that they first analyzed the historical conditions and reasons for why ideology has become enmeshed within agricultural production and modernization, then move towards the cultural and ethical motives of industrialization, and lastly, they identify the "roots of the tensions and resistance to solutions" (*ibid*). All three maneuvers are critical in the project of unveiling not only why GMOs are necessary, but also how a wider industrialization of agriculture can manifest in the form of ideology unfettered with the cause of human rights.

Of the factors outlined in their typification of the history of agriculture, Hardeman and Jochemsen noted decreasing marginal returns, rationalization (which will become important in the subsequent subtopic), structural problems, and a "gap between agriculture and society" (Hardeman and Jochemsen 2012, pp. 659-661). The first reason of decreasing marginal returns echoes Karl Marx's account of overproduction and under-consumption in *Das Kapital* (1867) in that technological improvements increase overall productivity while also diminishing the economic value of wealth and rate of returns on profit. Hardeman and Jochemsen found the opposite, and that many "changes in modern agriculture take place in the context of decreasing revenues and increasing costs. Although market prices always fluctuate in each sector of the economy, agriculture is characterized by long periods of low prices and short periods of high prices. At same time, the costs of necessary inputs in agriculture keep pace with general inflation: feed, labor, land, and machine prices have increased constantly" Jochemsen 2012, pp. 659-660). Farmers facing this economic problem in their view appeared "to have no alternative but to participate in the developments of mechanization, intensification, and specialization in order to maintain a reasonable income" (Hardeman and Jochemsen 2012, pp. 659-660).

As a reverberation of the earlier literature review concerning technology and the "technological" being distinct for Heidegger, Adorno, and Zerzan, the typified cause of "rationalization" proved to be a captivating thought in the piece. On this, Hardeman and Jochemsen determined that it was "in this context" that "rationalization may be defined as the introduction of goal-rational methods in a process previously based on accumulated experience, ultimately to achieve greater efficiency in agriculture" (Hardeman and Jochemsen 2012, p. 660). It was therefore in Hardeman and Jochemsen's view, an "essential characteristic of industrialization, evidencing the particular influence of science and technology. Fueling the engine of this industrialization, they assert that all measures taken by government in the interest "to change the structure of agriculture" are "informed with the desire for rationalization" (Hardeman and Jochemsen 2012, p. 660). Article 39 of the Treaty of Rome (1957), a precursor to the European Union, underscored Hardeman and Jochemsen's analysis of agriculture and its rationalization as an appendage of government in that it was a specific activity to regulate. Specifically, Article 39 enumerates policy objectives that "increase agricultural productivity by promoting technological progress and by ensuring the rational development of agricultural production" (European Economic Community, 1957).

This however presents a problem. When rationality becomes entirely instrumental in the practice of agriculture, it transforms into an “economic pincer,” causing “agricultural activities became more and more uniform” (Hardeman and Jochemsen 2012, pp. 660-661). As the economic pincers of instrumentality closed in on the farmers, they ironically would seek the very same scientific data and technology in their search for a solution, thus centralizing agriculture further and subsequently adding greater economic pressure. This, Hardeman and Jochemsen state, “made agricultural science a globalizing factor” (Hardeman and Jochemsen 2012, pp. 660-661). Now a globalizing factor, agricultural technologies, such as herbicides and pesticides as employed during the Green Revolution (1940-1970) altered the economics of farmers and development of entire continents without the option for alternatives. Latin and Central America felt the greatest effect of the Green Revolution as it was the very fulcrum to further specialize its traditionally agrarian economies. In the view of Hardeman and Jochemsen, this “resulted in highly impoverished diversity in present day agriculture” when compared to earlier centuries (Hardeman and Jochemsen 2012, pp. 660-661).

This problem, as posed by Hardeman and Jochemsen, is at the cross-section of CGIAR’s policy recommendations and investments in agricultural research. Resulting in the disunity and anergy between technologies, human society, and agriculture, they lament that “contemporary agriculture is a can of worms. Experts, both policy-makers and researchers have tried and are still trying to find solutions. And despite all efforts on a global scale, they have not managed to find effective and workable solutions. Generally speaking, the solutions used usher in a paradox: often they reinforce or aggravate the problems they should solve, or create new and sometimes worse problems" (Hardeman and Jochemsen 2012, p. 662). When situated on the issue of GM technology and the unresolvable paradox, Hardeman and Jochemsen found that GMOs came about from the problems of the Green Revolution. "When these pesticides turned out to cause serious environmental problems themselves, a new technology was introduced: genetic engineering of plants to make them resistant, either to certain, presumably less toxic, pesticides or to the pest. But the use of genetic modification forces genetic erosion yet further. This spiral of problems and "solutions" shows that the use of modern techniques to deal with their deleterious side effects has caused new problems to accumulate" (Hardeman and Jochemsen 2012, p. 668). In sum, Hardeman and Jochemsen explain quite well the reason why GMOs are necessary: they fulfill a rationalization of industry and thereby shape and alter the economic landscape. Today, that economic landscape is marked by the forces of globalization; either one agrees with an international practice, in this case, technology, or they are rendered a non-participant.

<u>Post-Left Anarchism and Critical Theory on the Question of Technology</u>:

Hardeman and Jochemsen were both keen to identify the paradox in finding a true panacea for the problems of contemporary agriculture under a technological-rational framework, however, the dilemma reaches to more benthic depths. The problem, some hold, lies within the very notion of technology itself. On the anarchist end of the spectrum, thinkers like John Zerzan and Terence McKenna agree with this view of technology, and some, like McKenna, offer suggestions as to how the technological impulse can be retranslated into a harmonious relationship between humans and their environment. Alternatively, and amongst the Frankfurt School, which owes its influences to Marx and Freud, is the tendency to view technology or instrumental reason as a blunt dialectical force of bourgeois value. Like the anarchists, members of the Frankfurt School provide their own rough solutions amidst the criticisms. Herbert Marcuse, for example, advocates a recapturing of technology from its oppressive reigns.

Let us begin in earnest with the most radical treatment of technology – the belief that technology was in itself the most definite and unresolvable problem that alienated humans from an organic life. Prior to the inception of agriculture, John Zerzan posits that it was the symbolization of nature which led to the inevitable separation of humans from their environment. Zerzan's essay "Agriculture" in Elements of Refusal (1988) features such an account of how symbols brought about agriculture and technology to both break from and transform our environments. In it, he wrote on the origin of and domination by numbers: "'In the non-commodified, egalitarian hunter-gatherer ethos, the basis of which (as has so often been remarked) was sharing, number was not wanted.' There was no ground for the urge to quantify, no reason to divide what was whole" (Zerzan 1988, p. 74). For Zerzan, it was not "until the domestication of animals and plants did this cultural concept fully emerge" (Zerzan 1988, p. 74). From the work of Pythagoras, Euclid, and others like them in societies outside of the Hellenistic sphere came "a linear rank order in which each member is assigned an exact numerical place" (Zerzan 1988, p. 74). In turn, Zerzan asserts that this placement of number within society followed "the anti-natural linearity of plow culture [and] the inflexible 90-degree gridiron plan of early cities" (Zerzan 1988, p. 74). It was the point at which culture, "numberized," became "firmly bounded and lifeless" for Zerzan (Zerzan 1988, p. 74). Art as well had a function in this process of transformation:

> "Art, too, in its relationship to agriculture, highlights both institutions. It begins as a means to interpret and subdue reality, to rationalize nature, and conforms to the great turning point which is agriculture in its basic features. The pre-Neolithic cave paintings, for example, are vivid and bold, a dynamic exaltation of animal grace and freedom. The Neolithic art of farmers and pastoralists, however, stiffens into stylized forms… With agriculture, art lost its variety and became standardized into geometric designs that tended to degenerate into dull, repetitive patterns, a perfect reflection of standardized, confined, rule-patterned life" (Zerzan 1988).

Zerzan's idea should be lucidly clear at this point: agriculture is the byproduct of segmenting and representing the natural through synthetic means. When humanity began to symbolize through art and numbers, the world became easier to "divide from what was whole" to more easily render property, taxes, and of course land into commodities. As a consequence of this, humans not only removed themselves from the system in which they once belonged, but they also provided the means of dominating both themselves and nature. What a possible solution to this view of technology may look like will be covered in the subsequent subtopic "On How to Potentially Salvage Technology."

Herbert Marcuse begins *One-Dimensional Man* (1964) from the Marxist foundation in observing that a "comfortable, smooth, reasonable, democratic unfreedom prevails in advanced industrial civilization, a token of technological progress" (Marcuse 1964, p. 13). Marcuse uses the text towards addressing positivism and its associated instrumental rationality that Hardeman and Jochemsen identified in the paradox of technological solutions. In the work, Marcuse argues that technology is not concerned entirely with either efficiency or being a solution, and is instead an extension of domination. "Today political power asserts itself through its power over the machine process and over the technical organization of the apparatus" (Marcuse 1964, p. 14). Describing the power wielded by technocrats of the period such as then Secretary of Defense Robert McNamara, Marcuse noted that the "government of advanced and advancing industrial societies can maintain and secure itself only when it succeeds in mobilizing, organizing, and exploiting the technical, scientific and mechanical productivity available to industrial civilization" (Marcuse 1964, p. 14).

Chapter Three: The Seeds of Control and Disenchantment

> Genetic control. Information control. Emotion control. [...] Everything is monitored, and kept under control. [...] The age of deterrence has become the age of control.
>
> Hideo Kojima, *Metal Gear Solid 4: Guns of the Patriots*, 2008

Marcuse (1964) and Zerzan (1988) believe that our capacity to remain in control of technology and its ends is an illusion, and instead that it controls our lives. Considering contemporary events, who could fault them for their "Luddism?" Recent times offer exemplary ways in which Marcuse, writing in '64, and Zerzan, in the late eighties to nineties, were in essence right. While both were surely familiar with novel incidents like the U.S. Department of Energy and Department of Defense's Nevada Test Site and the "Baneberry shot" of 1970 that resulted in the release of large amounts of radioactive fallout across the Midwestern states, they were also familiar with the patterns of technology (Lomov, Antoun, Wagoner, and Rambo 2004). Patterns that would foretell people such as Edward Snowden, a contractor for Booz Allen Hamilton whose 2013 "leak" of the NSA practicing wide and constitutionally questionable surveillance through an advanced datacenter in Utah and computer system "PRISM," as nothing wholly new.

From the anarcho-primitivist perspective, it is abundantly clear that technology is the prime cause of alienation and oppression. Reaching a conclusion on an order of Vladimir Lenin's *What is to be Done?* here would simply mean to eschew many unnecessary comforts, or possibly build what is known as a "microhouse" (or small structure) in the middle of nowhere and to conduct a serious attempt at a Walden Pond (Henry David Thoreau) experience (Kaysing 1995). While perfectly legitimate and acceptable for many of India's sadhus or holy men who engage in relatively extreme acts of austerity in religious asceticism living in caves and forests, such an act simply cannot work as a societal model. Instead, other possibilities must be considered.

The second anarchist mentioned in the previous subtopic, Terence McKenna, shares a fair amount of the skepticism towards technology and society with Zerzan. In a lecture titled "Into the Valley of Novelty" concerning the general state of affairs, he remarked that "[c]ulture is not your friend. Culture is for other people's convenience and the convenience of various institutions, churches, companies, tax collection schemes, what have you. It is not your friend. It insults you, it disempowers you. It uses and abuses you. None of us are well treated by culture, and yet we glorify the creative potential of the individual, the rights of the individual, we understand the felt presence of experience is most important, but the culture is a perversion" (McKenna 1998).

The Archaic Revival (1991) represents what a possible solution of McKenna would resemble. In the essay titled "Plan/Plant/Planet" (appropriately in specific relation to the continuing motif of agriculture), McKenna proposed that "we should adopt the plant as the organizational model for life in the twenty-first century, just as the computer seems to be the dominant mental/social model of the late-twentieth century" (McKenna 1991, p. 218). As a negation of positivism and instrumental reason's grasp on the twentieth century, the idea was to reintegrate human society with nature itself through a wider symbiosis and recognition, much like the views found in ecofeminism and deep ecology, that we are a part and extension of the earth.

If one were to take seriously the "New Age" and possibly far flung idea of using the plant as the organizational model for society as McKenna suggests, the limits of instrumental reason would be made known and from there reconciled. In the case of the Biosphere 2 experiment, for example, a "conceptual shift from a phenomenological understanding of the envelope of life to a physical, bio-, and geochemical approach to living matter and to the environment as a self-regulating and evolving system designed [as if it were] a planetary machine" (Höhler 2010, p. 42). While Biosphere 2 pursued the right course for a more holistic and integrative systems approach to life sciences, it still had its shortcoming. The project was flawed by an oversight that the limestone in concrete used to construct the arkological facility would leech carbon dioxide from the air and prove to undo the presumably homeostatic atmosphere.

Still, the best contender for answering the critiques of the Frankfurt School and anarcho-primitivists is in the shattering revision that the biological and natural is one holistic system onto itself where the traditional inputs and outputs of classical physics and the Cartesian foundations of instrumental rationality are not so easily identified. Salvaging technology must be achieved through re-envisioning the venture of science and practical reason through Heidegger.

Captured German rocket scientist of Peenemünde, Wernher von Braun, often serves as an example of one who had a revisionary approach to science in that it should not be used as a weapon though as an instrument of peace, and he is often used as the example of how science must be reformed. Though von Braun is a curious example, much of his work was used in developing Intercontinental Ballistic Missiles, though he detested the weaponization of space. The captive of the Office of Strategic Services' "Operation PAPERCLIP" and his views on the applications of science and how it was to achieve its goals were simply not revolutionary enough, and McKenna's "plant-based" paradigm seems necessary. In my view, problems arising from scientific advancement or ecological strains remedy themselves either through the work of visionaries or through historical necessity. Ecological homeostasis following a collapse however, as one may endeavor to imagine, will not always favor humanity. For example, John B. Calhoun's behavioral research on mice given utopic conditions indicated findings of an ethologic or behaviorally imposed population capacity. After discord and fighting for territory subsided in the elaborate and fully stocked mouse enclosure, the mice abandoned social relations and breeding altogether. That is to say that if humanity were provided with an unending supply of food and water with the only limitation being space, behavioral adaptations (behaviors nonconductive to reproduction) would emerge.

GMO Technology and its Faulty Assumptions of the Evolutionary Process:

Darwin had the concept of natural selection partially wrong upon the publication of the *Origin of Species* (1859). A lesser known critique offered at the time of its release was that, then, just as now, evolution is not a teleological process; it is not goal directed. Hearts and other essential vital organs are "perfect" only in so much that they serve their designated function appropriately. Traditional and more Cartesian views in science do not mesh well with biological organisms and ecosystems, as they are not only infinitely complex but that there is no one desired end. GMO engineering firms like the often scrutinized Monsanto (and rightly so in this author's view) fail to see this problem in ways that will be demonstrated.

Speaking on the mischaracterization and subject of evolution with the aid of observations from C.H. Waddington and Erich Jantsch, McKenna noted that they "found not the War in Nature that Darwinists reported by rather a situation in which it was not competitive ability but the *ability to maximize cooperation with other species* that most directly contributed to an organism's being able to function and endure as a member of a biome" (McKenna 1991, p. 221). Eugenicists and GMO engineers are not on an equal plane in this matter, however they equally believe that it is possible to orchestrate the genetics of species towards desired ends. Nothing could be far more removed from what actually occurs in this process.

Appearing in a June 2013 edition of *Nature Biotechnology*, Bruce Tabashnik, Thierry Brévault, and Carrière Yves analyzed the insect resistance of biotech crops. Titled "Insect resistance to Bt crops: lessons from the first billion acres," the authors of the study found that the "evolution of resistance in pests can reduce the effectiveness of insecticidal proteins from *Bacillus thuringiensis* produced by transgenic crops" (Tabashnik, Brévault, Yves 2013, p. 510). What the authors of the study mean by "insecticidal proteins" is that the GMO crops have been engineered with the genetic information from a bacterium that naturally produces an insecticide, *Bacillus thuringiensis*.

Effectively, any pests, or humans who consume the GM crop also consume the byproduct of the plants producing a toxin intended to increase crop yields from staving off pest infestations. Despite *B. thuringiensis'* relative harmlessness in contrast to *Clostridum botulinum*'s paralytic condition of botulism, toxins are ingested by humans. Further, the authors of the study noted that the "reduced efficacy of *B. thuringiensis* crops caused by field-evolved resistance has been reported now for some populations of 5 of 13 major pest species examined, compared with the resistant populations of only one pest species in 2005 (Tabashnik, Brévault, and Yves 2013, p. 510). Applying instrumental reason and biotechnology into ecosystems has shown to be wholly ineffective as a long term solution if, in the course of eight years, four pests have evolved a resistance.

Evolution being the open system with opaque and uncertain effects and influences has provided science with the insurmountable challenge of devising adaptations for organisms that would present a hardened resilience. Hardeman and Jochemsen's paradox again reemerges in that genetically modified crops have come to "reinforce or aggravate the problems they should solve" in addition creating "new and sometimes worse problems" (Hardeman and Jochemsen 2012, p. 662). And what is most troubling is that, as more insects develop this resistance, humanity pays a higher cost of consuming toxins that would otherwise not be present in their food. It is the classic example of a "lose-lose" scenario, making "worse problems." Thoroughly unsurprising, this finding underlies the concept of introducing exotic species into ecosystems with the intent to deal with a pest: the exotic species itself often becomes the new pest. Insects that must feed on GMO crops will evolve different and better mechanisms of overcoming the GMO safeguards, thereby creating a parallel similar to that of the battle between antibiotics and infectious bacteria. And, with respect to that arms race, industrial agriculture widely uses antibiotics as a means to increase yield in livestock. This practice, evolutionarily understood, implies that any zoonotic (cross-species) bacterial infection would enter human populations pre-resistant to anti-biotic drug classes.

Learning from the Project and Failure of Biosphere 2:

Let us return to the earlier mentioned case of Biosphere 2 for the interest of bifurcating the experiment into two helpful inquiries to aid the present discussion of reengineering life. One, what was the intent in the construction and conceptualization of the project? And, two, what could be understood in the project's ultimate conclusion? In considering these questions, it should be readily apparent not only what occurs when a biological lifeform or even ecology is emulated, but also how the act of emulation presents shortfalls, insights, disasters, and potentially unavoidable adversities.

Biosphere 2 was designated as a "2nd" biosphere with the first being planet Earth. Designed in the 1980s, Biosphere 2 was a geodesic structure designed from the architectural tradition of its proponent and creator Buckminster Fuller. Geodesic structures and Fuller's design prototypes gained a prominence in the late 1970s and '80s when the economic concern of utilizing the fewest amount of resources to produce the greatest amount of habitable space had also transformed into an ecological solution. Following publications such as Frank Herbert's science fiction work *Dune* in 1965 and the NASA missions to the lunar surface in the late 1960s, an idea began to emerge about the Earth as a blue marble – a "spaceship Earth." As a testament to this synthesis or idea of a spaceship Earth and the utility of Fuller's designs, the Disney park of Epcot in Florida takes in both its name and iconic design this very concept as an attraction. A project of the '80s and the now retro-futurism of its scientific and technological aims (e.g. a reusable space shuttle, the Strategic Defense Initiative, and electronic bulletin board communication networks), Biosphere 2 captured the spirit of planetary ecology as a concept and, with it, asked if it were possible to build a "self-contained" planetary ecosystem.

Systems ecologist John P. Allen and his firm Space Biosphere Ventures set ground on the project in 1987 in the arid plains of Oracle, Arizona. The structure, on its completion in 1991, featured a 1,900 square meter rainforest, 850 square meter ocean and coral reef, 450 square meter mangrove estuary, 1,300 square meter savannah, 1,400 square meter fog desert, and 2,500 square meter agricultural system with an underground human habitat (b2science.org 2015). In sum, it comprised an area of three acres with 7,200,000 cubic feet of sealed glass constituted by 6,500 windows (b2science.org 2015). Space Biosphere Ventures performed two separate experiments (one from September 26, 1991 to September 26, 1993, and another from March to September 1994) during their ownership of the facility in which they would seal the research occupants into the "ark" to observe whether ecological interactions could continue within a given system having no inputs aside from sunlight (b2science.org 2015). This was the chief intent and purpose of the experiment. In a parallel to GM technology firms, the belief of Space Biosphere Ventures was that life processes and their respective ecosystems are not only identifiable, but that they can be manipulated towards desired ends.

The experiment ended in failure on both occasions. Though you know of a primary "why," as one was briefly mentioned with regard to the CO^2 and concrete leeching, the combined array of "whys" present a better picture. It is my own belief that, even in the early phase of conceptualizing Biosphere 2, it was a flawed experiment. Though its atmosphere's homeostasis was disrupted by its very own construction through concrete, other problems also speak to the matter of how

Biosphere 2 was conceptually framed. For example, the first mission's waters were overstocked of fish, which resulted in a cascade of failures from the resultant clogging of the filtration systems thereby causing the desert to become too wet (b2science.org 2015). Without tides or an environmental stimulus, bodies of water within the structure became stagnant. In this manner, Biosphere 2 is successfully illustrative in demonstrating two things: highlighting the hubris of humanity through its attempts of bio-engineering, and showing the unfathomable complexities of ecosystems.

One participant in Biosphere 2's research as an inhabitant of the facility came to this realization after the near billion-dollar installation was abandoned. In her TED Talk, Jane Poynter reminds us it is that the "small stuff counts" (TED). As the central theme of the lecture, Poynter provides many examples of where a micro-ecology affects the larger macro-ecology. Through this shifting of focus, Biosphere 2 did not fail simply because its waters were overstocked with fish, or that wildly growing morning glories (*Ipomoea*) ensnared the trees of the rainforest. Biosphere 2 failed in overlooking micro causes. Poynter came to this revelation from observing her Arizona backyard, barren with tumbled river quartz and covered with the fallen leaves of a neighbor's tree. Though there was adequate shade from the tree to protect plants from exposure to the sun, nothing, no matter the effort or care, could grow in Poynter's backyard. As if through a recollection of Biosphere 2, Poynter questioned what would happen if the leaves were left where they fell. After a short time of allowing the debris to accumulate, Poynter noticed that the leaves formed an impromptu compost pile, providing enough nutrients and substrate in which wild grass can grow. Following the proliferation of the grass, Poynter would also observe other plants growing around the grass as it as well offered a refuge and resource to the backyard ecology. Poynter took this discovery into forming her own company, Paragon Space Development Corporation, with the verified conviction that indeed "small things matter" in ecosystems.

Primary to continuing further in this paper, it is absolutely vital and necessary to understand that an ecosystem is entirely similar to the Greek symbol of Ouroboros, a self-eating serpent. Inputs of one organism serve as the outputs of another and, like the Nataraja of the Hindu God Shiva, are constituted through acts of creative destruction. Poynter's discovery mirrors the effect of GMOs and any ecosystem into which they are introduced as the transgenic genetic materials or resistances (though will be evolutionarily counteracted) change the ecosystem on a micro level with macro consequences.

Chapter Four: Returning to the Human Concern of Agency

Introducing toxic proteins, even if harmless to humans, presents a serious ecological concern. The problem, if it is not already clear enough, is that ecosystems are complex holistic manifolds in which consequences are neither immediately apparent nor testable from the great fecundity of variables which cannot be clearly demarcated. The orientation of this subsection is towards elucidating and making real the sort of Michael Crichton cautionary tales as in *The Andromeda Strain* (1969), *Jurassic Park* (1990), and most poignantly the example in *Prey* (2002).

The superfluous referencing of pop culture is not merely incidental, Crichton's work aided in transforming the romantic critiques of the eighteenth century into a modern context. *The Andromeda Strain* inverts H.G. Wells' conclusion in *The War of the Worlds* (1898) as Earth being beset by an alien pathogen, rather than the bacteria and viruses of Earth affecting an invader. Again as in Wells' *The War of the Worlds*, we are provided with the lesson that life, even exotic and threatening life, cannot fully adapt to alien ecosystems. Again, a lesson here is also learned in that introducing genetically modified organisms into a natural environment will undoubtedly face challenges in adaptation which are not readily accessible to the novel's characters. Wells' martians and the alien pathogen in *The Andromeda Strain* fail to thrive from relatively simple biological and chemical conventions – disease and pH, respectively.

Never dawning onto this realization until this point, *Jurassic Park* is a re-adaptation of Wells' *The Island of Doctor Moreau* (1896), wherein both works include an island that is transformed into a laboratory where Shelleyesque monsters are designed with the help of science, leaving readers with the general theme that nature, when perverted through reckless applications of science, leaves a disunity between humanity and our environment. As will later be explored, this can even debase human dignity.

Prey's plot mirrors the exact concerns Dennis M. Bushnell voiced in his PowerPoint presentation, "Future Strategic Issues/Future Warfare [Circa 2025]," to NASA colleagues. The novel presents the scenario of swarming and self-replicating nanomachines capable of adapting to their environment in ways that were not imagined by their developers. Spoilers aside, the self-replicating nanomachines emerge to become a serious "grey goo" concern, a real possibility imagined by Dr. K. Eric Drexler, in which self-replicating nanomachines "run amok" and break down biological material, "eventually turning everything into 'grey goo'" (Motavalli 2009, p. 25).

Departures in fiction aside, scenarios of rDNA and transgenic plants becoming "wild" in nature are a very real concern. Not only can GMOs cause havoc on ecosystems or be rendered useless by an ecosystem; their deployment and use can also limit overall biodiversity and thereby become a liability in food security.

“For 10,000 years, we have altered the genetic makeup of our crops,” Pamela Ronald opines in a 2013 issue of the *Boston Review*. “Given that modern genetic engineering is similar to techniques that have served humanity well for thousands of years and that the risks of unintended consequences are similar whether the variety is derived from the processes of GE or conventional gene alternation, it should come as no surprise that the GE crops currently on the market are as safe to eat and safe for the environment as organic or conventional foods,” she continues (Ronald 2013, p. 17).

The Cavendish banana subgroup (a cultivar of *Musa acuminate*) and Ireland’s “Great Famine” help to illustrate how such a disaster would come about from a lack of biodiversity, and demonstrates where Ronald’s views are shortsighted. Where the Cavendish banana currently suffers from a lack of biodiversity, Ireland’s “Great Famine” acts a historical example in which one species of potato was nearly eradicated from disease. Potatoes and bananas are prime examples of evolution’s capacity to winnow populations of like similarity. Similar indeed, both the common potato and banana are clonal crops, meaning they reproduce the cultivar and tuber through replication of the plant itself (Rosen 1999, p. 295). Yet one final similarity is where the problem enters into focus. Both the Cavendish and the potato suffer from fungal blights: the potato faces the threat of *Phytophthora infestans* and the banana *Xanthomonas euvesicatoria* (Iskra-Caruana, Duroy, Chabannes, and Muller 2014, p. 84). Without genetic variation, resistances to *P. infestans* and *X. euvesicatoria* are null, leaving the only solution to be isolation and quarantine. Without constant maintenance and monitoring of genetically modified crops, variation and diversity will become an issue.

Mainsail to this problematizing of the danger is the issue of a winnowing in biological diversity. Studies on the issue offer scant insights as to what the risks amount to. G.V. Dana, A.R. Kapuscinski, and J.S. Donaldson attempted to ascertain such risk in conducting an “Ecological Risk Analysis,” or ERA, on the effects of GM maize on South African biodiversity. These were their findings:

> “We conducted two participatory ERA workshops in South Africa, analyzing potential impacts of GM maize on biodiversity. The first workshop involved only four biological scientists, who were joined by 18 diverse scientists and practitioners in the second, and we compared the ERA process and results between the two using descriptive statistics and semi-structure interview responses. The addition of diverse experts and practitioners led to a more comprehensive understanding of biological composition of the agro-ecosystem and a more ecologically relevant set of hazards, but impeded hazard prioritization at the generation of precise risk assessment values. Results suggest that diverse participation can improve the scoping or problem formulation of the ERA by generating an ecologically robust set of information on which to base the subsequent, more technical risk assessment” (G.V. Dana, A.R. Kapuscinski, and J.S. Donaldson 2012, p. 134).

As proper scientists, they noted that their findings were inconclusive on the original research topic. However, they also suggest having laid the groundwork through a more “comprehensive understanding of biological composition of the agro-ecosystem" for future ERA studies (G.V. Dana, A.R. Kapuscinski, and J.S. Donaldson 2012, p. 134). Only at this point is it prudent to suggest that a decrease in speciation and variation of an "agro-ecosystem" could portend disaster in the form of a pathogen, pest, or maladaptation spurned on by a nearly unlimited number of ecological factors. It is simply best to heed the warnings of clonal crops and note that their vulnerabilities owed to genetic similarities could very well bring about their extinction.

Life as an Intellectual Property:

Research and development in producing GM seedstock is a costly, multimillion-dollar venture. Like any other business with high overhead, mechanisms must be enacted to protect the investments so as to not only allow a return but also secure those returns for future financial quarters. It is precisely at this juncture in the analysis where the question of human rights begins to emerge from the gaseous opaque ether of instrumental reason and its application in the biological sciences.

Covering this section is a high order. It encompasses the constitutive cross-section of where science merges with economics and politics. Thoroughly investigated, it could easily form the subject matter of a volume series with theses of its own right. With the intent of brevity and to set up the basic problems, I intend to fixate on select themes so as to quickly draw in the following section the topic of human rights specifically. This section will focus on intellectual property, genetic rights management, genetic use restriction technology, the Cartagena Protocol on Biosafety and Biosecurity of 2000, and its institutional and internal failings.

Strangely, though not in a flippant or arbitrary manner, I feel that Crichton's *Jurassic Park* helps towards introducing these topics. In the novel, chief geneticist Dr. Henry Wu explains that the engineered animals have been deprived of the ability to produce lysine, an essential amino acid. Lysine is critically vital in forming Acetyl-CoA carboxylase, a molecule necessary in the catalytic "first step" in the biosynthesis of "fatty acid" that acts as a "metabolic pathway required for several important biological processes including the synthesis and maintenance of cellular membranes" (Polyak, Abell, Wilce, Zhang, and Booker 2012, p. 983). Without including supplements of lysine in the diet of the engineered animals, the animals would eventually die. The purpose for this "lysine contingency" is in preventing the escape of any species and to also prevent rival biotech firms from using pilfered DNA to easily recreate their own animals.

Encoding a similar contingency into every GMO has its advantages and disadvantages. GM crops outside of fiction are similarly patented and, likewise, engineered with GeRM (Genetic Rights Management) or GURT (Genetic Use Restriction Technology) for the same reasons as in Crichton's novel. An article appearing in a 2008 edition of the *Journal of Business Ethics* explains it rather nicely:

> "There are two main categories of GURTs: T-GURTs, which restrict the expression of a certain trait (phenotype) by switching on or off a specific group of genes responsible for particular phenotypic expressions; and V-GURTs, which restrict the use of

> the entire plant variety by switching on a gene that terminates further reproduction of the plant" (Bustos 2008, p. 65).

The purpose of using GURT is twofold. First, as in the lysine contingency, it prevents the uncontrolled spread of a GMO, and second, it ensures planned obsolescence in the seedstock of farmers. This will be later addressed in the subsequent subtopic of human rights as GURT's implications are wide reaching.

Diamond v. Chakrabarty, 447 U.S. 303 (1980) was a landmark case decided before the United States Supreme Court which ruled that "living things are patentable if they represent novel, genetically altered variants of naturally occurring organisms" (Coyne 2013, p. 42). Here, the overarching idea is that the Norns of technology, law, and economics have spun the fate of life itself into a patentable object, an intellectual property in its own right with profit incentive and mechanisms to control and dominate how that life replicates to ensure continued returns. Jan Art Scholte observed that, in regard to its span, "[g]lobal governance has figured importantly in both new sectors [bio and nanotechnology], *inter alia* by enshrining the intellectual property rights that provide much of the legal framework for profit making from these technologies" (Scholte 2000, p. 175).

Indeed, now the concern of human rights is beginning to take form. The idiomatic can of worms is with full certainty open and its invertebrate contents are assuredly squirming. Everything considered until this point, specifically regarding the role of technology and instrumental reason, has merged with respect to what can be considered as property within the purview of law and rights. Marcuse complicates the triad of liberty, technology, and oppression in remarking that under the "rule of a repressive whole, liberty can be made into a powerful instrument of domination" (Marcuse 1964, p. 17). Further, the range of choice open to the individual is not the decisive factor in determining the degree of human freedom, but what can be chosen and what is chosen by the individual" (Marcuse 1964, p. 17). Instead, the true "criterion for free choice can never be an absolute one, but neither is it entirely relative" (Marcuse 1964, p. 17). He quips that with regard to a democratic political order, the "free election of masters does not abolish the masters or the slaves" (Marcuse 1964, p. 17). Most importantly, "[f]ree choice among a wide variety of goods and services does not signify freedom if these goods and services sustain social controls over a life of toil and fear – that is, if they sustain alienation" (Marcuse 1964, p. 17).

In special attention paid to the above selections, the shear gravity of problems originating from genetic engineering within an open society is now plainly obvious. The "choosing" between organic or GM, if a task were even easy, let alone possible, does not unfurl the knots of repression. What is more is that temporarily increasing crop yields constitutes more than a simple "superimposed need" like the automobile, a common and legitimate target of the Frankfurt School, food prices maintaining a price floor and general availability is necessary in preventing famine. Consider for a moment the progression of science and what has been established as possibilities in genetic engineering until this point, and reflect on the potential human costs of all effects associated with those causes. Postulated effects, insofar as the aspect of “rights” is concerned, range from the mundane of being mandated to grow a certain strain of proprietary grass on one’s property, to the absurd and frightening thought that one must choose whether to engineer the genetics of their children given the practice being a widespread norm. Beyond whatever reaction these realities evoke within the reader, the most troubling of all ought to be the fact that the technology to govern life itself, with regard to its design, is privately owned.

Transitioning from plants to humans, GM technology and the issue of patents was the prime and critical reason why the Human Genome Project sought to catalog the human genome and release it into the public domain. If it had been accomplished sooner and by a private biotech firm, the findings would have been intertwined within patents (Parker and Parker 2003). Even still, modulating a particular gene for one cause or another can be patented. 23andMe, a corporation that provides genetic ancestry through mitochondrial DNA and y-chromosomal DNA testing to consumers, has been issued a patent (US 8187811) “related to human polymorphisms associated with Parkinson’s disease” (Harrison 2012, p. 510). A problem is in that the company, offering its genetic ancestry services, has “blurred the line between consumers and research subjects” (Harrison 2012, p. 510).

What does this imply for the status of human dignity when the species has come upon a point in history where the modification of itself and other life is realized? George Kateb recognized that it was human dignity in the main that could potentially ignite a “monstrous pride” that “drives people to exploit nature for human purposes and hence to ravage nature and ultimately make the earth uninhabitable” (Kateb 2011, p. 4). Dignity would seem to correlate with hubris, however Kateb’s argument is that it is dignity itself that must be preserved in order to inoculate against abuses in power and in that very hubris. He wrote that it was dignity that compels us to “direct [our] energies, *as no other species can* [emphasis added], to the stewardship of nature and therefore curtail its mad presumption against nature” (Kateb 2011, p. 5). His argument is a rather effective one in the problem of genetic engineering, and that is if our species is so unique that we have even reached the possibility of being able to permanently alter nature, we have an obligation to maintain the order of nature and not pervert it, or we risk destroying our own dignity in the process.

Inverting the analysis from humans back onto plants, that is exactly what GM foods have so far achieved – the blurring of lines between consumers and research subjects. The research subject however, in this case, is the Earth’s biosphere. Everyone within that biosphere should, in the best possible world, be aware of what is being done on their own behalf and also what they are consuming. One need not even need to consume a GMO to be potentially vulnerable: once one becomes wild or hybridized exposure is environmental. Just as the history of human experimentation has been turbulent in securing consent and knowledge of the experiments being conducted - the Tuskegee syphilis experiment and the U.S. Army’s “Operation WHITECOAT” - those potentially harmed by GMOs must also be informed. Just as the

Declarations of Helsinki (1964) and Geneva (1948) set standards in human experimentation, similar standards must be employed towards humans living within any ecosystem affected by variants of genetically engineered species as a logical conclusion. With the consequences of transgenic applications unknown outside of their "breaking free" and causing ecologies to adapt and mutate in response, they are essentially experiments in progress.

Such reasoning was the basis for the Cartagena Protocol on Biosafety and Biosecurity in 2000 and the Convention on Biological Diversity (1993). Where the Convention on Biological Diversity sought to preserve biodiversity as a principle, the Cartagena Protocol on Biosafety and Biosecurity attempts to prevent ecological crises from human intervention. However, it must be stated that neither is wholly perfect nor indeed effective at grappling with the issue of novel applications of GM technology. Problems that have arisen from these conventions and agreements include a low number of signatories, the reliance on a precautionary principle, the difficulties in oversight, and avoidance of contradictions in honoring other international agreements, such as those within the World Trade Organization.

In an article that appears in the *Pace Environmental Law Review* titled "International Development of Microbial Pest Control Agents: Falling Between the Cracks of the Convention on Biological Diversity and the Cartagena Biosafety Protocol?" Guy Knudsen identifies inherent problems with the protocols. A section titled "Biological Control of Plant Pests: A 'Biodiversity-Friendly' Technology?" features Knudsen noting the problems with the Green Revolution's overuse of pesticides and the importance of Rachel Carson's *Silent Spring* (1962) in the development of GM crops and that the use of microbes to control pests have for the most part been regarded as benign without much scrutiny beyond the Biological Weapons Convention of 1975 (Knudsen 2013, p. 630). This acts as a problem in that, again, no one is quite certain what the long term effects of approaches to pest control such as *B. thuringiensis* may ultimately be.

Similarly, the Cartagena Protocol on Biosafety and Biosecurity attempts to mitigate the "doomsday scenario" of GMOs on the basis of a precautionary principle. Just as Scholte remarked in the latter half of the previous subtopic, Sebastian Oberthür and Thomas Gehring write that the "tense and potentially conflicting relationship between the international trade order represented by the World Trade Organization and various multilateral environmental agreements, such as the Cartagena Protocol, constitute a prominent element of the broader agenda of institutional interaction" (Oberthür and Gehring 2006, p. 12). On this relationship, they uncovered two findings: one, that the precautionary principle is effectively weak; and two, that the Cartagena Protocol on Biosafety co-opted and began to align with the WTO on the trade of GMOs.

As food and life becomes intellectual property managed by biotech firms, food transitions away from more of a privilege rather than a right. And, echoing Marcuse, the choice "from" becomes increasingly untenable. Corporate policies and controversies surrounding Monsanto aid to illuminate the nuances of this rather well. While initially supporting "smallholders" in their "Monsanto Smallholder Programme"

(SHP), helping the resource-poor, rural, and small farmers with GM strains of crops as part of a corporate social responsibility platform, the company came to switch face and ask for royalties while enforcing ownership of their intellectual property (Glover 2007, p. 851). As addressed earlier in the section on GURT, "farmers are [also] restricted from saving genetically engineered (GE) seeds" (Martin 2013, p. 95). Continuing further, Martin, writing for the *DePaul Journal of Art, Technology & Intellectual Property Law* emphatically described the companies practices in "[using] its combination of seed utility patents, licensing arrangements, and patent infringement litigation against farmers to restrain competition in the seed industry" (Martin 2013, p. 96). In sum, and as developed in the preceding subtopics, Monsanto is the example *par excellence* of diminishing biodiversity through eliminating competition and through engineering uniformity of phenotypes among crops, employing GURT for financial incentives rather than for biological containment of recombinant DNA, and lastly, transforming life itself into an intellectual property.

Every human existing currently now or in the future is entitled by right to know how their food is produced, so that they can from that understanding, ascertain if those means are ethical. Also, humanity deserves, as a right, access to any plant or animal's genetic code, modified or otherwise. Organic molecules composed of adenine, guanine, cytosine, and thymine are constituted by these fundamental nucleotides, building DNA and RNA – the essence of life itself, but not life merely. Unquestionably, GMOs do alter our ecosystems, if even indirectly. Public discourse, disclosure, and legislative attempts to label GMOs should not be presented with obstacles and instead, examination and transparency. These principles are in accordance with a right of security, or self-preservation, a right to know, and a right of conscience to pose ethical questions. Questions that include a right to privacy for farmers and their crops stand as a relevant starting point in this measure.

Galvanized by an interest in the Free Software Foundation and the Electronic Frontier Foundation and their goal to advocate for consumer's rights and non-propriety software, I viewed the issue of GMOs as a direct corollary. Though we may one day be able to modify nearly all plant and animal genomes in a fashion similar to the GNU/Linux operating system, the metaphor of the present is that we are in a "walled garden" approach similar to Apple products. Formats, devices, and environments are all strictly designed to cohabitate and not cooperate with alternatives. DRM or Digital Rights Management functions in a similar capacity as GURT; users' limitations are developed to exercise more control over how software is used rather than for their safety or benefit. Effectively, we currently have the equivalent of software patents on our food when it comes to their genetic makeup, and these patents are enforced through law as well as technology in the form of genetic use restriction technology. This is not to our benefit as famine is more often a problem of distribution rather than production, and proprietary ownership of agriculture further stifles distribution. Either permit open gene "hacking," or limit the technology altogether.

Chapter Five: Conclusion - On Going Forward

> Every action, every activity, is surrounded by defects as a fire is surrounded by smoke.
>
> Krishna, *Bhagavad Gita*: Chapter 18, Verse 48

Cartesian metaphysics performed a true miracle in its vivisection and separation of the mind from the body. A revolution of its own right, Descartes and his *Meditations on First Philosophy* (1641) helped spur on the dialog that would eventually unfold into the greater European Enlightenment, laying the groundwork for scientific inquiry and advanced methods for instrumental reason to truly thrive. Communities such as the Vienna Circle, inspired by the work of German physicist Ernst Mach would later refine instrumental reason to its fullest extent, acting as a showcase to power and progress as seen in the radical technological developments of the twentieth century. But therein was a most serious problem. Advocates and apologists of instrumental reason never questioned why they pursued their aims until the theoretical possibilities of nuclear and environmental collapses became evident. Even after such a point, instrumental reason, argue its proponents, is the only game in town. Descartes did more than just identify the source of cognition; he fractured the plate hosting humanity and nature, and began the divide of the continental shelf. This is not a condemnation of his work nor any who owe much of their influence to him. I would say that this tangent's purpose is to identify when a science broke from a holism and made the world more measurable in isolating variables to manipulate with reason.

Contemporary science concedes that ecosystems are complex organisms. I am not entirely certain whether the analogy can fully capture how truly complex they are. Organisms have externalities and boundaries, and they are defined in a temporal schema. Ecosystems however are not confined to the same boundaries as an organism which inhabits it. Here I believe the Lovelock Hypothesis or "Gaia theory" explains what an ecosystem resembles in that there are feedback mechanisms, geophysical cycles, and even astronomical inputs and outputs that all can contribute to effects, becoming causes in themselves (Buratovich 2013).

Potential solutions to avert global ecological or human catastrophes can exist within a new science that embraces figures like Lovelock, or by those who wield approaches to scientific progress in a way distinct from what Einstein viewed as an "axe in the hands of a pathological criminal" (Neffe 2007, p. 256). Integrative and decentralized solutions that mirror biology's innate mechanisms of survival are a keen starting point to remedy any oppressive use of any technology, not just GMOs. One such means includes the perfecting of the photo-bio reactor, a tube circulating nutrient rich water along a growth medium culturing edible algae.

I also spoke to a PhD candidate, Mariano Alvarez, in the University of South Florida's plant biology laboratory studying epigenetics in wetlands vegetation. He shared many of my concerns regarding GMO technologies. Though I learned that there will soon exist no single monopoly on the technology as gene sequencing becomes more accessible to the general population, the solution of preserving biodiversity is in reducing the use of isogenic crops. Instead, farmers are better served by sectioning their fields with differing genetic lines of a crop so that in the event of an ecological or environmental hardship, recessive alleles in one lineage may offer a reprieve to the others. Fundamentally, what I learned was that biology and those working within biology mirror the anarchic basis of post-left political thought. Lifeforms are decentralized, self-propagating and actualizing entities that function towards reshaping and sometimes smashing oppressive systems to overcome and adapt. Seeing GM technology as an end or a solution is a folly, as life or ecosystems react constantly. GMO technology and industrial agriculture practices have yet to comprehend the same issue present in the medical field of "super bugs" emergent from widespread use of antibiotics. Systems and life are insoluble with one another; life circumvents systems in building its telos-free structure.

However, like GM technology, "hydraulic fracturing" is now being proposed as a solution to the problems of the day, such as the *costs* of production and that we are faced with a definite *resource scarcity*. Like the notion of efficiency behind GM technology, hydraulic fracturing (or "fracking") unfortunately has costs of its own. For example, people become sick through the chemicals that are released (Ehrenberg 2012, p. 23), and fracking has been implicated to cause earthquakes (Wilson 2013, p. 20). These great costs of health and safety are endured so that humanity can continue toward further applying instrumental reason, rather than asking questions on the basic order of "why are GMOs necessary?" In this Sisyphean endeavor we seem to diminish our dignity while disregarding basic rights recognized by the United Nations, such as clean drinking water (harmful chemicals used in fracking are introduced into the water table) (Adlard 2015). We also continue the usually not-so-appalling practice of privatization to lifeforms as a final stake in the rail.

To demonstrate this point Q.E.D. in what I feel to be its barest sense, I will utilize as one last example, the product known as an "EcoSphere." Manufactured by EcoSphere Associated, Inc., EcoSpheres are glass spheres of filtered seawater that function as "self-sustaining ecosystems" (eco-sphere.com 2015). You never "have to feed the life within," reads its description (eco-sphere.com 2015). Meant to adorn desks or windowsills, these spheres embody what an attempt of instrumental reason looks like in ordering synthetic ecosystems. The caveat is that while the "organisms [living] within the EcoSphere utilize their resources without overpopulating or contaminating their environment," they only have "an average life expectancy of two years" (eco-sphere.com 2015). Again, what we are to take from this is that ecosystems escape traditional applications in instrumental reason. Proponents of raw instrumental reason must realize that they cannot separate themselves from nature while trying to devise solutions *for* nature. Also, in thanks to George Kateb's *Human Dignity* (2011) we also learn that which protects our rights — dignity — is diminished when our hubris runs amok.

As far as possible solutions (though unconventional), there is a humorous segment in a 2008 documentary directed by Astra Taylor titled *Examined Life*. In the documentary, Taylor encourages philosophers and social theorists such as Judith Butler, Cornel West, Peter Singer, and Michael Hardt on the streets of New York City to speak about their approaches to theory and praxis in the modern world. When Taylor asks Slovenian philosopher Slavoj Žižek what he believes should be done about the problem of pollution while filming in a large-scale garbage processing facility, Žižek identifies that the ecological narrative of humanity and technology disrupting what was once organic is wrong. He posits that this is a "secular version of the religious story of the fall" (Taylor 2008). Instead, "nature" should be considered as a "big series of unimaginable catastrophes" (Taylor 2008). He notes that we all are aware of what ecological problems exist, but the remaining question is why we have not yet devised a solution. The argument made is that garbage must not be hidden and that it should be something that we live amongst so that we can "confront properly the threat of ecological catastrophe" exactly through "cutting off [our] roots [to] nature" (Taylor 2008). "We require more alienation" and "we should become more artificial . . . true ecologists love this" (Taylor 2008). Perhaps in either case, McKenna's reintegration with nature or Žižek's disavowing of the natural, we will come to realize how our problems became so problematic through synthesis while being able to see where the past watermarks of ecology and human rights once stagnated.

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