

2018

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MEAT REIMAGINED: THE ETHICS OF CULTURED MEAT

By

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Presented in partial fulfillment of the requirements

For the degree of

Master of Arts

In Environmental Philosophy

The University of Montana

Missoula, MT

Official Graduation Date: May 2018

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Meat Reimagined

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In this paper I explore a relatively new technology that is being developed to try and solve some of the major issues with modern animal agriculture called cultured meat. I cover the short history of this technology and where it is at currently before addressing two different ways of evaluating the ethics of cultured meat. Responding to much of the praise for cultured meat based on consequentialist ethics, I lay out reasons for skepticism and how some of these estimates might be overblown due to those people advocating for it being situated in the ideology of ecomodernism. I argue that ecomodernism makes one more likely to accept technological solutions as the primary solution rather than seeing the fuller context of social and political conditions that have created the problem. In my final chapter, I address how cultured meat is not going to repair the damaged relationship humanity has to the nonhuman world and that it actually furthers an orientation of control and domination towards nature. I conclude that cultured meat cannot solve the complicated issue of animal agriculture but it may be useful as a addition to other solutions rather than the solution.

Chapter 1: Reinventing Meat

“We shall escape the absurdity of growing a whole chicken in order to eat a breast or a wing, by growing these parts separately under a suitable medium.”

-Winston Churchill 1931, “Fifty Years Hence”

This paper aims to explore a recent and novel solution to the many problems associated with modern industrial animal agriculture. Cultured meat has been gaining more traction as an actual possibility in the past two decades, a technology that allows one to grow animal muscle cells outside of the body for human consumption. Considering the scope of the crisis in animal agriculture today, the potential of such a technology cannot be ignored and should be critically evaluated. Since this is a very new topic, I will spend the first chapter going through the history and mechanics of cultured meat and touch upon the relevant ethical issues at hand. The second chapter will be dedicated to viewing the potential of cultured meat through a consequences-based perspective. It will address why this evaluation is difficult in the face of uncertainty and introduce the framework of ecomodernism that helps illuminate the ideological underpinnings of such a technology. Finally, the third chapter will go beyond the immediate consequences of cultured meat for a deeper look at how this technology might impact our relationship with the natural world and why these kinds of questions matter just as much as whether cultured meat will use less energy than industrial meat.

The context for this type of technology emerging is the problems associated with modern industrial animal agricultural and the increased meat-eating that is made possible by this destructive process. Industrialized farming over the last couple of decades has created a slew of environmental ills and inhumane conditions for billions of animals. It is estimated that 18% of

greenhouse gases are released by animal agriculture when considering the cumulative effects of released gases from the animals, manure, and fossil fuels used during the whole process (Food and Agricultural Organization of the United Nations, 2006). Confined Animal Feedlot Operations (CAFOs) in the U.S. generate nearly 500 million tons of manure that is one of the leading contaminants of water (Environmental Protection Agency, 2005). In a report from the United Nations Environment Programme, there is strong evidence that, in general, meat and animal products require more resources and produce more emissions overall than plant-based alternatives (Hertwich, 2010). This is particularly true of the land animal agriculture takes up, especially when fertile cropland is used to grow feed for animals (2010).

Of course, there is some land that is not suitable for crops such as arid grasslands, but this is still a relatively small portion of the land being taken up by animal agriculture (Eshel et al., 2014). While there have been encouraging trends towards more humane and integrated animal agriculture, CAFOs still produce nearly 97% of the meat and animal products consumed in the U.S. (Foer, 2009). I am using humane to signal a type of animal agriculture that cares for the animal's wellbeing and ensures they have enough space to thrive and their suffering is minimized. Even if all animal agriculture could be switched to more humane and less industrial practices, there is simply not enough resources to meet the growing demand for meat (Eshel et al., 2014).

There was a modest decrease in meat consumption in the United States of about 9% overall from 2007 to 2014, especially of red meat, driven largely by the high price of red meat and by health concerns (Bentley, 2017; Durisin and Singh, 2018). However, with a higher demand for protein and prices dropping these trends are quickly reversing. The past couple of years have seen a sharp increase. The year 2018 is projected to have the highest per capita meat

consumption in the United States since 2004, at around 222.2lbs of meat per person in a year (Durisin and Singh, 2018). Additionally, as developing nations gain affluence and become more urbanized, meat consumption typically rises. This, along with rapid population growth, put estimates of meat production rising from 218 million tonnes in 1997-1999 to nearly 376 million tonnes by 2030. Countries such as Brazil and China have seen substantial increases in meat-eating in the recent past, with these numbers only expected to grow as these countries industrialize and their middle-class grows (World Health Organization, 2015).

Given the current reality of our agriculture system and expected projections, action must be taken to mitigate the negative toll of industrialized animal farming on animals, the environment, and humans. As this is a massive problem, there will likely not be one silver bullet that solves it, but rather a multi-pronged approach that considers a variety of solutions working in tandem. One such proposed solution that involves relatively new technology is cultured meat, or meat grown directly from stem cells. This technology has been developed with the hope that it might provide real meat without many of the problems associated with industrial farming. Although animal welfare issues are certainly a driver in of the discussion of cultured meat, I will be focusing specifically on environmental issues and humanity's relationship to what we typically consider the natural world, first laying out the history, some technical detail, and the main barriers for commercialization.

The idea of creating meat without the animal has been floating around since even the time of Churchill, but only within the last decade or so has it made progress towards becoming a reality, even one that might extend beyond scientific experiments into people's daily lives. In one of the first comprehensive books on the subject of cultured meat called *Clean Meat: How Growing Meat Without Animals Will Revolutionize Dinner and the World*, Shapiro (2018) goes

through the history that led to the current state of cultured meat. I will be drawing primarily from this source to explain the history and some of the major issues at stake. The first instance of meat being grown outside of an animal was in 2002 in a NASA-funded experiment to grow goldfish cells outside the creature for a possible source of protein in space. The project was successful in producing cells but they were never tested for edibility. A few years later, a public health graduate student named Jason Matheny developed an interest in the possibility of growing meat without the animal as a way to overcome the environmental and animal cruelty issues with industrial farming. Taking inspiration from the NASA experiment, he founded the first organization dedicated to promoting cultured meat, calling it New Harvest.

After unsuccessfully pitching his idea to the United States Department of Agriculture, Matheny found allies in the Dutch government who agreed to fund initial research into the topic. There was heavy publicity surrounding this initial research and this is when serious academic inquiry into the possibilities of cultured meat really began. New Harvest continued to focus on raising awareness and funding research. Meanwhile, one of the co-founders of Google, Sergey Brin, took an interest in the possibility of cultured meat and funded the creation of the world's first cultured burger, carried out by a researcher in Holland, Mark Post. Post succeeded in making the burger for \$330,000 and held a highly publicized taste test in 2013, making headlines about the world's first "lab-grown burger." Although it fried and browned like a burger, one taster described it as more of a "protein cake" than anything. This taste was the result of the burger being made solely of muscle cells without fat, blood, or connective tissue that all contribute to the taste of a regular burger. While this was a huge milestone, many barriers still remained for cultured meat to come anywhere close to commercialization.

In his book detailing this history, Shapiro then moves on to Uma Valeti, a physician and longtime vegetarian. He helped to found a startup called Memphis Meats focused on bringing cultured meat to commercialization as soon as possible. Building on the academic research already carried out, Memphis Meats started tinkering with details in order to bring cost down and perfect the taste and texture. As cultured meat has progressed, it continues to attract more funds from investors, especially from wealthy individuals from Silicon Valley. In 2017, Memphis Meats announced that it raised \$17 million in a round of fundraising from donors such as Bill Gates and Cargill, one of the largest food service companies in the world (Troitino, 2017).

Just (formally Hampton Creek), the company behind the popular vegan mayonnaise Just Mayo, decided in 2016 to enter the arena of cultured meat and Shapiro dedicates a decent chunk of the book to explaining their story and progress. Unlike Memphis Meats, Just is focused exclusively on poultry since chickens are the most abundant domestic animal and typically endure some of the worst conditions. They are hoping to break into the market by making cultured foie gras, or fatty duck liver. This product is highly sought after by food connoisseurs; yet, it is highly controversial. To achieve the desired product, ducks need to be force fed nearly constantly through tubes. This product typically goes for a whopping \$100 a pound, making it easier for Just to reach market prices with their product and be able to really compete. The ultimate aim is to replace the billions of chickens consumed each year, but the hope is that foie gras can give them the start they need as they work to drive costs down for chicken production.

Cultured meat builds on cell culture technology that has already been used in the medical field. The process of making cultured meat first involves extracting a biopsy of muscle tissue from an animal, which can be done without killing or greatly harming the animal.¹ Then

¹ The details of the process described in the next two paragraphs is drawn from Mensvoort and Grievink, 2014 and Shapiro, 2018

myosatellite cells are extracted from that sample, which are cells that are not yet fully differentiated but are further along than stem cells. They are in some sense “proto-muscle” cells, ready to rapidly turn into muscle cells in the case of an injury. These kinds of cells are abundant in the body and are able to turn into muscle cells and quickly proliferate.

The cells then need to be placed in a nutrient-rich medium with additional sugars and amino acids to multiply. This medium has typically been fetal bovine serum, or blood from the cow fetuses, but plant-based alternatives are being developed. The cells then need to be exposed to a nutrient poor environment that spurs on muscle differentiation. At this stage some process to simulate the effects of exercise is essential, such as physical manipulation, electric currents, or cycling through warmth and cold. The strands of muscle must adhere to some kind of scaffold, such as a bead. This increased surface area allows the muscle cells to proliferate quicker (Datar, 2015). Then these strands can be gathered together to produce a processed meat like a burger or a chicken nugget. This method can only make processed meats since the cells can only grow about 0.5mm thick and then they are gathered together to produce a meat product (Datar 2015).

While initially referred to as “in-vitro meat,” this term, along with related terms such as “lab-grown meat,” were generally abandoned due to how they negatively affected the perception of the meat. For the next couple of years “cultured meat” was promoted as a more marketable term, though surveys later indicated that the term “clean meat” outperformed all other terms (Shapiro, 2018). The term “clean meat” is preferred by those developing it because of the normative ethical force behind a word like “clean” that appeals to consumers. While certainly this term will be useful for marketing, I find “cultured meat” to be an accurate term while remaining more ethically neutral. I will be primarily referring to the product as “cultured meat” as I think this term best reflects the reality of how the meat will be made.

In addition to getting the right combination of nutrients and fats to get the taste just right, one of the biggest hurdles companies face is lowering the cost. At \$330,000, Post's burger was hardly going to be able to compete with cheap industrial meat. Significant progress has been made in reducing this cost, with Memphis Meats producing the first cultured meatball in 2016 for a 'mere' \$1,200. As of March 2017, the company proclaimed that it was able to produce a pound of chicken for \$9,000, which is nearly half of what it cost per ounce to produce the meatballs the year before (Troitino, 2017). While still obviously very costly, the reduction in price has been quite rapid and those working in the industry are confident costs will come down with innovation and economics of scale, citing how exponentially expensive such items as iPhones were in R&D. However, others express skepticism about such an elaborate and energy-intensive process ever reaching low enough costs (Shapiro, 2018).

One of the biggest questions regarding cultured meat is whether consumers will embrace it and in what kind of numbers. Even if all other issues are overcome, they will not mean much if practically no one is interested in eating it. Consumer surveys are mixed, but it largely seems to depend on how the product is presented and explained. Shapiro goes through a variety of polls and how the wording and information given affects the response. An initial poll in 2014 by Pew Charitable Trusts simply posed the question "would you eat meat grown in a lab?" with less than one-third expressing interest. A 2016 survey conducted from Florida Atlantic University showed more promise, giving a couple sentences of context. Even without a discussion of benefits, 61% of university students said they would probably or definitely eat it. When made aware of the potential health, ethical, and environmental benefits, this number rose to 77%. While these recent polls are encouraging, there is still a lot of skepticism that cultured meat will be widely accepted, especially with "natural" foods in greater demand.

A different issue concerning potential cultural obstacles is whether improvements in plant-based meat will make cultured meat superfluous before it ever hits the market. Plant-based meats have been rising in popularity even among those who are not vegetarian or vegan, and some of the latest products are closer than ever in terms of taste and texture to meat. The Impossible Burger has made waves at high-end restaurants for being a plant-based burger that “bleeds,” due to extracted plant heme (Robinson, 2017). A similar product, the Beyond Burger, is already being sold in grocery stores and has been praised as closer to a real burger than any veggie burgers currently on the market (Calderone, 2016). Those working in cultured meat acknowledge the possibility that plant-based meat might sweep the market, but they remain skeptical that all meat eaters will switch soon. Currently vegetarian meat is a mere 1% of the meat market (Shapiro, 2018). Although both the Impossible burger and the Beyond Burger have received praise from omnivores, its usually with the caveat that it is not quite the same or as good as a real burger (Calderone, 2016) One of the appeals of cultured meat over plant-based meat is that its “real” meat in the sense that its genetically identical to a traditional meat product.

Even if it overcame these barriers in public perceptions, it is also possible cultured meat might be caught up in regulations for years since it is a novel product. There is even a question of what organization would be in charge of regulating it, since the USDA regulates meat while the FDA regulates all other food (Shapiro, 2018). In the latest report coming from the Committee on Future Biotechnology Products commissioned by the National Academies Press, they believe that the FDA will likely be the primary regulator in the case of cultured meat. Since the USDA is focused on how animals are treated and slaughtered, they will likely not be taking the lead with cultured meat (“Preparing for Future Products of Biotechnology” 2017).

Regulatory approval could potentially go faster than expected though, especially considering the significant health benefits this technology could bring. Many of these benefits would stem from a lack of contamination and spread of food borne illness. Industrial meat holds a great potential for contamination by feces and bacteria where the sterile environment and lack of animal feces with cultured meat could largely avoid these issues. Despite the relative novelty, regulators might be enticed to push cultured meat to commercialization due to the potential to prevent much of the spread of disease connected with meat consumption. Additionally, since the fat must be added to the muscle manually, there is the option to add in more unsaturated fats and omega-3s rather than just the saturated fat found in traditional animal products (Shapiro, 2018).

There are a number of ethical issues relevant to the discussion of cultured meat, not all of which I will cover in this survey. There is obviously huge potential for animal welfare in this technology, but I am choosing to focus primarily on environmental impacts and our relationship to the natural world as I perceive these issues to be less straightforward and less discussed so far. Still, before going into these more complex matters it is worth giving a very brief picture of debates surrounding cultured meat in animal activist circles.

The topic of cultured meat is highly contested among vegetarians/vegans and animal welfare advocates. In 2008 the organization PETA (People for the Ethical Treatment of Animals) offered a \$1 million prize for whoever could develop commercially available cultured meat first (PETA, 2014). Although the time limit for the contest expired, they donated the funds to research, an example of a major animal welfare organization putting their support towards the technology (PETA, 2014).

Other advocates worry that it promotes the idea that humans need or should consume animal flesh. Particularly because commercial viability and consumer acceptance are still quite

uncertain, some express skepticism about the potential of cultured meat to displace all meat quickly and worry that this “fantasy” of eating meat without harming animals will take resources and attention away from advocacy centered around reducing or eliminating meat (Taft, 2016). Advocates also point to the use of fetal bovine serum as a growth medium as unacceptable from an animal welfare standpoint. Fetal bovine serum is a by-product of animal agriculture where blood is extracted from a cow fetus after a pregnant cow is killed. Clearly any meat cultured in this medium still relies on the death of animals and the serum is prohibitively expensive at about \$500 a liter (Shapiro, 2018). Recently companies have developed plant-based or synthetic substitutes, but the details on this are still vague.

One of the primary reasons cultured meat is being developed is to lessen meat’s environmental impact, so it is especially important to inquire into these claims and address what to do in the face of large uncertainties. While many argue that this technology is simply more efficient industrial farming without the animal cruelty and environmental impact, there is still the need to evaluate these claims critically. I will briefly introduce some of the main ethical issues at hand I plan to discuss before going into them with more depth in the next chapter.

Animal agriculture contributes nearly a fifth of total greenhouse gases, so lowering that will be essential to mitigating climate change (FAO, 2006). Animal agriculture can be very resource intensive and inefficient in cases where crops are being grown to feed to animals when they could be used to feed humans. An initial study published by the American Chemical Association estimated that cultured meat would result in 7-45% lower energy use, 78-96% lower GHG emissions, 99% lower land use, and 2-96% lower water use depending on the product compared (Tuomisto and Teixeira de Mattos, 2011).

However, a 2015 study critiqued this, and found that by including the inputs needed to create the growth medium and the energy and resources it will take to sterilize the bioreactors between each batch, there is a chance that cultured meat may use much more energy and extra resources to achieve its goals (Mattick et al., 2015). However, there is high uncertainty in these estimates, with the range extending from half of the energy of industrial beef to nearly 3 times the energy of industrial beef (Mattick et al., 2015). The energy required is going to depend quite a lot on the method used to exercise the muscle tissue, what the media is made up of, and the energy requirements of the bioreactor facilities themselves.

The questioning of these estimates is important in light of cultured meat being presented as taking less of a toll on the environment. One of these environmental areas of concern is the emission of greenhouse gases (GHG) that contribute to climate change. If cultured meat is even more energy intensive than traditional animal agriculture, this puts into question how much better cultured meat would really be in terms of GHG emissions and total contribution to climate change. On the other hand, there is still potential that it might be significantly less, so it cannot be dismissed simply on the possibility that it might take up more energy.

The biggest environmental benefit connected to cultured meat is likely the potential for significantly less land use. Although there are some exceptions, in general much of the meat produced today comes from CAFOs, which largely source feed from industrial farming on viable land that could be used to directly grow plants for humans (Foer, 2009). Considering the many demands on land that can result in habitat fragmentation and degradation of the land and waterways, reevaluating what we dedicate land to is imperative. As the population grows and the demand for meat extremely likely to increase, undeveloped areas may come under even more pressure to be developed for human consumption. The 99% less land use estimate has been put

into question by the 2015 study, but the uncertainty surrounding that is much less dramatic than energy estimates. Considering all the materials that will likely be needed, its estimated at 20 times the previous study, or roughly 80% less land use than traditional meat (Mattick et al., 2015). There will still be land needed to grow sugar and other inputs for the growth medium, but this will be significantly less land than needed to raise feed for animals.

A related issue is sustainability with resource use considering a growing population and the rate of consumption of resources that has shot up in the past couple decades. With a rapid growth and urbanization occurring globally, reduction of scarce resources and achieving maximum efficiency in an ethical manner will be important. Of course, these efficiency gains cannot come at the cost of animal wellbeing or human wellbeing as they have in the past, but in a world with billions of people resources must be used effectively to fulfill the demand of both humans and the many other forms of life with whom we share this Earth.

Part of meeting this demand efficiency without overtaxing natural areas has to come from “decoupling,” or the process of untangling economic growth and consumption from negative environmental impact. Cultured meat roughly fits into this paradigm, seeking to fulfill the demand for meat with much less impact and ethical contestations. Decoupling is one of the main tenets of a group of thinkers called Ecomodernists. They believe such a process can be done and must be done in order for humans to live peacefully on the planet and preserve natural areas. In the next section, I plan to utilize the framework of ecomodernism in order to examine the ways in which cultured meat might address these ethical concerns. Since cultured meat primarily relies on technological innovation and efficiency to avoid environmental ills, the doctrine of ecomodernism will be helpful in situating it in the context of wider environmental debates about how to solve some of our deepest problems.

Chapter 2: Ecomodernism and the Uncertainties with Consequentialism

In light of all the hype and optimism surrounding the potential of cultured meat, it is important to try and get a sense of how cultured meat is going to live up to its lofty promises and what points of skepticism might be relevant to consider. In the last chapter, I touched on some major ethical points cultured meat hopes to address that mostly relate to what the estimated consequences might be. Most people are approaching the ethical issues at stake in cultured meat from a consequentialist point of view, evaluating how ethically desirable something is based solely on the outcomes it produces.

The most popular form of consequentialism is utilitarianism, or the principle of bringing about the most good for the greatest number of people (and potentially other lifeforms as well). This is far from the only approach to ethics, but it is certainly an important approach in environmentalism. This is the approach I will be using to look at cultured meat and explore why there are difficulties getting a clear utilitarian picture of cultured meat. In the next chapter I will address other ethical concerns relevant to cultured meat that are not dependent solely on the immediate consequences. I already introduced some skepticism about some of the initial predictions for the environmental benefits, but in this chapter I hope to take things a step further and to show how certain ideological standpoints impact how one views the predictions about cultured meat. I plan to utilize the framework of ecomodernism as opposed to other ideologies because it focuses primarily on technological solutions to environmentalism and I think cultured

meat is an excellent example of trying to address environmental issues predominantly through new technology.

When consequences can be predicted with high degrees of certainty, there is less room for ideology to shape interpretation of those predictions. However, a developing technology might involve high degrees of uncertainty about what the effects might be or what advances might come in the near future. In cases like these, ideology will play a bigger role in how one interprets the predictions. One's ideological stance can greatly affect one's confidence in certain predictions of consequences when there is uncertainty present. Therefore, even evaluating something on a purely consequential basis can often end up being tangled up in ideological stances.

The philosophy of ecomodernism provides some context for cultured meat as a kind of environmental problem-solving and examining this ideology can help to understand the potential consequences. If we wish to get a fuller picture of what the consequences of cultured meat might be, we must understand from what standpoint those who are making claims are coming from and how they view environmental problems. I am not suggesting that ideological positioning wholly determines what predictions one is likely to accept or see as reasonable. Even with a developing technology, predictions should be based on the best empirical data we currently have and any strong divergence from this should be discounted. Still, within those limits there is often a range of possibilities, some of which may seem more or less reasonable based on your understanding of the world and what you view is truly behind environmental problems. Understanding cultured meat through the lens of ecomodernism helps to bring to light how this ideology affects the confidence in which many advocates have in some of the loftier predictions.

Much of the philosophical work to date evaluates cultured meat on expected outcomes, mostly uncritically accepting the predictions about a technology that has not yet been scaled up or fully developed. One of the most prominent utilitarian philosophers, Peter Singer, wrote a short piece in the *Huffington Post* after the first lab-grown burger, praising the project and voicing his support of a technology that could alleviate animal suffering and environmental degradation (2013). He made a straightforward case for the technology on the grounds of significantly less animal suffering and the environmental benefits that would be positive for both people and animals. However, he uncritically accepts the predictions for this technology made by those with a vested interest in painting an optimistic picture of cultured meat.

If one is going to evaluate the ethical standing of a technology by consequences, they should have a comprehensive and critical picture of what the actual consequences might end up being. Especially with emerging commercial technologies that are hoping to attract wealthy investors, there are reasons why those promoting the technology might be trying to paint a much more optimistic picture than what actually exists. This process might not even be a conscious intention to hide some of the uncertainties while singing the praises of the technology, because certain perspectives of the world and of technology are going to influence how “pragmatic” something appears.

In order to better understand how cultured meat fits into larger trends in environmentalism, it is helpful to examine the school of thought that is ecomodernism, sometimes referred to as ecopragmatism. One of the major centers promoting ecomodernism is the Breakthrough Institute, a “global research center that identifies and promotes technological solutions to environmental and human development challenges” (Breakthrough Institute, 2018).

The founders published the impactful paper “The Death of Environmentalism” in 2004, calling for environmentalism to move beyond being a single “special interest” about protecting nature out there rather than sustainability policies that address societal issues in conjunction with environmental ones. Shellenberger and Nordhaus founded the Breakthrough Institute around the same time, creating a hub from which to develop and promote this new brand of environmentalism they believed to be moving environmental goals forward and creating a positive vision of the future. ²

The school of thought of ecomodernism includes many different voices, but they tend to converge around some central principles, some of which are very similar to other environmental ideologies and others that seem quite opposed to tenets of traditional environmental thought. These central values are best articulated in a document called the *Ecomodernist Manifesto*, compiled by many thinkers to give a clear picture of what ecomodernists believe and why (Asafu-Adjaye et al., 2015). They embrace the idea that we are currently living in the Anthropocene, or an era where humans have become the most prominent geological force, affecting nearly all of the Earth’s systems and their composition to a great degree.

In this vein, they do not believe that nature in some pristine, untouched form exists, but rather that humans have a large hand in shaping the environment. They should direct this power towards making a good Anthropocene rather than viewing human influence in the world as fundamentally corrupting (Asafu-Adjaye et al., 2015). They push back against more “old school” environmentalism focused on pristine wilderness that tends to think of human interference as ruining pristine nature even if the intentions are good (Marris, 2017).

² Currently in 2018, Shellenberger is running for governor of California, selling himself as someone who will stand up for both nature and people (Shellenberger 2018)

One of the biggest tenets of ecomodernism is the belief that improved technology and intensification of technological processes can lead to better ecological outcomes while delivering the same or improved services to humanity. They believe “Modern technologies, by using natural ecosystem flows and services more efficiently, offer a real chance of reducing the totality of human impacts on the biosphere” (Asafu-Adjaye et al. 2015, p. 17). This aligns well with claims by advocates of cultured meat who talk about how much more efficient this will be than traditional agriculture. While they acknowledge the vast ecological destruction that has occurred in our modern technological era, they believe that through ingenuity, technologies can be made less damaging and much more efficient in order to meet the demands of a large human population (Asafu-Adjaye et al., 2015). Their emphasis then is on technological innovation rather than any radical reworking of society and our daily lives. Economic growth can coincide with improved environmental outcomes and modern development of third-world countries since “ecomodernists advocate technological advancement as the best means toward a triple win of climate mitigation, international development, and global economic growth” (Isenhour, 2016).

They believe modern industrial society has helped to bring about goods like women’s rights, longer lifespans, and more food security for much of the world (Pinker, 2018). Pinker is a psychology professor at Harvard who is involved with the Breakthrough Institute and argues for the need for enlightenment ideals against what he perceives to be a sort of self-defeating pessimism about modernism and progress present in environmental circles. Pinker frames the problem by saying “the trade-off that pits human well-being against environmental damage can be renegotiated by technology. How to enjoy more calories, lumens, BTUs, bits, and miles with less pollution and land is itself a technological problem, and one that the world is increasingly solving” (Pinker, 2018). This is quite a large claim, and there is a difference between the claim

that new technologies can help environmental issues and the claim that that environmental issues are at their core *technological* problems that can and will be solved primarily through technological innovation. The problem of humans not caring enough about nonhuman lives, for example, is likely not going to be solved by technology alone.

As Shellenberger and Nordhaus stated in their flagship paper “The Death of Environmentalism”, “Solutions depend on how we structure the problem” (2004). Hence, if the problem is framed in terms of simply a lack of better technology, the solution is obviously going to focus only on that innovative technology instead of other factors at play that might be important. Ecomodernism frames our current environmental crisis in terms of the need for more efficient and less ecologically damaging technology. Due to this framing, they are likely to see something like cultured meat as *the* solution, rather than one possible part in helping to combat the ills of CAFOs. A different framing could still include cultured meat as a part of solving the problem, but it would acknowledge other contextual factors. For example, if the problem is put forth in terms of the culture of excessive meat-eating that has developed over the last couple of decades in the United States, then the solution would involve a cultural shift to a more plant-based diet. This wouldn’t exclude cultured meat as potentially helpful, but it wouldn’t rely solely on this technology as the solution to a relatively complicated problem.

While they attempt to distance themselves from laissez-faire capitalism, in general ecomodernism aims to work within the current system of capitalism and modernization. One of the hallmarks of modern capitalist society is the focus on efficiency or creating more with less waste and resources. It is the battle cry of modernism and one of the driving principles behind much of industrial society. There is an incredible focus on efficiency as the solution to energy and resource issues, believing efficiency gains will be a primary driver of well-being and less

ecological destruction. Although few would argue against efficiency as generally a good practice, the logic of efficiency must be put in context. What might be sacrificed in the pursuit of efficiency and who exactly is reaping the benefits of that increased efficiency?

Efficiency in and of itself is not necessarily good, at least not in a moral sense. Efficiency simply means the process of utilizing resources in a way that maximizes outputs while minimizing inputs and reducing waste and time needed as much as possible. What is needed to increase a certain yield per energy/resource input might have unforeseen consequences. The relative benefit of increased efficiency must be measured by looking at the full context. For example, there have been many efficiency gains with machinery and advanced technology in fields such as manufacturing. However, these gains have more often than not harmed workers, creating less of a need for human labor and putting many people out of jobs. Therefore, it must always be asked who exactly is actually benefiting from efficiency gains and who or what might be bearing the costs of these gains.

Some ecomodernists, for example, advocate for CAFOs over small, free-range animal agriculture due to this being supposedly more efficient with limited resources (Swain et al., 2018). Even if industrial animal agriculture is more efficient than small-scale, there are serious ethical concerns with animal welfare and the other ills of this type of practice such as pollution from giant piles of manure. This “efficient” practice is largely considered morally abhorrent for these reasons, so it seems undesirable to advocate for a practice many other environmentalists are scrambling to do away with. Defending cultured meat purely on the grounds that it will be vastly more efficient does not address the full scope of moral issues, as efficiency in no way guarantees that there will be good ethical consequences resulting from these efficiency gains.

Ecomodernism largely grows out of Enlightenment ideals that focus on humanism, science, and a linear notion of progress where society is constantly getting better and more advanced (Isenhour, 2016). Ecomodernists resist the idea that pre-industrial humans lived in some kind of perfect harmony with nature, claiming that there were significant effects on the environment from early humans. In the manifesto, they argue that “a population of no more than one or two million North Americans hunted most of the continent’s large mammals into extinction in the late Pleistocene, while burning and clearing forests across the continent in the process” (Asafu-Adjaye et al., 2015, p. 16). The impacts of earlier humans are coming to light with more recent research, and the ecomodernists maintain that the reason early humans were not even more destructive was because of their relatively small populations.

They cite multiple examples of humans overcoming “natural” or predicted limits such as overpopulation issues and threats of mass starvation in the 60s-70s (Pinker, 2018). How these supposedly “natural” limits are overcome is through a process called decoupling. The ecomodernists believe that “Intensifying many human activities-particularly farming, energy extraction, forestry, and settlement-so that they use less land and interfere less with the natural world is the key to decoupling human development from environmental impacts” (Asafu-Adjaye et al. 2015, p. 7). The point of decoupling is to develop technology that allows humans to flourish while greatly mitigating their effects on the environment. This would allow continued economic growth and affluence within human society while lessening environmental impacts. Cultured meat is a clear example of decoupling since it attempts to employ technology to produce the same vast amounts of meat with significantly less environmental damage.

The problem inherent in over-promising the benefits of a technological fix can be illustrated by a parallel that can be drawn between cultured meat and the efforts to implement

carbon capture and storage (CCS) within the last 10 years. I bring up CCS because Hamilton, when comparing CCS to climate engineering, argues that CCS created a moral hazard where the promise of the technology close at hand led to less action or care for mitigating climate change. I think cultured meat runs a similar risk of introducing a moral hazard. CCS aims to greatly reduce or eliminate carbon emissions at the source by utilizing technology to capture carbon as it is emitted from power plants and securely store it deep underground, effectively offsetting at least the carbon that comes from fossil fuels (Hamilton, 2011). This is an attempt at utilizing technology to achieve de-coupling of carbon emissions from the economic development that comes from burning fossil fuels. Billions of dollars of public funding followed the excitement over the potential to not change our energy system drastically but still mitigate climate change (Hamilton, 2011).

Only two or three years later, the promise of carbon capture started to crumble as most major projects were severely delayed or abandoned due to cost and technological infeasibility (Hamilton, 2011). Even now, a little less than ten years later, carbon capture continues to not live up to its promises, with the flagship Mississippi CCS project declaring in 2017 that it was being abandoned because CCS proved too costly and riddled with problems (Condliffe, 2017).

Although it is still in development and might yet produce some results, it is hard to argue at this point that all the research and funding poured into CCS has been helpful in reducing emissions and it is likely it even took away resources from other alternative energy projects that could have actually been implemented.

This raises the issue that the promise of cultured meat will create a moral hazard where people become less concerned about the issues with current animal agriculture because of the promise of an “easier” technological solution just around the corner. Already there are headlines

like “Clean Meat, Via Lab, Is On The Way” and “Lab-Grown Beef will Save the Planet-and be a Billion-Dollar Business” (Burningham, 2016; King, 2018). It might serve to take away the sense of urgency needed in activism regarding animal agriculture. If there keep being promises of cheap cultured meat right around the corner, this will make people more likely to just wait it out and not change their habits. It is difficult to get people to reduce their meat consumption, and the promise of an easy fix on the way for all the environmental ills and animal welfare issues of meat is almost certainly going to deter people from sacrificing meat currently.

It is quite unclear at this point whether cultured meat will suffer the same fate as carbon capture. Still, the story of carbon capture provides a good warning against relying heavily on technology that does not yet exist at a reasonable cost. An orientation towards technology as the solution to environmental problems made people more likely to be hopeful about the predictions of CCS. It goes to show how much more uncertainty there is in these kind of projects, and how often that uncertainty is downplayed to secure funding and promote a certain technology as the solution.

Cultured meat clearly fits into the ecomodernist paradigm of developing innovative technology that is assumed to use resources much more efficiently in order to reach environmental goals and is promoted by at least some from the movement. A prominent ecomodernist, Emma Marris, references it in her piece on interwoven decoupling, stating “I am becoming more and more convinced that most meat animal production should be eliminated in favor of factories that produce cell-culture ‘lab-meat’” (Marris, 2017). She defends this view rather than eliminating or greatly reducing meat consumption by saying “sacrifice has proved to be an ineffective environmental tool...the smarter move is always the make the environmentally superior choice the cheap and easy choice. Lab meat can do that.” (Marris, 2017). Lab meat is

also mentioned in some speculative articles about the future of meat featured on the Breakthrough Institute website.

I think Marris makes an excellent point about the need to not simply demand great sacrifice from individuals. It might be better to interweave environmental responsibility into the fabric of everyday life by making it the obvious choice. I think this is perhaps one of the reasons why there hasn't been major success voluntarily lowering meat consumption. In a culture where the standard is not environmentally-friendly and where it is actually difficult and requires at least a perceived sacrifice, most will follow the current of society. The point is that the conditions (whether socially, financially, or physically) that make the environmentally conscious choice the easy choice need to be put in place to achieve maximum participation.

Many countries in Europe can attest to the success of a cultural or structural shift that makes doing the environmental-friendly thing the norm. A journalist named Elisabeth Rosenthal speaks to this phenomenon, saying “low-carbon footprints depend on the infrastructure of life, and in that sense Europeans have an immediate advantage” (2009). After living in Europe for a few years, she concludes that due to the limited space and cultural norms, it is significantly easier to have a lower impact life than in America. The key lesson to take is that this lower impact life is the norm or has become the norm, so it does not feel like a sacrifice for people in France to live in smaller spaces and without air conditioning (Rosenthal, 2009).

While Marris may be right that sacrifice is not an effective environmental tool, the unquestioned leap comes in when we say the best way to solve this problem is through the specific technology of cultured meat rather than other changes that would also make it easier for people's food to have less impact. There are countries like India where vegetarianism is a fairly big part of culture, and it is certainly not impossible to imagine lower meat consumption

becoming the norm through social pressure and availability of good plant-based food. This again relates to the framing of the problem primarily in technological terms, rather than a wider context that incorporates technological solutions as potentially helpful.

Claims of successful decoupling have been put into question by other environmental thinkers. While there's certainly cases, such as Sweden and Germany of fewer resources and less energy used due to technology, these analyses often ignore how the environmental burden in some cases is often simply shifted to other countries (Isenhour, 2016). When the ecological footprint of all that goes into these processes including the ecological cost of the imports needed to make such a thing happen, it almost entirely cancels out the benefit of some of these efficiencies for energy or food (Isenhour, 2016). This is not the case with all improvements in efficiency in Europe, but a significant amount of efficiency increases utilizing more advanced technologies cause more environmental issues elsewhere. If technologies are simply dumping the environmental burdens on other countries, this is clearly an unsustainable system that depends on environmental exploitation of mostly developing nations so developed nations can have the environmental burden out of sight. The burden still exists, and due to the transnational nature of many environmental problems, such as climate change and ocean acidification, these will still affect the developed nations negatively.

Cultured meat is going to require plenty of resources to build and maintain the facilities and feed the cell cultures themselves. In order to keep costs down, much of these resources will likely come from developing countries. That means much of the environmental burden of manufacturing will simply be shifted out of sight to developing nations. The United States will no longer have the ugliness and pollution from CAFOS, but the pollution and raw resource extraction might still be happening elsewhere. This environmental burden may well be less than

the environmental burden of CAFOS, and this is certainly an important point. The real danger in such things is if people do not acknowledge or recognize those trade-offs and pretend that the environmental burden has almost entirely disappeared due to the genius of technology. All physical actions in the world have environmental consequences, so we have to be explicit and clear about which of those consequences are acceptable and which are unacceptable rather than pretending we can transcend all environmental consequences.

Another problem with the stories of successful decoupling is that commonly efficiency gains lead to a sort of “rebound effect” called the Jevons paradox where they end up driving more consumption and energy use (Dumont et al., 2012). Although improved technologies in developed nations have led to some impressive efficiency gains, much of this has been offset by increased consumption and energy use (Isenhour, 2016). The reason proposed for this is that the gains in efficiency are then reinvested to increase production. Instead of simply reducing material use and energy, those gains are then seen as opportunities to reinvest those resources elsewhere in order to drive consumption and increased profits. While this is not an inevitable outcome, it draws attention to how efficiency gains must be met with a commitment to not increasing (or preferably decreasing) consumption. The main message seems to be efficiency gains alone are not enough to truly address our ecological issues without considering what the hidden cost of those gains might be and stemming consumption for offsetting the gains.

In this case, it is not hard to see how the potential efficiency gains made with cultured meat might be partly offset by encouraging and increasing consumption of meat. Even at the best estimates, cultured meat will still be more impactful than plants alone, and hence many people switching from industrial meat to cultured meat wouldn't be as desirable as switching to a largely plant-based diet. Meat consumption projections worldwide are extremely high, and if this

technology is successfully implemented, it would likely encourage people to continue or increase their current meat intake since it will supposedly no longer involve the guilt of animal cruelty or environmental degradation.

There's a lot to question in the simple story of decoupling, but even those at the Breakthrough Institute acknowledge the problems with the rebound effect and how this must be countered in order for efficiency gains to mean something. None of this completely undermines the role of better technology helping to secure a more sustainable future, but it does demand we do not give in to simple stories about the inevitable march of technological progress and look critically at when and how technology will be useful in making life better for all beings on Earth. This includes evaluating how specific kinds of technology may help or hinder those goals, as there seems to be a significant difference between inscrutable bioreactors and a stronger kind of plow.

The projections regarding the potential greenhouse gas emissions reductions perhaps embody some of the most uncertainty, largely stemming from high uncertainty about energy demands. As I mentioned in chapter one, initial rosy estimates of less energy demand have been challenged. While the initial 2011 study estimated 7-45% lower energy use, a 2015 study put energy use anywhere from half of what industrial beef currently uses to nearly three times what industrial beef uses today (Tuomisto and Teixeira de Mattos, 2011; Mattick et al., 2015). Although it is hard to tell at this point before the technology is scaled up, it is certainly true that to a certain extent culturing stem cells is going to be an energy intensive process requiring stable temperatures, mechanical exercising of tissue, and sterilization of the environment to avoid contamination (Mattick et al., 2015). This makes sense, as essentially cultured meat is replacing these biological functions that produce meat with mechanical ones. Although it is obviously a

reductive way to look at the process of raising an animal, one can view it as the animal's body providing certain conditions to the meat cells to achieve the end product. You still need energy for these processes, it will just come from electricity rather than the energy stored in the animal's body.

With this skepticism in mind, it seems the potential of cultured meat to produce less greenhouse gases will be more modest than originally proposed, with the potential that it could even equal or exceed industrial farming's greenhouse gas output. One important point is that while there is still a lot of energy needed, they are raising only the "desirable" parts of an animal at a much faster pace than an animal can be brought up to slaughter weight. It's reasonable that this could make the process efficient enough to make up for the energy used in replicating biological processes so that cultured meat could still be a better option. However, we must be careful of simply "shifting" the burden of energy to another sector so that it is not as apparent.

This also makes the potential of cultured meat to lower greenhouse gas emissions tied to renewable energy. Even if cultured meat was more energy-intensive than industrial agriculture, if renewable energy rapidly scaled up in a similar time period, then total greenhouse gas emissions would be greatly lessened. As of 2016, renewable energy makes up about 10% of total U.S. energy consumption and roughly 15% of U.S. electricity generation (Energy Information Administration, 2017). If renewable energy is required to make the greenhouse gas emissions of cultured meat significantly lower than industrial farming, this adds further uncertainty regarding the feasibility of the task. It would be possible for cultured meat factories to pledge to run exclusively on renewable energy, but this would be restrictive and potentially more expensive than relying on fossil fuels.

The estimates regarding less land use tend to hold up better under criticism, but there are still some worries that the 99% less land use estimate is too extreme. The estimates for less land use come from the fact that huge tracts of land are dedicated to growing feed for animals. It takes significantly more resources and land to produce a single unit of meat protein than a single unit of plant protein (Hertwich, 2010). Due to the relative efficiency of cultured meat compared to industrial meat, advocates claim that barely any land will need to be used at all. Though they are certainly right that cultured meat is likely to use quite a bit less land than current practices, it is unlikely its footprint would be virtually zero. More conservative estimates place it more around 80%, which is still an enormous reduction (Mattick et al., 2015). Land will still be needed to grow sugar and nutrients to feed the cells, along with whatever plant material is needed for a synthetic growth medium (Agapakis, 2014).

Ecomodernists commonly propose that intensification of technological processes will leave more land that can be left to “nature.” The idea of what exactly nature is continues to be a highly contested and fruitful debate in environmental circles, but here the ecomodernists seem to roughly be referring to places without excessive human development and potentially even minimal human habitation. While this is certainly a possibility, there is little said about the actual process of governments or organizations acquiring the land that would be out of use and making it some kind of protected area or working landscape. If the plan is to restore these previously agricultural lands to prior habitat, the cost of completing even a fraction of the work would likely be astronomical. Those spaces might be abandoned, they might be developed, they might end up as highly-managed natural spaces. While more room for “nature” is certainly possible, there are quite a lot of steps between that land not being used as farmland and it becoming habitat for all kinds of creatures.

There are also significant ethical issues in how to most effectively to use resources to meet the needs of a growing population. As more countries engage in industrialization and gain affluence, the demand for resources typically skyrockets and there's evidence to suggest this demand levels off after a while; Some think we have reached this point in the United States of "peak stuff" where we are unlikely to expand resource use greatly (Asafu-Adjaye et al., 2015). This does not seem especially reassuring when the excess consumption and resource of the United States and countries like it is a major cause of environmental degradation that is at the very least just as impactful as rising populations in developing countries. Encouraging increased consumption when the resources of the world are already strained seems like a risky bet if technological innovation does not deliver its promises. If we continue on the path of increased consumption and the majority of the environmental ills are not solved by technology, we will be in a much worse place. If we work to decrease consumption and those technologies do in fact greatly help to produce products with much less input and environmental damage, we will be no worse off.

It is likely that if cultured meat replaces a decent portion of the meat industry, then many animal agriculture jobs will be lost. As with many technological innovations, there will be new jobs created but overall it is likely to be a significant net loss due to heightened efficiency (Shapiro, 2018). This does not have to inherently be a bad thing; perhaps those in the industry will be able to secure other jobs that pay decently. However, more often we've seen that the workers of these industries like coal mining and steel manufacturing live in towns that are built upon a certain kind of economy and have a lot of trouble transitioning. This often results in a lack of decent jobs and many of the young people looking elsewhere for opportunity.

It is clear that the kind of perception of the world that ecomodernism presents influences how one interprets the potential of certain technologies and even how they interpret the uncertainty surrounding it. On the other hand, those who are harsh critics of ecomodernism have a certain orientation to the world that causes them to view certain kinds of technologies with suspicion. If they are firmly convinced that capitalism and industrialization are at the heart of our ecological problems, it is reasonable that any solution proposed in those frameworks will be rejected. While this kind of radical criticism certainly contributes something quite valuable to the movement, it still might block people off from even considering the usefulness of certain technologies. Large-scale rejection of much of modern technology can be as untenable as uncritically embracing new technologies. Whenever any solution is proposed to a large-scale issue such as industrial farming, one must look for how the problem was structured.

In the case of cultured meat, those ethical dimensions that are not directly tied to immediate consequences have largely been ignored. An ethics that considers nothing but the consequences is often shallow and fails to touch on the full picture of our ethical lives. Even if something had potential good consequences, if it diminished our lives or the world in some other manner we might still have ethical grounds to reject it. Although everything may in some sense be viewed as a consequence, I am referring to the division in philosophy between ethics that are based more on immediate, tangible consequences and ethics that incorporates issues beyond that such as long-term relationships or a person's character. As we move forward with increasingly complex technologies, we must seek to evaluate these technologies not just solely on their potential consequences but also how they might affect our relationship to the nonhuman world.

Chapter 3: Controlling Biology

The last chapter focused primarily on consequentialist ethics and how evaluating cultured meat primarily from that perspective required a wider understanding of context and ideology. In this final chapter, I want to touch on ethical issues that have been largely unexplored in conversations of cultured meat that are too focused on the more immediate consequences. I believe that these issues extend beyond the common conception of consequentialism because it goes beyond the immediate and direct consequences and takes a wider picture of what happens to us as people and our relationships. I wish to address the “unnaturalness” concern with cultured meat, and how it may point towards something that is genuinely troubling, that is, how we continue to distance ourselves from the nonhuman world until it becomes a relationship of abstractness. I also want to explore how cultured meat continues the logic of industrialization and the implications of this for our connection to food and how understandable our food system is to the average person. I concur with Galusky’s analysis that cultured meat expresses a desire for ever greater control over the natural world, and dive into some issues this presents for a technology allegedly dedicated to environmentalism.

By far the most common objection to cultured meat seems to be that there is something unnatural about it, and in evaluating public comments on articles pertaining to the topic the worry about unnaturalness is common (Laestadius and Caldwell, 2015). Prominent food activists, such as Marion Nestle and scientists such as Michael Hansen from the Consumer's Union, claim that cultured meat goes against the current trend towards natural foods and will likely be unsuccessful because of this. In some surveys there has been found what is referred to as a "yuck" factor by some participants who are hesitant to embrace cultured meat that is tied to this idea of unnaturalness or an overly technical approach to food (Laestadius and Caldwell, 2015). In response to this, advocates of cultured meat rightly point out that the majority of our food is produced in labs first and involves many ingredients and processes we might consider "unnatural" (Shapiro, 2018).

If we are operating under the typical definition of natural, then current industrial meat would likely be considered unnatural. The word "natural" has a complicated history, but it is typically used to mean that something that is derived from nature instead of made or heavily influenced by humans. In her breakdown of the word naturalness, Siipi talks about one of the categories of naturalness being history-based (2008). I think this is the most relevant idea of naturalness to conservation, as it deals with how something was created and to what degree there was human intervention along the way.

Despite the human involvement, some might consider traditional farming more natural in this sense because those animals are considered a part of nature and the processes of growing meat is due to biological processes that humans did not create or manipulate greatly (Siipi, 2008). What is complicated even in that example is how much humans have influenced those animals and their processes through things like selective breeding, making them less natural than

a wild animal. This human control over animal bodies goes to a new level when it comes to modern industrial farming, and many have argued that this system is unnatural (Shapiro, 2018). There is a huge degree of human interference to control the animals and their biological processes as much as possible, to the extent that it seems that industrial farming cannot be considered natural in any meaningful sense.

Given this, those who argue cultured meat is unnatural may be correct in pointing out the high degree of human control and interference, but it does not appear to be significantly more unnatural than the current practices of industrial farming that accounts for the vast majority of our meat. In creating cultured meat, the biological processes are carefully controlled and directed by human intelligence and machinery. The animal is only needed at the very first stage for cell extraction, after that it is unnecessary for the rest of the process. Cultured meat might appear more unnatural in some ways than industrial meat because of a higher degree of human control but considering the incredible amount of human manipulation already present in industrial farming, cultured meat does not appear significantly more unnatural. This tendency to regard cultured meat as unnatural while not considering industrial meat unnatural is usually an unwillingness to recognize the amount of human manipulation present today in our animal agriculture. However, even though it still starts with cells from a living organism, the final product does not come from a living creature the way traditional meat does. So, there is a sense in which this meat is being produced in a way that does radically depart from how all meat has been produced up until now, that is, inside an animal.

I think drawing attention to the “unnaturalness” present in much of our food system is helpful, but it does not go far enough. In his book *Thinking Like a Mall*, Vogel takes up this very issue of how the categories of natural and unnatural do not stand up well under scrutiny and

actually do not serve us well in pursuit of environmental goals. I think this analysis helps to clarify some of the issues with maintaining a strict binary between nature and society. If by “natural,” we mean that which is not touched or influenced by humans, then it is clear there is nothing that fits that definition in the era of climate change (Vogel, 2015). This is a point made back in 1989 by Bill McKibben in his book *End of Nature*, but Vogel takes issue with this story of nature being destroyed by any human influence. If nature is defined as the nonhuman and separate from humans, it sets up a strange ontological dualism where “What ends nature is nothing other than the human touch, a touch that, rather Midas-like, has the uncanny ability to transform the natural into something outside of nature” (Vogel, 2015, p. 11). The concept of nature as something completely untouched and separate from humans cannot be maintained when humans are biological creatures who must interact with “natural” entities to survive. Humans are not able to transcend the physical world in a way where whatever they involve themselves in takes on a whole different character of unnaturalness.

Since the premise of something being unnatural seems to rely on an artificial separation between humans and the rest of nature that can't be maintained, Vogel thinks it is an unhelpful distinction that is often morally charged and used to further whatever the speaker's goals are. He states:

The human species and its behaviors presumably evolved through the same sorts of biological processes as other species, and those processes were presumably mediated by the same sorts of chemical and physical forces. If this is so, it is unclear why the consequences of those behaviors deserve to be called “unnatural.” If humans are natural, then their burning of fossil fuels, or their use of chlorofluorocarbons, would seem to be natural too, hard to distinguish in terms of naturalness (though doubtless more

consequential for the environment) from the activities that other organisms engage in.
(Vogel, 2015, p. 11)

Under this rather strict definition of naturalness, Vogel is correct in asserting that all human activities might be considered natural by virtue of humans being biological creatures that came about from evolutionary processes. In the context of environmentalism and wider society, naturalness is often thought to be a good in itself, and preferable to the “artificial” that is produced by human beings (Siipi, 2008).

While Vogel addresses the troubling obsession with pristine, presumably untouched wilderness and naturalness, I do not think he takes on some of the better, more measured reasoning for what we might call naturalness or what values might be at play besides simply stating the natural as inherently good. Vogel largely presents a binary of naturalness and unnaturalness, and while certainly this kind of binary thinking has an influence in environmental thinking, many advocates speak more about degrees of human intervention and control being significant.

In response to the notion that humans have ruined all the naturalness on earth, Ned Hettinger claims:

Unless one ignores a central point maintained by defenders of the natural--that naturalness comes in degrees--and accepts the discredited notion that in order for something to be natural it must be absolutely pristine, then dimensions of nature can be natural (that is, relatively autonomous from humans) and can be valued as such even when they have been significantly influenced by humans. (2014, p. 178)

This clears up how something like traditional animal agriculture could be more natural than the current form of industrial agriculture. Still, this does not establish exactly what is troubling about

an “unnatural” food system, or why we should strive to have a more natural one. Naturalness has been co-opted for many different purposes and to support some troubling positions on relatively shaky ground, such as the common assertion that homosexuality is unnatural. The word unnatural carries quite a bit of baggage with it, so it might be more helpful to talk in terms of degrees of humans asserting control over the nonhuman world and how this affects that relationship to other entities.

In order to talk properly about control, we need to establish the kind of industrial context cultured meat arises in and how control is a part of this logic.³ Cultured meat attempts to solve many of the problems associated with industrial meat by furthering that industrial logic to its conclusion. In this context, “technology...serves as the source of disaster and the promise of progress” (Galusky, 2014, p. 932). The industrial technologies that made CAFOs possible are often considered the source of our crisis in current animal agriculture, and yet those industrial technologies when improved promise a way out of the very problems that they created. Galusky further claims that “This is the contemporary condition--looking to technology to solve problems wrought by technology” (2014, p. 932). That means even if the supposed “problems” are fixed, we have taken a step deeper into the kind of logic that is often thought about as causing much of our modern environmental issues.

The logic of industrial agriculture is to maximize desired output (i.e. protein or calories) while minimizing costs through greater efficiency. When this is applied to living animals, it results in the current inhumane system where animals have been bred to maximize edible meat to the detriment of their own health, often kept in cages and overfed antibiotics. The animal body is

³ There are different notions of control when it comes to humans and the rest of the world. The type I am primarily talking about in this paper is what might be called engineering control, which is carried out by a small group actively working on these endeavors and operates at the scientific level. This differs from consumer control where the general public is engaging to different degrees with the world at large.

to the greatest extent possible bent to human purposes, but there is a limit to this bending in addition to all the negative consequences that result from this control over animal bodies. This control is taken to its a logical conclusion in cultured meat, where instead of reducing an animal to a protein machine there is “Just a protein machine, without the animal” (Galusky, 2014, p. 932). The animal, in any real ontological sense, disappears. It fades into the background, its body now perfected by humans for human consumption so that the actual animal is no longer relevant or even in the picture. Cultured meat represents “a move from the factory to the laboratory that strives to remove the animal (and the affiliated systems and processes) from the equation” (Galusky, 2014, p. 932).

The aim of industrialization is to “modify the problems out of the body” (Galusky, 2014, p. 936) and in cultured meat this takes the form of leaving behind the body itself. The “problem” is really any features that do not promote maximum efficiency and economics for human use of meat. Our perception of what the problems are depends on how we are seeing animals, and if we are seeing them only as meat factories then many of their typical biological functions will appear as problems. The animal itself becomes the problem, its (somewhat) autonomous existence as a separate kind of biological being with its own desires gets in the way of producing meat as efficiently as possible. But an animal body is not just a meat factory, it exists for its own sake with all the “inefficiencies” of living a life.

No matter how much selective breeding and even potential genetic modification is done, a chicken is still at base a biological organism that has many parts adapted for living out its own life and purposes. If humans are only interested in using certain cuts of meat inside a chicken, then the rest of what makes that functioning body possible is considered useless after it has contributed to the production of meat. Organs, beaks, eyes and all the like might be considered

useless to humans and therefore under this reductionist model it would be preferable to produce only what is of direct use to humans without the rest of the animal body.

Making meat that was never an animal in the first place leaves behind the question of the human's relation to animals. Meat is finally fully cleaved from the animal, that distancing that first started with industrial farming reaches its conclusion. Meat and animals truly become separate things. Meat becomes an unproblematic food source that is produced by experts in modern, advanced ways while animals exist elsewhere. In order to address worries about hurting a sentient being, this process only engages the sentient being for a minimally invasive biopsy. This is one of the appeals of cultured meat, that all our ethical questions regarding how to treat animals and whether it is right to kill animals for food are seemingly solved. Out of concern for the animals, the relationship to the farm animal disappears, reduced to a more abstract idea that sentient beings are no longer suffering for this meat. Despite perhaps abstracting this relationship, it is hard to deny the appeal of not putting animals through inhumane conditions or killing them. It appeals to many people's desire to not cause harm to animals, and this seems to be one of the biggest ethical draws of cultured meat. But even if it has these desirable consequences, it still obscures a tangible relationship to animals.

This continuation of industrial logic sweeps to the side questions about our relation to animals and the role of industrialization and the current capitalist system in environmentalism. In the talk about cultured meat:

The ethical questions surrounding eating meat are not so much engaged as eliminated.

People are not asked to confront the ethics of eating meat-whether in the basic question of killing animals, or in the technologically mediated question of the human, animal, and

ecological stresses exacerbated by industrialized systems and capitalist logics. (Galusky, 2014, p. 937)

I want to focus on that last question, of how cultured meat specifically addresses or fails to address the issues of humanity's relationship to the nonhuman world. I think looking at cultured meat through the paradigm of control illuminates an important aspect of this question.

One way to view cultured meat is as a significant step in asserting human control over biological processes and other life. This is in the context of humans increasingly asserting this kind of engineering control, but cultured meat is significant in its degree and how that control is being enacted. Unlike with previous industrial farming, cultured meat involves abstracting the biological processes that create meat in an animal body and replicating them via technology and human intelligence in the lab. All the complex processes that contribute to an animal developing its flesh in a certain way are taken outside the body itself to be perfected and more in line with human desire. Though the use of new technologies like stem cells, humans can exert more control than ever before over meat, and in ways that couldn't have been previously possible such as adding in different types of fats. By taking control of the process of meat from the cellular level and controlling all the variables along the way, human control becomes even more profound.

Why is humanity's attempt at ever increasing control of biological and environmental processes concerning? One response may be that humans have overestimated their knowledge in the past, and that this hubris has led to disastrous unanticipated consequences. Therefore, it is highly likely that our knowledge of the world and how it works is still incomplete, and if we assume it is complete when it is not, there will be ill effects that were not intended. In trying harder to assert our intentions on the world, we are faced with how our intentions are never

translated perfectly into reality. Even with a very high degree of knowledge, we can't control the world like some digital simulation we are running where we have total control over all the parameters.

I think the problem goes deeper than simply not having enough knowledge, and I think that has to do with what Vogel calls "the gap." The issue is not that we do not have enough knowledge to enact our intentions in the world, but that by virtue of living in a physical world we do not write the rules for, there is always a gap between our intentions and the results of our actions (Vogel 2015). Vogel states that "There is a gap, in the construction of every artifact, between the intention with which the builder acts and the consequences of her acts, a gap that is ineliminable and indeed constitutive of what it is to construct something" (2015, p. 113). Artifact is used here to mean something that has been infused with a human purpose. This gap is not closable, it exists by virtue of humans being biological creatures in the world and hence is there in every action humans do. Any kind of total control of manipulation of biological processes is therefore an illusion and ignores the reality that even if somehow our knowledge was perfect, we still couldn't achieve what might be considered total control in terms of our intentions matching our consequences exactly.

Galusky is concerned that our increasing attempts to exert control over the natural world will make us less tolerant of failure, by which I believe he means our impatience when our intentions do not match the results of our actions (2014). Galusky states "Historically, we know that our knowledge systems have been, and continue to be, incomplete. So, in a world where failure is likely, what happens when we need it to be impossible? Failure has no place here" (2014, p. 944). Our knowledge of the world has improved a great deal but there is still so much about the complicated processes of biology that we do not have a firm grasp on. Even if our

knowledge systems could be perfect, this still wouldn't allow for us to completely control the consequences of our actions in the world.

If there is always a “gap” between our intentions and the consequences, how are we to understand an intolerance of failure if that failure is inevitable? The intolerance of failure is because we are taking on the responsibility for a variety of complicated biological processes and in order to make the desired product our intentions need to be closely mapped to reality. Even in highly monitored, sterile bioreactors there are things we cannot control. We can't completely eliminate the possibility of contamination at one of the stages of production or cell cultures acting in ways that were not anticipated that impede the making of the product.

Since we are taking on responsibility for such processes fully, failure can be more catastrophic because of the higher degree of control. Failure becomes worse in some sense because we are trying to micromanage every part of the process, and thus we expect biological processes to conform to our will. Failure being more catastrophic is not just about unintended consequences being worse, but about how in this context humans take a step further into trying to assert human intention deeply into the world. This creates an orientation to the world where one views biological processes as tools in creating a desired product and thus becomes more intolerant when those processes do not conform fully to your will. When every stage is carried out with precision, there is less acceptance for the “gap” and less tolerance for the world not conforming to human desire.

There's an urgency to getting cultured meat on the commercial market, with companies like Just hoping to get products on the shelves as soon as late 2018 and Memphis Meats hoping to achieve that goal by 2021 (Shaprio 2018). While this urgency is understandable considering

the ongoing degradation wrought by current industrial animal agriculture, it is doubtful that researchers have actually perfectly replaced the biological processes that lead to the development of meat. That's not to say it is impossible to accomplish this, but considering how the animals we eat have evolved over many hundreds of thousands of years, it is likely we are missing something in replicating this process in this very new field. This certainly is not an argument against research into such products, but that it is likely human hubris to think that in a matter of years we have technologically replaced the biological systems that create meat.

Nutritional science is still a very young field, and the discoveries of the last twenty years or so show us just how mistaken our understanding of food has been. As we've developed more and more processed foods, we've discovered how complex and important whole foods are and traditional ways of eating that provide combinations of nutrients that we do not entirely understand. An easy example is that just a couple of decades ago fat was considered terrible for your health and low-fat foods flooded the market, only to make everyone's health much worse considering the importance of fat and how many low-fat foods were full of sugar and additives (Pollan 2007).

This is because “even the simplest food is a hopelessly complex thing to study, a virtual wilderness of chemical compounds, many of which exist in complex and dynamic relation to one another, and all of which together are in the process of changing from one state to another” (Pollan 2007). When we reduce food down to just a couple of key components, we are usually missing some crucial elements and interactions that we do not fully understand yet. Cultured meat has similarities to a field called synthetic biology, which instead of just modifying a couple of genes aims to make whole swatches of DNA and even whole organisms from their most reducible parts via human design. Although cultured meat does not have to involve engineering

of the genomes, I still think it has similarities to synthetic biology because it attempts to simplify nature and remaking it better with human intelligence. This simplification is concerning because “by attempting to eliminate complexity and contingency, synthetic biologists might end up losing sight of the emergent properties that define living systems, which are themselves historical accumulations, being the result of billions of years of evolution” (Calvert, 2008, p. 393).

Aside from the potential health hazards, this fits into a larger point about the problems when humans try to apply too reductionistic an approach to complex biological phenomena. This reductionist framework is likely to often be missing emergent properties that come from the interactions between all the things we can and can't understand. The desire to reduce food down to its nutritional components fits into the paradigm of control which turns us away from appreciating the complexity of life and tries to transform it into a simple math problem that we can master.

The idea of achieving total control over biological processes is an illusion, but its promise is one that can cover over the realities present in making any sort of food, especially by industrial means. In a video explaining cultured meat development on Just's website, they end up eating cultured chicken while the very chicken the cells were extracted from wanders around the picnic table unharmed. The narrator then goes on to say “we've figured out how life really works, and now we don't need to cause death in order to create food” (Just Website, 2018). That's how the video ends, on the feel-good sentiment of having “figured out how life really works” and the wonders of technology seemingly freeing us from the dirty work of killing animals in order to enjoy meat. This idea of figuring out life seems to embody a kind of hubris about our knowledge of biological processes. While our understanding of such processes has clearly advanced and is certainly something to be in awe about, there remains the danger of thinking that finally we have

figured out how life works and hence can manipulative it more exactly to our purposes. This type of thinking that is also common in synthetic biology seems to point “towards a reconstruction of nature which is instrumentalizable and utilizable for our purposes” (Calvert, 2010, p. 95).

The line “we don’t need to cause death in order to create food” really reflects this fantasy to divorce humans from biological systems, when taken to the extreme, can only be a delusion. Even though the cultured chicken nuggets did not involve the direct killing of a chicken like conventional meat, it still involved the taking of life in some manner. All the materials for the nutrient bath likely came from agriculture, and materials for the bioreactor came from mines and manufacturing plants. Many of these processes involved a taking of life, either directly or indirectly through habitat loss and pollution. There is no way to bypass the need to take life in order to live, it is the basis for biological life on Earth. How we take that life and what life we take matters a great deal, but we must be careful to keep in mind all the ways we take life to sustain humans, and so often not just for human sustenance but for human pleasure, as many people in the developed world could exist in good health without the excess of meat they consume.

Of course, I do not mean to suggest that those advocating for cultured meat are denying in any sense that there are material inputs and some degree of taking life for cultured meat to occur, but my worry is that these things are downplayed and distanced to the point where they are not considered and their wider effects are almost entirely left out of the discussion. For example, the proponents of cultured meat espouse how much less resources cultured meat will take to produce without hardly any mention of how exactly the material inputs that *are* needed will be obtained and what environmental effects they might have (Agapakis 2014).

In addition to this logic of control covering over the reality of what it takes to make food, it promotes an unhealthy orientation towards the nonhuman world. We do not need to think of a “nature” totally independent from humans to understand that there is a significant ethical relationship between humans and the nonhuman world, particularly the living world. Cultured meat fits into the ecomodernist paradigm of “hacking” biology in order to make it better serve our purposes.

In an article surveying the different issues present in synthetic biology, Calvert claims “The idea underlying much synthetic biology is that making biological systems from scratch will make them better than they are in nature” (2010, p. 100). Here the nonhuman world is seen as something that is inefficient and needs to be improved upon with human technologies and intelligence. Even the biological process of how an animal comes to have mature flesh is thought to be wildly inefficient and can be greatly improved upon by maximizing efficiency and taking away all the messiness of a creature that exists for more than simply human consumption. I think this leads to a kind of tunnel vision where the nonhuman world is viewed in terms of how useful it is to a capitalist human society and anything that is not useful in this manner is considered a problem. This could potentially lead to a lack of respect for how other life does not exist just for humans. In an age where we attempt to shape much of the world to these capitalist human ends, we miss an appreciation for creatures outside of ourselves and how they have ends beyond our own.

In addition to this potentially damaging relationship, cultured meat seems to further a lack of relationship or relation of abstractness to one’s food that has been the norm with the last couple decades. This condition can be explained by utilizing the device paradigm created by the philosopher of technology Albert Borgmann. A device is a piece of technology that provides the

desired end while concealing the operations of how this is accomplished, so that a certain commodity is delivered without the supposed “burdens.” A device is in contrast to a thing, which is something embedded in context that requires skill to function. Borgmann claims “A thing...is inseparable from its context, namely, its world, and from our commerce with the thing and its world, namely, engagement” (Borgmann, 1984, p. 41). In contrast, a device has no real context and does not promote engagement with the world, instead providing a service that is available, or “rendered instantaneous, ubiquitous, safe, and easy” (Borgmann, 1984, p. 41).

Modern industrial farming is an example of a device, in the sense that it delivers the commodity of meat in ways that are disengaged from any context and made cheaply and easily available at many locations at any time. Instead of challenging this context, cultured meat continues the producing of meat via devices that obscure how exactly the food is made. The meat arrives in the supermarket, made by a different method but still just something the consumer buys without any thought at all about what it took to create such a thing in that store at that time. There’s no place, no connection, likely little awareness of how this particular piece of meat came to be and the resources it took to render this service. In the context of this technology, “animals fade into the background, rather than being brought to the forefront of our confrontations with meat, with nature, and with our ethical priorities. For many, this is the appeal of the technology” (Galusky, 2014, p. 945). Putting aside the question of our relationship to animals simply maintains the detached way of consuming meat that we have grown accustomed to. This detachment means no real thought or engagement with the issues of eating animals.

The question of what exactly humanity’s relationship to animals should be and whether they should be raised and killed for food at all is far beyond the scope of this paper. My point is

that cultured meat attempts to solve the issue by sidestepping the question, by deferring it to a future where it may no longer be relevant or not addressing what the world of human-animal relations will look like if cultured meat succeeds. If sidestepping the question does not address the issue that is actually at hand, then it is a bad move. Other cases of going around the question may actually be a case of answering the question in a different way, but I do not think this is the case with cultured meat. Cultured meat attempts to answer the question of how to fix our animal agriculture without actually addressing the problems underlying it, it only treats the surface level symptoms. Although some advocates concede that its unlikely to take over the whole meat market and it is likely that there will still be some small demand for humanly raised animals, others are explicit in their hope for a world where no animals will be killed for food (Shapiro, 2018). We do not have to romanticize a bygone pastoral life to realize that there was a *relationship* there, and perhaps we can have different ones, but this process appears to not give us a relationship at all.

We should be concerned about relationships both between people and their food, but also the conditions that produce or obscure these relationships. One way to understand these conditions is to analyze cultured meat from the perspective of food sovereignty, a movement aimed at empowering people by “rebuilding the relationships between people and the land, and between food providers and those who eat” (U.S. Food Sovereignty Alliance). It aims to counter the control of food by a few centralized corporations focused on profits more than food security and the health of both people and the land. The emphasis is on local food, connecting people with the land, animals, and connecting those who purchase food with those who produce it. Cultured meat would most probably not be a step in the direction of food sovereignty, rather it would continue the control of food by a couple corporations with access to the necessary technological resources. This would continue the disconnect between people and how their food

is produced. The movement of food sovereignty aims to build stronger, resilient communities and address many of the issues that come from our current industrialized food system.

Without any real engagement with food and a lack of knowledge about how the food comes to be available, people are unlikely to dive deeply into how the food comes to be. This allows the potential problems with this technology to stay in the background and does not address the other problems present in our food system and consumptive culture where the negative effects of convenience are hidden. Cultured meat can't restore or create this kind of relationship, and hence it is unlikely to truly solve all our issues with meat. As we gain more ability to try to control all aspects of the world, we must ask ourselves "How much do we want to assert our intentions onto the world?" (Galusky, 2014, p. 941). This question matters not just for the potential immediate consequences, but also for how we relate to the world and how we move forward in the environmental movement.

Perhaps our environmental reckoning demands something deeper, something that does not ban all tech solutions but sees them as a possible part of a larger reckoning of humanity's relationship to the rest of the Earth. A cultural, spiritual, and political reckoning that transforms not just our technologies but our lives, ourselves, our sense of what it means to be a human being existing in this world with other beings. This call is nothing new, but it is difficult and perhaps this why it is so easy to get carried away with technology that would seem to solve our issues without demanding so much.

Cultured meat cannot truly create a relationship to the world, but that does not discount its potential usefulness in such a future. Dan Barber, a chef in Pocantico Hills involved with the farm-to-table movement, acknowledges the potential and limits of cultured meat, saying "if you can supplement a farming system with cultured meat, that is one thing. But if your goal is to

improve animal welfare, ecological integrity, and human health, then replacing animals with laboratory products is the wrong way to go.” (Specter, 2011). Barber thinks cultured meat does not address many of the root issues, but still recognizes that meat demand is likely to go up and cultured meat could serve as a supplement in meeting that demand. These root issues Barber talks about include a damaged relationship with animals, land degraded by industrial agriculture, animals and plants being raised separately instead of complimenting each other, and people having connection to their food and the land.

In order to accomplish this, cultured meat needs to be talked about in the context of many other solutions, since it can only stand as *the* solution when the many ethical concerns I have brought up in this paper are ignored. These issues need to be addressed, and they matter for how we approach other environmental issues as well. We need to have a way for people to become more connected with their food, to care about where it comes from and who is producing it. There are already many efforts to accomplish such aims, and they should be supported especially when it comes to reducing industrial meat consumption and getting people to think critically about how meat is produced. There should be more research into the most effective ways to actually get people to reduce their meat consumption, and then those strategies should be implemented wherever they can be.

An example of how meat consumption can be successfully reduced is the blended burger, or when beef is combined with at least 25% mushrooms in order to reduce the total amount of meat eaten. Recently the fast-food chain Sonic has included these burgers on its menu, and measures like this could be stepping-stones in normalizing less meat consumption (Charles, 2018). Another driver of more sustainable eating has been the Menus of Change Initiative launched by the Culinary Institute of America and the Harvard School of Public Health (Culinary

Institute of America, 2018). Menus of Change engages food service leaders, top chefs, and others influential in the food industry to promote food options that are sustainable and healthy as well as tasty. They advocate a plant-based sustainable diet and aim to make these options as available and attractive as possible. They conduct an impact assessment of their advocacy each year, measuring how many respondents that had introduced new sustainable menu items or changed their sourcing in light of the recommendations made by Menus of Change. These kinds of efforts are helping to advance more environmentally-friendly ways of eating without any huge technological innovation, and they should be given just as much attention as efforts such as cultured meat.

We also need to actually address the question of our relationship to farm animals and how they deserve to be treated. While lessening consumer demand can play a big role in this, we might also want to push for much stricter standards about how farm animals can be treated. Additionally, we need to continue those hard conversations in academia, among our communities, and in our political sphere about how we should treat animals. Slowly we are seeing these conversations shifting Americans' attitudes towards farm animals, and this trend will hopefully accelerate if we advocate for it.

An orientation towards the nonhuman world that aims to control as much as possible is an unhelpful position if we value things outside of our modern lifestyles, and thus technologies such as cultured meat should be pursued with a different framing. A potential framing I have sketched out here might be one that centers on respect for other life, a withholding of control in some areas, and a sense of humility that critically approaches a multiplicity of solutions to complicated issues. Our goal should not be to exert as much control as possible over biological processes, as this continues a troubling orientation towards the natural world that must be

challenged if we are to truly shift our environmental attitudes. If we are to fit cultured meat into the overall picture of how to address the problems in animal agriculture, it cannot be the central focus due to how many issues it either ignores or continues, and because the short-term feasibility is more questionable than most advocates suggest. As we seek to have a better relationship with the nonhuman world and address our many pressing environmental concerns, we need to consider how such technologies will contribute or inhibit these deeper goals that lie beneath the apparent problem and proceed as best as we can.

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