

*Of fake meat and an anxious
Anthropocene: towards a cultural political
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Of Fake Meat and an Anxious Anthropocene: Towards a Cultural Political Economy of Alternative Proteins and Their Implications for Future Food Systems

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Introduction

In 2019, food technology company Beyond Meat, the makers of the plant-based Beyond Burger, went public on the New York Stock Exchange (NYSE). The Los Angeles-based company was one of the earliest ventures to launch in the recent wave of alternative protein (AP) companies along with Eat Just and Impossible Foods in the US, as well as similarly high-profile ventures in Europe and Asia (Stephens et al 2019). Beyond Meat is the first ever plant-based food company to list on the NYSE. The company's shares nearly tripled in value by the end of their first day of trading and at the time of writing the company is valued at over \$1 billion (Murphy 2019). Impossible Foods has had a similarly headline-grabbing time in recent years. Its pea-based products and proprietary ingredients that cause their burgers to bleed like conventional meat have led technology and market analysts to herald the company as 'revolutionaries' and 'the Tesla of food' (Hicks and Stein 2016). The company raised \$200 million in its 2020 funding round – bringing the company to a total of \$1.5 billion raised since its founding in 2011 – and expanded its partnerships with Burger King, Walmart, Target and other major food chains across the US (Poinski 2020).

Like other biotechnologies before them, media coverage of APs has tended to skew to the celebratory (Painter et al 2020), with the glitz of the latest investment cycle or prototype launch often overshadowing broader debate on what APs might mean for the future of food and farming, and what challenges remain for the sector. A great deal of this breathless coverage articulates the ways that the Impossible and Beyond Burgers are on the front lines of solving any and all crises related to the production and consumption of meat: from climate change, to the direct environmental destruction caused by livestock production, to health complications from the consumption of too much red and other animal-derived meats, yet all without sacrificing the taste and pleasure of meat eating (Sexton et al 2019). As the Beyond Meat website states, their latest burger – the 'even-better Beyond burger' – is 'for your health, planet, [and] BBQ'. And it's not just AP companies who are pushing this win-all narrative. To the surprise of many in the AP sector, the biggest names in conventional meat processing and retail have jumped into AP development, launching their own product ranges and/or investing in AP start-ups. It is now commonplace to see senior executives from Tyson Foods, Cargill and other meat and dairy giants effuse about the world-saving benefits of "expanding the future of protein" beyond solely animals, and rebranding themselves as "protein leaders" (Tyson Foods, 2021).

Similar tropes have been echoed by the AP sector known as cellular agriculture. 'Cell-ag' involves the cultivation of animal-derived meat, but instead of through livestock husbandry and animal slaughter, animal cells are harvested from a host animal to be grown in tissue culture, similar to that used in the growth and regeneration of human and other biological tissues. The most famous public performance of cell-ag was the unveiling of an in-vitro, cell-cultured burger in London in 2013. The burger reportedly cost \$300,000 to create and involved investment from the likes of Sergey Brin, the progenitor of Google. A more recent unveiling marked another historic moment for the sector: the first public sale of cultured chicken nuggets was made in December 2020 at an exclusive members-only restaurant in Singapore.

Created by San Francisco-based company Eat Just, the event followed the landmark approval of cultured meat by Singapore's food regulators – the first country in the world to approve a cultured meat product for public consumption. While there remain a number of technical and regulatory obstacles to achieving large-scale commercialisation and cost-effectiveness of cellular agriculture, this has not stopped those in and around the industry heralding its revolutionary potential in dealing with the ongoing and increasing crises of the Anthropocene, particularly those related to conventional livestock's impact on the environment. Like their plant-based counterparts, these are products that promise to be “good for people, animals and the planet” (Clara Foods, cited in Sexton et al 2019); a total fix that replaces the perceived inefficiencies of biology with the control and efficiency of technology. Cell-ag has similarly captured the imagination of animal rights and welfare types, yet unlike the substitutionist approach of plant-based alternative proteins, cell-ag proponents promise ‘real’, animal-derived meats and milks, but without the animal death, suffering, and zoonotic and ecological risks associated with industrialised meat production. Rather, a cell-ag ‘post-animal bioeconomy’ (Datar 2015) is envisioned to either involve immortal cell lines (i.e. banks of cell lines that replicate without the need for animal inputs) and/or small ‘donor’ herds that provide a relatively limitless supply of cells from which to produce the likes of real hamburgers, pork, chicken, duck or shrimp, but this time in laboratory petri dishes and eventually in larger-scale bioreactors and fermentation tanks.

In this chapter, we consider the rise of plant-based and cell-cultured APs and critically assess their current and potential impacts on the development of food systems across the US, UK and Europe. In the latter half of this chapter, we focus specific attention on the rise of cell-ag given its potentially far-reaching ethical, material and spatial ‘disruptions’ to conventionally-produced animal meat food systems. Our discussion and analysis are positioned within the broader landscape of recent research on APs. For example, studies have examined AP regulatory and legal considerations (Seehafer and Bartels 2019), as well as technical challenges (Stephens et al 2018; Post et al 2020), and life-cycle analyses (LCAs) (Lynch and Pierrehumbert 2019; Tuomisto 2019). Consumer-focussed work on the acceptability of APs across demographic and cultural contexts has also comprised a large proportion of recent AP research (Bryant and Barnett 2020), while narrative analyses (Morris et al 2019; Sexton et al 2019), bioethics and philosophy (Chauvet 2018), and sociology of science approaches (Stephens 2013) led early research interest in APs.

Across this past research, a core strand of social science work on APs has examined the contexts and processes through which this emergent industry has formed. For example, in their study of the cultured meat sector, Stephens et al (2019) highlight the institutional and interpretative processes by which cultured meat has been made sense of by different publics and ultimately served to bring an industry and its future markets into being (see also Stephens and Ruivenkamp 2016; Jönsson et al 2016; Stephens 2021). Others have looked across broader AP ‘movements’, mapping their material, cultural and spatial politics (Guthman and Biltekoff 2020; House 2019; Mylan et al 2019; Clay et al 2020), political economies (Yates-Doerr 2015), economic geographies (Mouat and Prince 2018; Sexton 2020) and biopolitical outcomes (Sexton 2018) that are materialising with and through recent AP development. This recent body of AP research builds on established interdisciplinary scholarship that has long been interested in animal-free practices and diets, from philosophical (Francione 2012), to cultural (Cole and Morgan 2011; Harper 2012; Doyle 2016), nutritional (Radnitz et al 2015) and environmental perspectives (Lappé 1971).

In building on this AP research landscape, we are particularly interested in exploring two themes: first, the market-making processes of this new industry – that is, how the possibilities of APs have been framed and contested by different interest groups (e.g. Jönsson 2016); and second, the material,

cultural and political economic implications these framings present to the future of food and farming. Our analysis draws on the broad conceptual lens of cultural political economy in general (e.g. Sayer 2001; Jessop and Oosterlynk 2008) and as applied to the study of food systems (e.g. Watts et al 2018). In this, we explore the cultural politics of APs in their discursive construction as ‘planetary saviours’ in relation to their marketisation and materialisation as a burgeoning sector of the food economy, and as a potential reconfiguring force of the broader food system. In deploying this cultural political economy lens, we specifically analyse two ‘moments’ in the trajectory of APs that raise critical questions for the development of food systems. The first explores the promissory narratives and resistances they have encountered as they have been marketised and mainstreamed. Here we pay particular attention to the ways that the narratives of *crisis*, *anxiety* and *urgency*, as well as the *scale* of livestock-related problems in the Anthropocene, have (re)authorised the power of Big Food as central to solving these crises. Our second moment is more speculative and narrows our analysis to only cellular agriculture. Here we ask: what are the ethical and spatial implications of taking the animal ‘out’ of meat production via cell-culture technologies, and how will these implications be felt in different places and over different timeframes? We posit some of the ways that APs have the potential to reconfigure the ethical and spatial nature of food systems at the same time they have the potential to replicate and deepen the moralistic justifications of maintaining the current concentrated political economic structures of agri-food capitalism. We conclude with a series of questions designed to further develop research on APs in the context of the changing contours of the food system.

Promises and contestations: Making better ‘meat’ for anxious times or giving Big Food an urgent leg up?

*“Food has the potential to nurture human health and support environmental sustainability. Instead, our food is **threatening both**”*

*“Because food systems are a major driver of poor health and environmental degradation, global efforts are **urgently needed** to collectively transform diets and food production”*

*“Faced with the challenge of feeding about 10 billion people a healthy and sustainable diet by 2050, and with a rising number of environmental systems and processes being pushed beyond safe boundaries by food production, methods of food production need to be **urgently reviewed**”*

Willett et al (2019: 447, 450)

Food has continually provoked deep-rooted anxieties throughout human history (Belasco 2006). Fears of not having enough food, not having the ‘right’ type, having to eat ‘good’ food and avoiding the ‘bad’ have been (re)produced throughout the ages, often shaping and being shaped by advancements in technological knowledge, and cultural and political economic trends (Jackson 2015). Most recently, food has become a central concern in scientific and policy narratives about the so-called Anthropocene we are said to currently live in. Defined as the human-induced era of planetary ecological changes, the Anthropocene has come to represent an existential crisis that has in turn created a state of anxiety and urgency across societies, governments and institutions.¹ Some ‘thing(s)’ and ‘something’ *must* be done—and done *now* (urgency)—to confront the currently ongoing and potential future threats and catastrophic collapse (crises), or it will be too late (anxiety). In the context of food, related framings of crisis, anxiety and urgency are exemplified in the much-publicised EAT-Lancet report entitled *Food in the*

¹ See Sklair (2020) for more on the controversial definitions of the Anthropocene.

Anthropocene where we are told that food systems are threatening human health and environmental sustainability. Yet, in an era *also* defined by a neo-liberalised ‘disaster capitalism’ (Klein 2008), the narratives of crisis, urgency and anxiety that make-up the Anthropocenic condition are at the core of the paradoxical role agriculture and food are now seen to occupy in contemporary societies: on the one hand, food is a global-scale and multi-fronted threat to planetary survivability, resilience and prosperity, while on the other, it is an untapped opportunity for major health, sustainability and economic wins. As we will show below, the narratives of crisis, anxiety and urgency, coupled with the material development and timing of APs, have provided Big Food with the affective and market-friendly opportunities they need to remain key players in solving the problems they have had a very real and existential hand in.

In addition, within these debates, particular narratives about the *scale* of animal agriculture have featured as a central ‘matter of concern’ (Latour, 2004) in driving contemporary Anthropocene crises, including everything from climate change, soil degradation, chronic health illnesses and antimicrobial resistance (to name a few) (Godfray et al 2018). The existing massive scale of livestock on the planet, the predicted increased demand for meat in industrialising economies coupled with projected global population increases over coming decades have collectively advanced a deepening sense of urgency for ‘doing’ animal agriculture differently, or indeed, doing away with it in many places (Neo and Emel 2016).

It is against this backdrop of Anthropocene crises, its logics of anxiety and urgency, and the scale of both the challenge *and* opportunity of rethinking livestock production that recent AP activity has emerged. By no means the only food system solution put forward, APs have nevertheless gained widespread attention and support from powerful investors, mainstream media and most recently partnerships with incumbent Big Food corporates. Promissory narratives of what APs might achieve in response to Anthropocenic anxieties have formed a central part of their materialisation. In this, Sexton et al (2019) outline a typology of five key promises – *healthfulness* (e.g. “high protein” and “disease-free” products), *global food security* (e.g. feeding the “9 billion by 2050” and the hungry “2 billion” today in Majority nations), *benefitting animals and the environment* (e.g. “earth-friendly” and “kinder” alternatives), *greater control in terms of food safety and functionality* (e.g. produced in “safe, sterile, controlled conditions”), and *retaining the same eating experience as conventional animal foodstuffs* (e.g. “the revolutionary plant burger that looks, cooks, and satisfies like beef”). These promissory narratives collectively work to “make the ultimate promise of a better food system for all, and in turn a better food future for all” (ibid, 59).

Broad (2020) explores the promises of cell-cultured and plant-based meat products through the conceptual lens of metaphors. He notes two metaphors that dominate AP narratives: the metaphor that ‘meat is made’ which broadens the category of meat beyond solely animal bodies to also include cells and plants; and, the ‘metaphor of the market’ which centres capitalist markets as the most effective forum for advancing AP innovation. Broad’s conclusions on the implications of such metaphors for the possibilities of AP technologies echo the concerns raised by Guthman and Biltekoff (2020), who argue that AP promises have functioned as an obfuscation of what is (or not) being disrupted in the name of Anthropocenic crises. A primary critique across both studies concerns how techno-optimist promises can black-box the technologies in question and “make it difficult, if not impossible, for the public—or anyone really—to meaningfully assess the promises and their potential consequences, much less hold their proponents accountable to anything but pecuniary concerns” (Guthman and Biltekoff 2020, 16). Consequently, commentators have argued that the ability to imagine or create alternative ways of *doing* AP innovation has been narrowed and de-legitimised (Sexton 2020) and the concerns and values of different publics are at risk of being overlooked (Broad 2020). Others note that critical voices from

outside the industry are largely missing in mainstream coverage of, and decision-making in, AP development (Painter et al 2020).

Despite the overwhelming positive framing the AP industry has received in mainstream coverage, its promise of multiple wins for people, planet and profits has met with significant resistances from different interest groups. Perhaps unsurprisingly, a primary group of counterclaims has emerged from incumbents involved in conventional livestock production. Powerful lobby groups and farmer organisations have questioned the technical viability, legality and ‘realness’ of AP products (Sexton et al 2019). Characterisations of APs as ‘Frankenfood’ and ultra-processed products have drummed up fears of further separating us from where our food comes from and advancing the corporate capture of food systems (Blythman 2018). A number of high-profile lawsuits have been filed in the US by livestock industry incumbents contesting the labelling of AP products as ‘meat’, prompting counter-suits from the AP industry that in many cases are still ongoing (Stephens et al 2019). In addition, the framing of APs as a direct and complete replacement of global livestock production has been pushed by a number of key individuals and publications from the AP industry. For example, Pat Brown, CEO of plant-based meat company Impossible Foods, has repeatedly stated in public interviews that he wants to make livestock farming obsolete through his products (Greenfield 2021). A recent report by RethinkX (2019) that was widely cited amongst the AP industry made headlines for its dramatic prediction that 90% of jobs in US beef and dairy production and their associated industries will be lost by 2035. Farming communities were further angered when in 2018 prominent AP institutions and individuals pushed for the sector to adopt ‘clean meat’ as a new name for their cell-cultured and plant-based products. This framing was seen by many in conventional food and farming circles as explicitly and antagonistically positioning conventional meat as the ‘dirty’ option (Stephens et al 2019).

Yet, and importantly for this chapter, at the same time as resistance has risen from some parts of the Big Food landscape, a particular group of agrifood industry players has ended up leading the charge on a more celebratory, incumbent engagement with the AP sector. Multinational livestock processing companies such as Tyson Foods and PHW Group, along with major food retailers and fast-food chains (e.g. Tesco, McDonald’s) have been notable for their lack of resistance to APs. On the contrary, they have actively invested in and started their own development of APs and done so much sooner than the AP industry anticipated. In 2020, California-based Memphis Meats secured the biggest investment for a cultured meat company to date (at the time of writing), raising \$161 million in their Series B funding round which included Cargill and Tyson Foods amongst its backers. In early 2021, Netherlands-based Mosa Meat announced it had closed an \$85 million Series B funding round with key investors including global animal nutrition firm Nutreco and the CEO of online food delivery company JustEatTakeaway.com. This round follows their Series A funding in 2018 which was led by M Ventures and European meat processing giant Bell Food Group. Major names in supermarket retail (e.g. Tesco, Walmart) and global fast-food chains (e.g. KFC, McDonald’s, Burger King) have made landmark partnerships with Beyond Meat, Impossible Foods and other recent plant-based AP companies over recent years. Multiple high-street food retailers have launched their own plant-based product lines (e.g. M&S’s ‘Plant Kitchen’ range) and in 2018 Tesco hired a Director of Plant-based Innovation. In a further public commitment to AP futures, Tyson Foods made headlines in 2018 for announcing it was rebranding from a ‘meat company’ to a ‘protein company’.

For us, it is these narratives of crises, anxiety and urgency—as well as the more implied concerns over the scale of the livestock sector—that have specifically worked to authorise Big Food (and specifically Big Meat) as critical and, indeed, unavoidable actors in solving the Anthropocenic problems associated with meat production and consumption. Agri-food giants have sought to rapidly and unequivocally position

themselves as a core set of players able to solve the food-related Anthropocene crisis, to do so urgently given the problems humanity faces, and to deal with the state of societal anxiety surrounding, in particular, climate change. They have, in effect, made themselves indispensable—and thus critical nodes of power that shape the AP sector and its trajectories—through two principle means. First, they have deployed the ‘too big to ignore’ arguments used by other multinationals (e.g. Unilever; see Doyle et al 2020) that suggest that only *they* have the technological, investment and knowledge capital to innovate, scale-up and bring APs to market. For example, Tyson Foods CEO stated in a 2018 Bloomberg interview about APs that “[Tyson is] so big that the industry can’t change if we don’t lead” (Little 2018). Second, given the amount Big Food has already invested in APs in terms of capital—albeit small for the overall agri-food sector, yet large compared to investment capital in the AP space—many have developed a tangible rationale for their authorisation as important and powerful actors to shape AP innovation and marketisation. As a recent Bloomberg article detailing Big Food investment in APs puts it:

Tyson isn’t the only player in the conventional meat industry making unconventional investments. Cargill Inc. bought into Memphis Meats, too. Perdue Farms Inc. is investing in humane processing equipment, slow-growth chicken breeds, and niche organic brands. Even Hormel Foods Corp., maker of Spam, is developing animal-free products. If Tyson doesn’t stay ahead of the game, it runs the very real risk of falling behind. “We want to actively disrupt ourselves,” says Hayes [CEO of Tyson Foods]. “We don’t want to be Kodak”. (Little 2018)

Thus, to (re)authorise themselves as sustainable food actors and legitimate ‘honest brokers’ in the Anthropocene, Big Food has developed its own unique set of promissory narratives in relation to APs: namely, their *outsized role* in food systems, their *expertise*, their *economic and political capital*, and their already *existing investments in APs* collectively work to position themselves as best-placed to solve the urgent crises and anxieties of the Anthropocene. In true disaster capitalist fashion, the self-proclaimed ‘fixers’ are those who played no small part in driving food systems to their current social and environmental states. A key outcome, then, of the AP sector’s appeals to urgency, anxiety and crisis, coupled with the market-friendly opportunities it represents, has simultaneously allowed Big Food to position itself as *the* legitimate and necessary actor in bringing about a better, fairer and more sustainable protein future for all.

Taking the animal out of meat: Speculations on the ethical, material and spatial implications of cellular agriculture

“Our goal is to take ethical considerations off the table, and to make the best choices from the perspective of sustainability, climate change, global health, and animal welfare.”
Bruce Friedrich, Executive Director of GFI (cited in Illing 2016)

This cultural-political economic analysis of APs highlights the ways in which Anthropocenic crises, anxieties and urgencies have authorised novel and incumbent corporates across the food sector to ‘disrupt’ the food system, and that a key part of this so-called disruption is in fact the preservation of business-as-usual in agri-food capitalism. We now turn to a more speculative discussion of the potential impacts of APs on the future of food systems. Building directly on Morris et al (2021)’s research priorities on the de-meatification of food systems, we assess the possible implications for how cellular agriculture might reconfigure core aspects of the food system. More specifically, we ask: what are the potential *ethical, material and spatial* implications of removing animal death from the production and consumption of meat? We are, of course, very wary about attempts to predict the future in general and specifically in relation to the future of food. Rather, in the spirit of this volume’s desire to develop a food

systems research agenda, we present a series of prompting questions and discussion points designed to not just illuminate critical areas worthy of future research, but also develop some sense of the potential pathways (animal) food systems might travel with the further mainstream marketisation of cellular agriculture. As a reminder we focus here mainly on the Minority world and the potential and specific impacts of cellular agriculture.

As mentioned briefly above, there are currently two predominant imaginaries for a *post-animal bioeconomy* (Datar 2015) facilitated by the technologies of cultured meat. The first imagines, in effect, the complete removal of the animal from the food system: cell lines are initially extracted from, for example, cows, chickens or pigs, to then become ‘immortally’ replicated through infinite cellular regeneration from which the resulting meat is then produced ad infinitum and at scale (Stephens et al 2018). Animals are theoretically no longer needed in this process. Such an approach represents the most absolute version of a post-animal bioeconomy. The second process involves so-called donor herds whereby cells are continually extracted from the various animals, to then be produced into meat also ad infinitum and at scale. In this process, the animal is not completely side-lined but rather a considerably reduced number of much smaller herds globally can be kept alive as a kind of cell stock. Thus, while animals are still a fundamental part of this process of cellular agriculture, there is no direct animal slaughter involved in the production of meat. Both of these approaches offer up a form of ‘no direct death’ cellular agriculture that have important implications for the ethical, material and spatial futures of food systems.² The discussion below is not exhaustive in its coverage of these potential implications, but rather is intended to both highlight existing themes and prompt new questions that build on recent reviews of AP impacts (e.g. Hamdan et al 2017; Chauvet 2018; Stephens et al 2018; Newton and Blaustein-Rejto 2021). While the different implications we explore overlap to a large extent – for example, any material and spatial changes to food systems from cellular agriculture will, by their very existence or characteristics, have ethical implications – we have separated them below for clarity and focus.

The Potential Ethical Implications of Cellular Agriculture: Eating and Producing without Death to Save the Planet

The possible ethical implications of the production of meat through cellular agriculture are in some ways the most obvious: we get to eat meat that promises to be free of direct death, exploitation and cruelty. By taking animals off the table in this way, proponents of APs see these technologies as a way to take ethics off the table per the quote opening this section. By this logic, consumers will effectively have no reason to consider the ethics of their choices around meat any longer. Along with the end of animal death, so too could there be the ‘death’ of ethical consumerism or other variants of consumers choosing the ‘right’ or ‘good’ form of meat (Johnston 2008). All consumption of cultured meat becomes ethically good in this way: it does away with the moral quandaries about eating something produced through death and with a high ecological footprint while, at the same time, providing meat that promises to be good to eat in terms of a familiar and pleasurable experience.

It is important to highlight here that there are still significant question marks over cultured meat being able to deliver its win-all promises once production is scaled up. The process is expected to require

² At the time of writing, foetal bovine serum (FBS) is still used as a key component in cell-ag growth medium. FBS is a by-product of the dairy and meat industries, harvested from the blood of cow fetuses separated from pregnant cattle during slaughter. Several companies are currently working on the development of a serum-free medium for truly ‘no-death’ meats (McCormick 2021).

relatively high energy consumption (Lynch and Pierrehumbert 2019) and it remains to be seen how other promises relating to antibiotic use, nutritional quality and other ecological impacts will fare against the pressures of becoming technically and economically scalable. Since 2019 a number of cellular agriculture companies have announced plans to start building pilot plants in the US, Europe and Israel (VegEconomist 2021). Time will tell what trade-offs are potentially made during this next stage of the industry's evolution. There remains considerable optimism within the cellular agriculture sector, at least publicly, that their processes will deliver a choice of meat at scale that is good for our bodies and our bank accounts, good for animals and the planet, and also good for the agricultural corporates they have partnered with.

A set of core questions for further exploration include the following: how and in what ways will cellular agriculture shift and change our ethical—along with other multi-varied, contextual and contingent (Goodman 2016)—relationships to meat, livestock animals and nature in the broadest possible terms? In particular, does cellular agriculture prompt us to develop novel relations and ethics of care to 'companion species' (Haraway 2003) as donor herds or perhaps remnant animal herds designed to stay on the landscape for tourists and/or grassland management (van der Weele and Driessen 2013)? Does eating cultured meat become an ethical eating practice designed to allow us to care for other, geographically 'far away' humans impacted by climate change, agricultural pollution and/or food insecurity? Critically this last question spotlights the problematic ethical framings of the cellular agriculture industry that often draw on a kind of neo-Malthusian 'hunger-scape' in which overpopulation and insufficient agricultural production, and specifically of protein supply, at the global scale are foregrounded as the primary challenges of current and future food systems (Sexton et al 2019).

A second core set of questions revolves around the ontological status of what is meant by 'meat' given the technological and biological affordances of cellular agriculture. Will meat produced through cellular agriculture—which at the molecular level is expected to be the same biological product as conventionally-derived animal meat—be judged to have the same ontological status as 'real' meat derived from animal production and slaughter? It appears as if the definition of what 'meat' is and can be is slowly dissolving with the introduction of cellular agriculture, plant-based 'meat' and the possibilities available from insects (House, 2018). There have already been legal and social battles over how we define 'meat' and 'milk' (Stephens et al 2019). How will these continue to play out in coming years if the AP industry continues to grow in economic and cultural power, and what are the implications for both the cell-cultured and plant-derived meat markets? Another important question surrounds the ways that 'real' meat is infused with masculinity and gendered politics (e.g. Adams 1990; Roe 2018): if cellular agriculture produces animal-derived meat but through its lab-based process, what implications does this have for how it is defined in gendered terms for consumers and the possible easier ride to acceptance by male eaters? Could it be more acceptable to male consumers and eschew the more plant-based epithets of 'soy boy' or the ways that vegan diets are often coded as 'female' and/or as a threat to hyper-masculine tropes of physical strength and virility?

More than likely what we will see at least in the short term is a bifurcation in markets for cell-cultured, plant-based and animal-derived meats as they all come to exist simultaneously in food systems. Ethical eating choices and responsabilised consumers will thus remain front and centre as these respective markets develop and evolve in relation to each other. Commentators have raised the very real possibility for cellular agriculture products to simply *add* to existing meat systems rather than *replace* their conventional animal-derived counterparts, at least in the short to medium term (cf. Newton and Blaustein-Rejto 2021). This is potentially one of the biggest ethical and material concerns about AP development, especially given the current culture of urgency that calls for radical change to have any

hope of avoiding worse-case scenarios of planetary breakdown. A near-future scenario where plant-based and cellular alternatives have simply added to the overall pie of industrial food production and consumption will have done very little to disrupt the ongoing power of Big Food—despite claims of ‘self-disruption’ from the likes of Tyson—and the economic, social and environmental injustices that prop up their business models.

Much of the industry and media boosterism surrounding cellular agriculture frames it as a replacement for animal-derived meat, whereby demand for cultured meat goes up and, correspondingly, demand for slaughtered livestock meat goes down (Dutkiewicz and Rosenberg 2020). Yet if the history of ethical consumerism and previous ‘saviour-like’ products are anything to go by, we will most likely see an expanding demand for meat alternatives in addition to existing animal meat demands, plus the capture of new vegetarian and vegan consumers who may have previously avoided fast food and other restaurants because of a lack of choice. Some of this additionalism³ of meat alternatives is already evidenced in a recent statement by the CEO of Burger King’s parent company who stated that they were ‘...not seeing guests swap the original Whopper for the Impossible Whopper. We’re seeing that it’s attracting new guests’ (Newkey-Burden, 2020). The head of communications at Veganuary sees it this way: ‘Fast-food restaurants don’t have a particular vested interest in serving up dead animals. They just want to serve products they can make a profit on. So, if we can help them make a profit on products that don’t involve dead animals that can only be a good thing’ (Newkey-Burden, 2020). Yet, if the desire to reduce the number of livestock for ethical and ecological reasons is to be realised, then additionalism poses a significant threat to this end goal and should be much more fully investigated for its ethical and ecological quandaries in the face of climate change, the power of Big Food and the often stated purpose of cellular agriculture to transition us away from the farming and death of ‘real’ animals.

With cellular agriculture and its promises and potentialities, it is hard to not offer up some science fiction-esque questions in light of this possible bifurcation of meat production and consumption systems. Is there a possible future whereby the masses consume an affordable, scaled-up, readily available cell-cultured meat and the well-to-do eat ‘real’, slaughtered animal meat? Does animal death become a form of reputational capital only afforded by the richest amongst us or, at a global scale, the richest on the planet? In this scenario, poor consumers eat ‘clean’ meat with a clean conscience—if they think about it at all—and the rich continue to eat animal-derived meat with little conscious concern—if they think about it at all. There is, of course, the opposite possibility whereby the wealthy are those who can afford cultured meat—as appears to be happening now given the current high prices—and they are the ones eating ‘good’, cultured meat and accruing the ethical capital of solving climate change through their shopping trips and family meals. Eating cultured meat may thus become a form of virtue signalling for the wealthy as responsabilised consumers who can afford to eat cultured meat to save animals, people and the planet. Either way, the ethical, racial, class and gendered dilemmas embedded in the rise of cellular agriculture is worthy of much further consideration.⁴

The Potential Material and Spatial Implications for Cellular Agriculture: Assessing the Future Economic Geographies of Death-free Eating and Farming

³ In some ways, this is an interesting novelty to the agro-food system innovation processes of ‘substitutionism’ and ‘appropriationism’ articulated by Goodman et al (1987) we are beginning to see a kind of ‘additionalism’ to current food systems through the development of novel markets for APs.

⁴ These questions should be asked in addition to those related to the ethical and moral concerns about racialised and gendered labour and ecological exploitation throughout the industrial food system—and its alternatives.

The mainstreaming and growth of cellular agriculture holds many potential material and spatial implications for food supply chains, agri-food networks and socioeconomic change. We only have space to introduce and discuss a few and have chosen those most applicable to cultured meat and those we feel bring some of the timeliest issues currently faced by this emergent sector to the fore.

First, like the development of any good novel capitalist market, cellular agriculture will work to produce new forms of commodification of biological resources, technological processes, production methods and, of course, goods to be sold on markets to consumers. From animal cell lines and serum ingredients, donor herds and new breeds of animals, to fermentation processes and intellectual property surrounding the whole of the cultured meat enterprise, commodification will drive economic development and vice versa as markets develop. Several critical questions are important to ask in this context: will these forms of commodification and the intellectual property surrounding cultured meat reinforce the economic concentration evident in current Big Food-owned supply chains? Will it allow new and different players – such as Big Pharma – to capture (more) parts of the food system? Or will cultured meat be diversified and devolved to more/other innovators who can then develop their own power in food systems and disrupt existing supply chains to a certain extent?

On more specific details: with infinitely replicable cell lines and/or donor herds, who will own these and control them, and where in the world will they exist? Some in the cellular agriculture sector see a possible future in a kind of devolved and diversified system of small donor herds that supports innovation and economic development across a variety of types of animals, types of landscapes and types of ‘meat’. In this imagined future, what scope is there for cultured meat to revitalise smaller, craft-led, agroecological livestock farming? What are the barriers to entry, and how might this differ across Minority and Majority World contexts? Again, a bifurcated meat supply chain seems more likely at least in the short to medium term, with donor herds in existence and potted around various landscapes while more traditional animal livestock systems that harvest meat after slaughter still remain viable and likely. Indeed, ‘real’ meat might become more valuable and support the continuing—or even expanded—existence of these farming systems in smaller, rural communities that depend on their economic viability. This of course depends greatly on the ability of cellular agriculture to prove itself technically and economically beyond the scale of the lab, as well as barriers to entry being addressed in terms of knowledge and technological accessibility, consumer acceptance and regulatory approval being achieved beyond Singapore.

Second, the expansion of cellular agriculture into something we eat everyday has the potential to impact on environments, landscapes and livelihoods in important ways. There are, for example, the large-scale ecological implications of transitioning to cellular agriculture which reduces the overall number of livestock in agri-food systems. Will this be sufficient to support the reduction of carbon emissions to reach net-zero as promised by national governments through the Paris Accord? How will the energy required to make cultured meat mitigate these reductions? In addition to the possible ecological impacts of widespread cellular agriculture, the potential reduction in numbers of livestock on the land holds important possible implications for livelihoods and landscapes. For example, with the reduction of livestock what happens to farmers, farming jobs and rural communities? Do they disappear to a large extent or concentrate into smaller and fewer locales? Does fewer livestock mean *more* people on the landscape because there is effectively more room, or *fewer* people if the land is given over to rewilding and conservation services? Will these reimagined landscapes create more and different jobs in food and farming (e.g. as cell scientists or biochemical engineers) or reimagine rural livelihoods away from agriculture towards conservation and eco-tourism?

On this latter point, a key vision of the cellular agriculture movement is the expansion of re-wilding and the development of landscapes full of past native species. Former farmers may become more akin to rural land managers, designing landscapes to further suck up carbon emissions and contribute to net-zero targets. Livestock-related land and water pollution might also begin to disappear with reductions in livestock numbers leading to reductions in manure run-off and contaminants in the production of animal feed. There is, of course, the counter argument that we cannot have sustainable agricultural systems without some livestock replenishing nutrients in the soil, in addition to concerns over the cultural relevance of the rural idyll, lifestyles and cultures that might be altered as livestock leave the land through cellular agriculture. A recent study of UK attitudes to landscapes found that sheep, cows and trees were voted the top three most popular landscapes, highlighting the deep cultural significance (albeit often heavily romanticised) of seeing livestock animals in our landscapes (Rust et al 2021). It is these concerns that raise one of the most fundamental questions in the shadow of the widespread shift to cultured meat: who and what is the countryside for, who decides this, and how might these fundamentally political and geographical questions play out in often marginal, powerless and economically depressed rural areas?

These points all collectively speak to a bigger issue concerning the process by which *transitions* towards cellular agriculture may play out over shorter, medium and longer terms in different places and at different scales. As we have mentioned, it is predicted that cellular agriculture and plant-based products will exist alongside conventional animals for some time, rather than instigate a complete and immediate substitution effect despite some relatively dramatic predictions to that effect (i.e. RethinkX 2019). This has implications for the extent to which APs can deliver on their environmental and health promises in the short and medium term if they are simply increasing *overall* production and consumption of food. For example, will the growing demand for food crops like wheat, pea and soya – the most popular bases for plant-based meat substitutes and potential ingredients for cultured meat growth serum – further entrench intensive production systems around the world and exacerbate localised food insecurity, particularly in poorer nations dependent on agricultural exports?

Longer term forecasts predict that the short term additionalism that APs will likely create is simply an initial and necessary step in a broader shift that will eventually see conventional livestock products reduce in number, particularly as AP competition and changes in climate, regulations and reputational pressures render livestock the next ‘stranded assets’ (Scott 2019). There is little, however, in AP narratives that challenges the continued culture of over-consumption that is at the heart of its innovation model and its short-term forecasts of scaling from lab to initial production. The dominant promise of APs is not about *eating less but better* meats and milks, but about continuing to eat the *same if not more* of these foods without the ecological and ethical guilt that comes with conventional animal agriculture. How, and indeed if, this latest expression of green consumerism bucks the trend and delivers on its promises over the coming years requires continued critical assessment.

These points emphasise the need to critically examine AP implications across different timescales to understand where and by whom their effects and benefits will be felt. For example, we have seen that much effort has been spent by the AP industry itself and incumbent agri-food corporates on centring Big Food as key facilitators of AP development in the short to medium term. This centring has largely been justified by the latter’s economic and material means being deemed the most effective at scaling up the production and promised benefits of APs *quickly* in response to the era of planetary urgency. In other words, partnerships with Big Food have become a *necessary* short-term step that can buy us and the planet time for more radical, systemic reform later on; this is very reminiscent of the ‘put out the fire

first so there is still a house to rebuild later’ argument. While these justifications often belie a sense of ‘there is no other way’ and ‘we don’t have time to do it differently’, it is important to recognise that transition pathways such as this are made up of choices – choices of who gets to decide, who gets to lead and who is missing from the table; of what social contracts, ethical values and innovation models are prioritised; and of where and how technological development and its mainstreaming takes place. The *choice* by AP proponents to partner with incumbent agri-food corporates in the short term has important and very material effects over different timescales. For example, is it reasonable to expect that accessibility to AP technologies for smaller producers will increase in the medium to longer term if Big Food takes the reins in the short term? If Big Food with its big budgets takes on the high risk and expense of early R & D, how might we expect the intellectual property landscape of APs to develop over the coming decades? Whose interests will be served and what lock-ins will be created by choosing to take AP production out of the lab and into initial production through partnerships with Big Food (and Big Pharma)?

In sum, *how* the AP industry scales up and instigates a transition away from conventional livestock production will determine who will benefit, and when and where these impacts will be felt. Thinking across timeframes as well as places and scales is, we argue, a fundamental part of these discussions. Yet far from needing to re-invent the wheel in this endeavour, there is a wealth of research that has explored pathways and challenges for ‘just transitions’ within food and farming (e.g. Blattner 2020), and in other industrial sectors (e.g. see Newell and Mulvaney 2013 on energy transitions). There is much scope for the AP industry itself and researchers more broadly to draw on these frameworks to think through a more holistic vision that ensures notions of justice and sovereignty are embedded in larger-scale transitions away from conventional animal agriculture towards APs (Broad 2019), and that lessons are learnt from previous encounters between AFNs and the mainstream.

Conclusions: Taking APs forward in food systems research

While the food technologies we discuss in this chapter are ostensibly new, the promises they claim, the ethical dilemmas they raise, and the critical questions they prompt are largely familiar to researchers of (alternative) food systems and food-related innovation and technological change: namely, what constitutes a ‘better’ future for food and farming? Who gets to decide how this better future is imagined and put into place? Who or what is overlooked, and what role should technology, markets, food movements and corporations play in transitions to just and sustainable food systems? Our aim here has been to begin thinking through some of these themes in relation to APs and to signpost future directions for food systems researchers to produce further in-depth critical work on the continuing development of APs and their current and potential impacts on food systems.

We focussed first on the role Big Food has and continues to play in shaping the politics of possibility of APs, and how this is having very real implications on what APs are, what they might deliver, when, and for whom. We showed how the contemporary moment of planetary urgency, anxiety and crisis—and their scaled politics—coupled with the market-friendly model of the AP sector, has created yet another opportunity for Big Food to centre itself in the ‘reinvention’ of the food system. While we have shared our concerns based on historic precedence of this ‘too big to fail’ and/or ‘too big to ignore’ flavour of green capitalism, more critical work is needed to assess whether these specific actors and the reinvented futures they are proposing are best placed to bring about the radical social, ecological and political economic change that is needed in the construction of sustainable food systems.

Second, we argued that it is important to continually reflect on the various implications of APs across place, scale and over different timeframes as the AP industry continues to scale up. There has been a

tendency in the AP sector to eschew critical debate on the technological (i.e. high-tech) and ideological (market-based) approach that has largely underpinned AP development to date. Appeals to urgency, anxiety and crisis have in part been used to close down such reflections on the basis that there isn't time to *not do something*, or that the old critiques of market-based approaches are at best unrealistic and at worst obstructive to bringing about the urgent change we need. Rather, what would happen if we position APs—and their framings of urgency, anxiety and crisis—as central to asking the most important question of all in these turbulent and alarming times: What, in the broadest possible sense, are food systems *for* and *how* and *by whom* should they be controlled? Clearly critical research on the place-based, scalar and temporal promises and material changes embedded in APs must continue and be further extended as these foods increasingly enter the mainstream of current and future food systems.

We are of course generalising across an entire and currently emergent sector that does not always itself identify as a singular movement or industry and is made up of diverse people, geographies, motivations, products and technologies. There are some directly involved in AP development who are concerned about the points we have raised in this chapter, and those who are working to think differently about how best to 'do' AP innovation that does not lead to yet more (or indeed the same) Goliaths controlling the global food system. A crucially under-developed area for facilitating these types of conversations is the lack of meaningful engagement between those working in AP development, conventional farming and alternative food communities. To date AP discourse has been dominated by increasingly incendiary and binary arguments—in both academia and popular culture—of what food is and what it should be in the face of contemporary crises, with little understanding or, in some cases, purposeful mischaracterisation of what is contested and shared across AP and more conventional farming divides. There is much potential and a critical need to bring the rich knowledge base of different farming and food systems communities across different geographies, as well as responsible innovation and food sovereignty/justice movements, into conversation with AP development as a key part of opening this emergent sector to alternative possibilities and outcomes.

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