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Pig towers and in vitro meat: Disclosing moral worlds by design

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Abstract

Technology development is often considered to obfuscate democratic decision-making and is met with ethical suspicion. However, new technologies also can open up issues for societal debate and generate fresh moral engagements. This paper discusses two technological projects: schemes for pig farming in high-rise agro-production parks that came to be known as 'pig towers', and efforts to develop techniques for producing meat without animals by using stem cells, labelled 'in vitro meat'. Even before fully entering our world as actually realized systems or commercially viable products, these technologies disclosed societal concerns over animal agriculture. These concerns were expressed through active public responses and were informed by formal methods of assessment, such as applied ethics and lifecycle analysis. By closely examining how features of these designs entered public debates and ethical thought, we trace the moral world-disclosing character of technological projects. We find that these proposals generate occasions for debate and gather new societal actors to form new coalitions or rifts. Both technologies gave rise to particular understandings of societal issues. As the central means through which problems were discussed changed, new types of arguments were considered relevant and ontological shifts could even be seen to occur with what was considered 'real meat' and the 'true nature' of animal farming. We argue that world disclosing involves a renewed sense of the character of political and moral agency, whereby the sensibilities that constitute a moral subject are redefined. Finally, we explore the inner tensions and ambiguities of this process of moral and political change by confronting the notions of 'world disclosure' developed by Dewey and Heidegger, thereby connecting to recent debates within both STS and political theory on how to understand political processes in a technological culture.

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Introduction

Animal farming in the industrialized world is increasingly considered to be problematic. People are concerned about its various environmental (side) effects, as well as about animal suffering and the global injustice of land use for animal feed production rather than hunger alleviation. This paper describes the emergence of two radical technological designs that have been proposed in the past decade to address these concerns: *pig towers* (*varkensflats* in Dutch), large scale high-rise farming systems designed to raise up to a million pigs as part of an integrated 'industrial ecology'; and *in vitro meat*, research projects for producing meat using muscle stem cells without the need for live animals. Rather than 'assessing' these proposals for their potential pros and cons, this paper examines the dynamic normative processes these technological designs generated when they were made public. We analyse what we call the moral world-disclosing character of research and design projects in order to contribute to ongoing debates on the nature of politics and ethics in a technological culture (Keulartz et al., 2002).

Technology beyond the dichotomy of threat or solution

Many early 20th-century philosophers of technology warned of technological intrusion into the 'life-world' turning human life into a bleak and meaningless existence (Habermas, 1969; Winner, 1988). In an era that saw the advent of nuclear weapons and increased bureaucratic rationalization, it was argued that technology and the associated scientific methods of measurement, calculation and optimization would steadily encompass the everyday world and humankind's understanding of itself. It was commonly held that technology left little or no room for imagining or realizing other, more meaningful forms of life, subsuming everyday practices under the technological imperative of ever increasing efficiency, with politics becoming more and more rationalized into a bureaucratic technocracy (Feenberg, 1999). Today, our technological future is mostly deemed to be far less gloomy. Technologies, ranging from smart-phones to hybrid cars, are generally looked upon as convenient and 'domesticated' ways to improve our lives. Most new technologies are viewed as desirable consumer goods or are considered solutions to pressing problems. Global concerns over resource depletion, environmental degradation and climate change are expected, or at least hoped, to be dealt with, not only by radical political and behavioural change but also by technological means. At most, these may arrive too late, or bring unexpected side effects, which in turn would call for more adequate technological solutions. Whenever new technologies, such as genetically modified organisms (GMOs) or nanotechnologies, are considered as potential (moral) hazards, these new devices or techniques are scrutinized in detail for their possible impacts and associated risks. More and more, this type of scrutinizing is itself turned into a technical discipline. Ethics committees, or sometimes elaborate lay panels, are meant to direct the course of research and development, aiming to preclude the eruption of heated societal controversy. The analysis of potential risks and side effects is

considered all the more important, as technological advances can be found to displace democratic politics (Nahuis and Van Lente, 2008; Winner, 1988). Technological change in many ways is political, but lacks in transparency (Jasanoff, 2003) – something that is deeply problematic – while, as Winner has argued, artefacts do have politics. Artefacts bring a certain social and political organization; they contain implicit choices regarding who stands to lose and whom to gain from new socio-technical orders; and they assume and promote specific conceptions of the good life (Swierstra and Waelbers, 2012). However, these normative and political effects of technologies tend to be implicitly conceived as external threats to an otherwise morally neutral or unproblematic world. They are considered reasons to bring the development of technology under political control and to bring these sites of displaced politics under the roof of the parliament, or to search for new institutional forms of direct democracy (Dryzek, 2000; Korthals, 2008), to analyse the ways in which designers should take the normative implications into account (Verbeek, 2006), or to draw attention to and call for new *sub-political* forms of democratization, in which technological advances are carefully scrutinized for their potential implications (Beck, 1992).

In this paper we aim to complement analyses that focus on the dangerous (side) effects of technologies, by describing in detail the wider ethical and political processes connected with technological projects. We shall consider novel technological developments to be prime occasions for public deliberation (Latour, 2005), rather than simply as threats to democratic politics. Accordingly, we will explore in detail the processes through which technology and ethical thought and practice can be found to co-evolve (Keulartz et al., 2002). We also will discuss the ways in which technology development may give rise to new understandings of what it means to be a political subject (De Vries, 2007). In our view, new technological designs *disclose moral worlds*. They may even provoke novel normative interpretations that extend well beyond the immediate areas in which the technologies are to be deployed. Technologies are surely not to be considered morally neutral, but neither is the societal status quo morally neutral. The default position of technologies as intruding into our everyday world, brought forward in the tradition of the philosophy of technology, seems to have prevented a broad exploration of this process.[1] In this paper we examine the processes by which new technologies are made the (prime) site of political contestation and ethical (re-)interpretation, and we propose to channel some of the ethical distrust and political involvement generated by new technological designs away from these intrusive new elements, in order to focus on a critical engagement with the existing practices of the world in which they are proposed to be situated.

Redesigning animal agriculture: Pig towers and in vitro meat

In this section we describe two technological projects that have not (or 'not yet') materialized as fully operational 'black boxed' devices or products. Over the past decade these techno-scientific projects in various guises and forms have nevertheless gathered a considerable amount of public interest. First we will discuss their initial emergence and associated public responses, after which we will trace in detail how they function as moral world-disclosing designs.

Pig towers

The most widespread and consistent development in agricultural production seems to be its increasing scale. For some decades (for example, in the Netherlands) the number of pig farms has halved, while the number of pigs per farm has doubled.[2] The productionist logic of lowering marginal costs in intensive agriculture while increasing labour output and efficiency has been pointing for some time now in the direction of ever-larger farms. At the same time, modern intensive farming has encountered several limits: the use of scarce space, animal welfare concerns, the unsustainable production of crops for feed, environmental emissions and nuisance to local residents, especially in a densely populated country such as the Netherlands. At the end of the 1990s some Dutch researchers took this development to its logical conclusion and designed what became known as the 'pig tower' (or *varkensflat* in Dutch). What was officially named '*Deltapark'* was a plan for a six-storey building, 1 km in length. It was meant to contain 300,000 pigs, 1.2 million chickens, a slaughterhouse and a salmon nursery (De Wilt et al., 2000). The ideal location would be somewhere in a large seaport such as Rotterdam, near the supply of cheap grains and usable wastes from the food industry. The facility was projected to be largely self-supportive and to produce no environmentally damaging emissions. The manure would be used to generate bioenergy, for heating greenhouses on the roof and fertilizing mushrooms in the basement. Pig feed went in at the entrance, pork out through the exit, and windmills sat on top. Even the pigs would be better off this way: they would not be transported alive and would live in stable groups, both of which reduces aggression, and they would be provided with more space than in their current housing; in one version, the pigs would even have a balcony to go outside and enjoy the fresh air.

In this visionary, integrated design, most of the problematic aspects of intensive pig farming were claimed to be solved by technological means: 'the kind of farms that can arise if the problems of the environment and animal health, yes even animal welfare, are purely solved by technology'[3] (Thinktank, 2000: 33–34). The design also was a logical solution for the land-use planning challenge of how to adequately situate the economic activities and deal with the problematic side effects of intensive farming. Some commentators considered the projected 'industrial ecology' as a large-scale version of the organic farm with its (in this design at least partially) closed substance cycles. In fact, it was argued to be the only way that the number of pigs raised in the Netherlands could ever be given the amount of space required for organic farming without severely encroaching upon human living space (De Wilt et al., 2000: 5; MVRDV, 2001). The *agroparks* would result from integrating the industrial production processes from several sectors and the knowledge from various scientific disciplines (Smeets, 2010). Besides being a highly efficient form of land use, it would optimize agro-logistics by reducing transport distances and combining flows of substances. And the planned design, informed by lifecycle analysis (De Wilt et al., 2000: 18), would maximize the resource and energy efficiency of pig production (Smeets, 2010). In addition, it would minimize the risk of contamination with viral and bacterial diseases in a completely closed system that does not involve transporting live animals from the premises. The agropark concept was part of a new trajectory for

the technological organization of farming, understood as an encompassing 'system innovation' (De Wilt et al., 2000; Grin et al., 2004), innovation to be realized by semi-governmental organizations engaged in 'transition management' (InnovatieNetwerk, 2004).

The plan was revealed to the press by the Dutch minister of agriculture on 4 October 2000 –'World Animal Day' – on a boat trip with harbour officials, ostensibly searching for a suitable location for the design. The proposal instantly raised a storm of protest in the national media. A heated debate ensued in which all kinds of actors came to the front. Farmers, rural organizations, public figures and animal welfare organizations all denounced the project on their own terms, while allusions were made both to fascism and Stalinism (InnovatieNetwerk, 2004).[4] Later that year, the scheme was turned into an artistic design, 'Pig City', by the Dutch architectural firm MVRDV. A computer-generated three-dimensional rendering of 44 towers, each rising an incredible 622 m high, graphically depicted millions of pigs in their integrated industrial ecology, each floor including trees and a balcony on which the inhabitants could search for truffles (MVRDV, 2001). These 44 towers would contain the entire pig production of the Netherlands meant for export. Another 32 towers would be distributed throughout the country near urban areas. For many critics, this depiction visually represented the ultimate endpoint of the catastrophic rationalization of meat production. Meanwhile, the design also provided a three-dimensional pictorial representation of national pig production statistics, resembling the isotypes Otto Neurath developed in the 1930s (Neurath et al., 1973; Patteeuw, 2003).

In 2006, the plan was again proposed, but this time there was a concrete project to actually build an 'agroproduction park' in the harbour of Zaanstad. However, after vehement discussions, the town council did not approve the plan, in part because of the limited employment generated by the highly automated facility. By 2007, the concept of the *varkensflat* once again gained prominence in the Dutch popular media, but this time as a term to designate large but more conventional pig farms, with up to 30,000 pigs, that were being planned in rural areas. These facilities (not high rises, but with at most two floors) were the largely unintended outcome of zoning policy measures to move intensive agriculture away from residential areas and nature reserves. The large scale 'megabarns' did not offer the same environmental and animal welfare benefits as the initial pig tower designs, though some improvement was realized by 'end of pipe solutions' such as air filtering systems. In the meantime, a few 'agroproduction parks', which were more true to the original pig tower idea, had reached the planning stage, but they were met with fierce resistance from a coalition of environmental activists and local residents (Hoes et al., 2008). The researchers and designers who developed the initial scenario meanwhile turned elsewhere to create integrated agro-parks. In cooperation with local partners, they became actively involved in setting up 'Greenport Shanghai', a showcase of environmentally friendly, large-scale agricultural production facilities, situated on 27 km^2 of reclaimed land, and in one scenario involving 1 million pigs (Smeets et al., 2007).

In vitro meat

Another central trend in livestock agriculture, besides the increasing scale of production facilities, has been the breeding of ever more productive and efficient animals (Boyd,

2001). Pigs and broiler chickens in particular are being equipped with ever-improved conversion factors for efficiently turning feed into meat, as the animals are designed to invest less energy in superfluous behaviours and bodily features. In this trajectory, a technology that takes this development in agricultural production to its logical conclusion would be meat production without animals. This is currently the aim of various research and development projects on 'in vitro meat'. The goal of these projects is to produce muscle tissue from stem cells, without requiring the 'carrier organism' to grow it on. Theoretically, one could grow spareribs and chicken wings as cell cultures in a laboratory, though at the moment even a small filet of cultured meat is a considerable challenge.

Various techniques are being studied to attain these goals, ranging from scaffolding muscle cell cultures to techniques of 'organ printing' (Hopkins and Dacey, 2008). So far, only a small amount of lab-grown meat has been produced, as there are still several techno-scientific hurdles to surmount before tissue cultures with taste and structure resembling actual meat can be commercially produced.[5] One challenge is how to make the stem cells grow in a medium to form muscle structure. This was attempted by positioning the cells on a scaffolding structure, and by stimulating the muscle tissue with an electric pulse or mechanically. Recently it was found that it is possible to induce growth of muscle stem cells without stimulation by using ordinary Velcro as a scaffolding material (Langelaan et al., 2010). Another challenge for scaling up the process for potential commercial production is to produce less expensive nutrient plasma. Currently this plasma is an animal product (calf serum), which would need to be of vegetable origin (from algae, for example) in order to cater to vegetarians who might be willing to eat this type of meat, and to make good on the promise of completely doing away with animal suffering and environmental problems associated with livestock farming (McHugh, 2010). Some researchers have decided to move from undifferentiated (embryonic) stem cells to muscle stem cells for making meat, as the former are considered too controversial with potential consumers. Notwithstanding the remaining technological barriers, the principle of having stem cells grown for meat production is considered 'potentially feasible' (Van der Weele, 2007). This has led animal protection non-governmental organizations (NGOs) to welcome the promise of in vitro meat, and promote the funding of research efforts. In particular the North American animal rights organization People for the Ethical Treatment of Animals (PETA) has embraced the research and development of in vitro meat, by offering a prize of 1 million dollars for any organization that creates a commercially viable product and brings it to market by 30 June 2012 (People for the Ethical Treatment of Animals, 2008a).[6] By creating this prize, PETA set the terms for what it considers a beneficial meat product: not only should it be 'indistinguishable from real chicken flesh', neither the product nor its development should involve animal testing or 'contain or [be] produced using animal-derived products, except for starter cells obtained in the initial development stages' (People for the Ethical Treatment of Animals, 2008a).

In the Netherlands, in vitro meat has featured in the popular news media primarily in the science and technology sections. A popular-science TV programme in 2006 issued a prize for coming up with a good name, to replace the Dutch name of *kunstvlees* ('artificial meat') or the commonly used *kweekvlees* ('cultured-meat'). Coverage in this

particular popular science media genre indicates that the reports focus mainly on the techno-scientific possibilities of microbiology and the research challenges for being able to produce meat in the laboratory (Noorderlicht, 2006). But, in vitro meat is not only a research project situated at universities and funded by governments (in part indirectly, as side projects to tissue engineering research for regenerative medicine). In some countries (such as Australia and France) it has also, or even primarily, featured as an art project: a few 'bioartists' working on 'disembodied cuisine' have even come to be considered experts in the field (Langelaan et al., 2010). These projects are situated in the art world, in museums and art galleries, where in one project a living frog was displayed, while in the same room previously grown tissue (allegedly) obtained from the very same frog through biopsy was being prepared for a public meal (Catts and Zurr, 2002). Cultured meat at this point is still in the process of development, and it cannot be taken as a clear-cut future object with a definite shape or self-evident qualities: its development is bound to encounter difficulties with mimicking 'normal' meat, and in contending with the specific demands and 'hesitations' of potential consumers, as well as unexpected high costs, resource use, and risks.

Both technologies – in vitro meat and pig towers – have given rise to media attention and public debates. Pros and cons of these proposals have been brought forward, their potential impacts have been assessed through analytical approaches such as lifecycle analyses (Tuomisto and Teixeira de Mattos, 2011) and applied ethics (Hopkins and Dacey, 2008). But the dynamic process involving these designs and their subsequent discussion is more complex and far reaching. This has become clear already from the variety of techno-political trajectories and public reactions we have just reviewed. More is at stake in these struggles and debates than the technical character and potential realization of these proposals.

The dynamics generated by pig towers and in vitro meat

Both new proposals simultaneously imply a (critical) depiction of existing production processes, while thoroughly redesigning those processes. The intricate combination of discovery and invention embodied in the proposals includes shifts in both material and symbolic ways of engaging with the world. We shall describe such technological designs as 'world disclosing': (1) not only do they occasion particular political assemblies, but they also (2) demonstrate new issue definitions and (3) give rise to new moral subjects that emerge out of the struggles and debates surrounding them.

Political process: How things generate issues, debates and publics

As we noted, the early designs of pig towers occasioned heated debates. The issue the publics responded to (and were called into being by) is the question of assessing the proposed technology: What is thought about putting half a million pigs in a high rise industrial facility? This was the immediate question that was put on the public agenda with the initial design scenario. But the impact went beyond mere agenda-setting, which would presume standard political institutions populated by already configured actors and representatives.

First of all, a different, and in this case larger, set of concerned actors coalesced in response to the proposal than would have been the case had the usual participants in environmental or farm animal welfare debates convened to discuss current farming practices. The radical proposal assembled a public that extended well beyond those groups that would have been directly 'affected' by a decision to build such a typical facility, groups such as those living near the projected 'mega-barns' who were concerned about health, traffic safety and the quality of their open landscape. But the extremity of the pig tower design, and the cultural 'soft spot' it apparently managed to touch, made a larger portion of the public think about this design and respond to it. Such a reaction occurred even with the pig tower proposed for the 'non-space' of the Rotterdam harbour, which would not directly affect any local inhabitants. Interesting coalitions emerged along with these responses, producing new possibilities for agreement, as both farmer organizations and a number of animal spokespersons protested strongly against the proposal. In their protests, however, the agricultural representatives mainly stressed the 'Stalinist' character of these 'collectivized farms' (Telegraaf, 2000), the more urban 'cultural elite' animal spokespersons tended to draw comparisons with the holocaust (for example, De Jonge, 2000; InnovatieNetwerk, 2004). In contrast, environmental (rather than animal) NGOs exhibited a more complex reaction: 'it could indeed improve emissions' and 'at least it could be a way to break the lobby of the farmers', so that it would be easier to make the entire intensive farming industry leave the country. The realization of the design would provide leverage to break the coalition between the farmers and a rural population that identifies with farming, and reduce the cultural role of livestock farming in the Netherlands. However, a general sense of shared opposition to the radical pig tower design remained, opposition which also ran through the national parliament and across the Dutch political spectrum. Both the Socialist Party ('has the minister gone mad?') and the Liberal Party (VVD) ('I wonder whether the minister is level headed') refused to take the proposal seriously.

In 2007, in the southeast of the Netherlands, a scheme for an 'agro-production park' gave rise to local protests. A plan for a facility in the village of Grubbenvorst was presented that would combine poultry and pig farming with energy production and a slaughterhouse. The assemblage was named 'New Mixed Farm' (*Nieuw Gemengd Bedrijf*), evoking the traditional mode of farming that still provided its own inputs and used its own outputs (Hoes et al., 2008). Concerns voiced by local residents about increases in traffic and zoonotic diseases were dismissed as belonging to the NIMBY ('Not in my backyard') repertoire in what was essentially a spatial planning issue. But while the environmental NGO *Milieudefensie* (the Dutch 'Friends of the Earth') saw its base of activists widen from a mostly urban, left wing, highly educated constituency to include a broader rural constituency, the concerns about large-scale, intensive agriculture were voiced in more general terms. The public conception of large-scale, intensive pig farming thereby shifted. In a rural setting, the term '*varkensflat*' appeared to kindle broad opposition to supersized mega-barns, even though there was always a danger that the coalition of actors on the multiple issues involved would fall apart again. When local residents claimed: 'This type of facility belongs in an industrial zone' (Trouw, 2007), the wider issue of animal welfare and local worries over health and traffic were again separated (Termeer et al., 2011).

With the in vitro meat proposal, new coalitions also were forged, and new sites emerged for exchanging arguments and visions. In February 2010, several renowned animal activists and the Dutch science museum NEMO staged a public debate on in vitro meat, under the heading 'Pure Meat', attracting a crowd of over a hundred participants. Members of animal activist NGOs found themselves sitting beside molecular biologists and holding discussions with a variety of politicians and entrepreneurs. The aim of the science museum meeting was to generate debate among relevant actors about the possibilities for cultured meat, and ultimately to encourage commitment to that potentially viable technology. The meeting culminated in the central actors involved signing a petition to the government to invest in more research.

On this occasion, the debate repeatedly turned to the current situation of meat production and its unsustainable feature, but also interesting is who was *not* present at the gathering: namely, farmers. The animals were represented by their self-proclaimed spokespersons: animal rights and animal welfare NGOs (*Varkens in Nood* and *Dierenbescherming*). Basically, everybody else with a stake in the various issues around livestock farming was there, or somehow represented, though nobody publicly mentioned the absence of a farmer or of the farm lobby. In public debates over the pig tower, which overtly aimed to do away with independent farmers, they were still present and had their say. In the in vitro meat assembly, they were no longer considered relevant. Another gathering around in vitro meat occurred a year earlier, at a stakeholder meeting set up by a combination of natural scientists, philosophers and social scientists studying various aspects and implications of in vitro meat. At this occasion, the chair of the Dutch Vegetarian Society (*Bond voor Vegetariers*) participated in a creative discussion on the future of food, along with a researcher from a large meat packing division of Unilever, representatives of the ministry of agriculture, and food designers.

However, in vitro meat not only promoted new coalitions, but it also created rifts within existing organizations. Some turmoil was generated by in vitro meat while it was still in its early phases of research and development. When, as mentioned earlier, the North American animal protection organization PETA decided to put up a prize of 1 million dollars for the first commercial in vitro meat product, this decision caused 'a near civil war' within its board, as some members felt that this technology would only strengthen the immoral idea that animal flesh is to be eaten by humans (Schwartz, 2008). So instead of bringing different interests and views together in one coalition, as initially happened with the opponents of the pig tower, in vitro meat divided critics of current practices in animal husbandry.

Shifting issue understandings

The debates on projected pig towers and in vitro meat inevitably also moved towards scrutinizing current practices of animal farming. Comparisons were often made between the projected situations and existing problems, especially in formal assessments and policy analyses of the schemes (Langelaan et al., 2010). The pig tower design can be understood as a response to the Classic Swine Fever and Foot and Mouth Disease crises in the 1990s, which had recently raised public dismay about agricultural practices and their regulation. In what was proposed as a way to reduce the complexity of the system

and make it easier to control, the high-rise facilities would order the 'chaotic' practices of farmers and eliminate the untraceable movements of animals (Bos, 2004). The design would preclude farmers from ignoring regulations and reduce the possibility of transmitting diseases through contact with wild animals. Existing practices were thus revealed as chaotic and unruly. With the pig tower, specific characteristics of current livestock production were proposed to be dealt with in innovative ways: carbon dioxide and methane emissions, the elimination of transporting live animals, the use of land and scarce resources and the energy efficiency of production. Even though the potential effects of this type of livestock-management on animal health and the risk of disease outbreaks remained controversial, comparing the projected qualities of the agro-production park with current conventional pig farming showed that the new design offered an improvement on almost every ethical variable (Thinktank, 2000). Notably, the harm to animals would be reduced, as they would not be moved around in trucks, and each animal would be provided with more space than in current conventional farms. The transport, not only of live animals but also of feed, which is involved in the current system of livestock farming is highlighted by both pig tower plans and the in vitro meat project, as both emphasize the costs and environmental emissions associated with such transport. As the new agro-park design was set off against current pig production practices, those current practices were implicitly evaluated on these terms. Even though the proposal was almost universally derided and dismissed, the current problems it highlighted were explicitly considered as ethically important by all actors in the field. For instance, people who normally would not speak out or even have a position on these issues stressed the environmental costs and animal welfare problems of live pig transport. In an analysis commissioned by the government to understand the resistance against the pig tower proposal, an overview of critical arguments against the design noted problems with current agriculture: 'The large scale, the perceived negative effects on animal health and animal welfare, and the loss of autonomous family farms in the rural area, appear to have generated the most resistance.' The report mentioned corresponding advantages of the plan, such as 'less towing around with animals, beneficial impacts on the environment and landscape, and reduced risks of livestock diseases' (InnovatieNetwerk, 2004). In many subsequent discussions on the future of intensive pig farming in the Netherlands, even when not explicitly organized around this proposal, the concept of *varkensflat* figured as a frame of reference. By attracting various criticisms, the designs even drew attention to broader concerns and alternative proposals. One such proposal for closing global substance cycles was to make up for the extraction of nutrients through imported soy pig feed by shipping manure back to South America to refertilize the land.

'Cultured meat isn't natural, but neither is yogurt. And neither, for that matter, is most of the meat we eat. Cramming 10,000 chickens in a metal shed and dosing them full of antibiotics isn't natural' (in vitro meat scientist Jason Matheny, quoted in Sandhana, 2006). People involved in the project of creating in vitro meat implicitly as well as actively define current livestock farming as deeply problematic (Haagsman et al., 2009; Langelaan et al., 2010). By emphasizing the moral importance of this product more than the potential market value, they publicly claim that current livestock would be better off without having been born, and that environmental and other concerns require drastic measures to be taken. Viable cultured meat promises to

eliminate many concerns about meat production and consumption. If this technology were to be fully developed, it is expected to make more efficient use of energy and raw materials, to greatly reduce environmental emissions, and to terminate animal welfare concerns (Bhat and Fayaz, 2011; Tuomisto and Teixeira de Mattos, 2011). The discussion surrounding it highlights new problems, indicators and criteria of sustainability, such as the resources used with conventional meat production, and the spatial requirements of the globally growing demand for animal protein. When the proponents focus on (the promise of) improving environmental costs, and resource and energy use, they produce detailed descriptions of the current burdens on the agricultural sector. These include emerging risks of zoonotic animal diseases and their impact on humans, and the impact of the preventive use of antibiotics. They also argue that existing meat production is an inefficient way to produce protein. The in vitro meat scientists promise improved conversion factors over current beef and pork production, and they stress improvements in hygiene over current farms and slaughterhouses.[7] But, most notably, the possibilities claimed for in vitro meat production include a complete absence of animal suffering that would set a new standard of animal welfare on which to compare farming practices. The utilitarian calculus in arguments for livestock production would no longer be offset by the estimated utility for human consumers. Now, proponents of live meat production would need to claim that it is in the benefit of farm animals to live their productive lives.

Even before it has been shown to be a viable technology, cultured meat has started to have some impact on the understanding of the issues of livestock farming among participants in discussions of its development. In the ensuing public discussions, new 'ontological' struggles emerged. With the stem-cell-based alternative, meat becomes differentiated into various types of meat that compete with one another in terms of purity and authenticity. Willem van Eelen, the elderly pioneer of in vitro meat jumped up at the science museum debate to exclaim: 'Do not call it artificial meat, this will be real meat!' In vitro meat can be considered an 'as yet unidentified ontological object' (Stephens, 2010), which severely unsettles not only our central categories such as living and non-living, organic and inorganic, plant and animal,[8] but also helps re-imagine our ideal relations to non-humans and articulate how to think about culturally important forms of land use. In addition, the imagined and experienced meaning of dead and living bodies becomes open for reinterpretation: traditional meat eating can come to be seen as eating a 'corpse', while eating in vitro meat can be thought of as eating something both hygienically clean and morally pure. From the side of a traditional meat eating culture however, lab-produced in vitro meat thus far has been defined as lacking in authenticity and meaning, with one renowned organic butcher calling it 'soulless meat'.

So far pluripotent muscle stem cells have only been successfully isolated from mice, rats, rhesus monkeys and humans. Attempts have been made as part of the in vitro meat project to culture embryonic stem cell lines from pigs that sustain self-renewal while retaining pluripotency. This effort has proven difficult, as porcine stem cells are found to require different in vitro conditions from human or mice stem cells (Du Puy et al., 2011; Wilschut et al., 2010). Stressing a need for pig (or chicken) stem cells discloses that it is still a particular type of animal cell from a particular species that is to be eaten. The taboo on consuming human flesh is maintained, but some commentators play with connections

to deep-seated cultural taboos, by highlighting the reality for many people of a strong and embodied moral and political commitment against eating flesh (Warkentin, 2006).

The importance of language for discussing moral concerns on animal farming is generally attested by the struggle over descriptive labels such as 'factory farming' in the US and 'bio-industry' in the Netherlands, as well as the commitment of many authors in the field of animal ethics to using the term 'non-human animals'. Language has central importance for the two cases we discussed: farmers refuse to call their farms *varkensflat*, which their activist opponents are all too keen to do, as it has become a derogatory term to dismiss all large scale animal farms. The search for an appealing name for in vitro meat that would diminish its monstrous character and focus attention on its potential benefits is still going on, as it is clear to everyone involved that the name will be important for its eventual public acceptance. Often the names that are proposed as well as the associated imagery stress the ambiguity of the products. 'Labchops', 'petrimeat', 'meat 2.0', 'vatbeef' and 'test tube burgers' were some of the entries in the Dutch contest, or were puns that emerged from magazine articles. All of these terms highlight the hybrid character of being artificial and to some extent alive, while some other names stress the associated moral advantages: 'happy meat', or 'animal free meat'. At the same time, we can imagine that, following the introduction of in vitro meat and broad public acceptance of it, the normality/abnormality associations may become inverted. At some point, in discussing in vitro meat, terms will need to be devised to describe 'normal' meat: perhaps as 'animal meat', 'dead meat' or 'cadaver meat'. Accordingly, the new product would open up a new perspective on what to consider normal and acceptable. This possibility reveals that new technologies can give rise to new concepts and vocabularies, while at the same time getting their meaning from the language used to describe them.

New moral subjects and new forms of political agency and responsibility

As a third element of the world-disclosing process, the designs interfere with understandings of the character and scope of moral agency. Where the current mode of meat production had been seen as a given situation that emerged from traditional practices and the undirected interplay of technologies and markets, it now emerges as something that needs to be either consciously preferred, continued and improved, or stopped altogether. While companies involved in the current form of production often refer to consumer preference for cheap meat as a driver of intensive farming, they are now confronted with political choices. These choices emanate, not only from parliamentary politics – where there is a tendency to relate decisions about farm animal welfare to scientific techniques and consumer choice, such as in the EU Welfare Quality project (Law, 2009; Roe et al., 2011) – but also from the challenges brought forward by these new technologies. The Dutch government struggled at several levels with this new (moral) view of its various governmental forms of agency: in its role as regulator, as funder of innovation (subsidizing in vitro meat research and agropark development), and as spatial planner (on questions of whether to allow for mega farm development). The two technologies induced two very different types of normative agency for deciding on the future of animal agriculture, where the pig tower arose as a political and spatial planning issue, in vitro

meat emerged mostly as a matter of techno-scientific research and individual consumption. Debates over large-scale agroparks were in part locally driven by community protests, while deliberations over in vitro meat were not linked to any local constituency. In neither of the designs did humans figure in any active way as part of the eventual production process. And animals were only roughly sketched as three-dimensional renderings in the computer-generated towers of MVRDV, and schematically depicted at the start of the flow charts abstractly explaining the making of in vitro meat.

Various parties developed their positions as moral and political subjects of the new technology. Not only did these technologies strike a chord with particular interest groups, but these 'relevant social groups' (Bijker, 1995) also formed in the process of designing and materially interpreting those technologies. The shared dismissal of the pig towers and the broad fascination with in vitro meat implied quite radical positions and moral roles in relation to existing farm practices. Prior to the pig tower design, farmers saw themselves confronted with either consumer demand or with governmental requirements, but now they had to respond to newly emerging publics and to reinvent themselves as having a professional but still intimate relationship with animals that automated high-rise installations would not offer. As one pig farmer responded when presented with an overview of the benefits of an *agropark* during a public discussion on a pig tower project in Zaanstad: 'But we can do all that too!' To which the manager of the *agropark* consortium retorted: 'But you don't!' Consequently, these proposals dismissed farmers as moral subjects capable of improving farming practices. Both technologies ignored the practice of farming as meaningful in itself. The farmer and his or her skills in these plans were rendered superfluous or relegated to a luxury niche market. Alternatively, they were changed beyond recognition, such as when some pig tower proponents emphasized the possibility that farmers could rent a floor in a high-rise agro-park, literally realizing the 'vertical integration' of the agro-food industry.

The idea of in vitro meat drew attention to various concerns that inform ethical lifestyles such as vegetarianism, as it induced a potential redefinition of the relation between meat and the slaughtering of animals. With both techno-scientific projects, environmental and animal welfare NGOs had to redefine themselves in relation to the production of meat, and to struggle internally in order to develop positions towards their shifting constituencies. The animal rights NGO PETA, as part of the prize they offered to create animal free in vitro meat, published a recipe for a fried chicken dish as a prescription for 'real meat'. One of the criteria for receiving the prize was: 'Produce an in vitro chicken-meat product that has a taste and texture indistinguishable from real chicken flesh to non-meat-eaters and meat-eaters alike. Judging of taste and texture will be performed by a panel of 10 PETA judges, who will sample the in vitro chicken prepared using PETA's own fried "chicken" recipe. The in vitro chicken must get a score of at least 80 when evaluated in order to win the prize' (People for the Ethical Treatment of Animals, 2008b). Even though PETA argued that in vitro meat propagation was aimed at those people who 'cannot kick their meat eating addiction', for some within the organization, the proposal seemed to concede to the importance of meat as a culinary craving. Meanwhile the PETA leadership defended its promotion of in vitro meat as a pragmatic rather than morally pure strategy (Schwartz, 2008).

At the same time, the microbiologists involved in researching and developing in vitro meat attempted to create meat without causing any animal suffering, and claimed to worry about even the least infringement of animal bodily integrity. Part of the in vitro meat research programme aimed to produce an alternative to the commonly used bovine calf serum as a growth medium for stem cells. 'Since no other animal sources are wanted in the process of in vitro cultured meat, conventional culture medium, which is commonly supplemented with fetal bovine serum, has to be adjusted' (Langelaan et al., 2010). In part, this aim was motivated by the fact that the exact content of the existing animal serum growth media was unknown and variable (Haagsman et al., 2009). But, beyond this consideration, the in vitro meat project apparently led the tissue engineers to commit to the ethical ideal of veganism: of not intentionally killing or even harming a single animal during food production. These microbiologists – members of a profession that is not generally known for a commitment to avoiding any form of animal suffering – stressed how the biopsy used for obtaining the stem cells would not need to kill a single animal. The source animal often was sketched as leading a princely life for the rest of its days in a sanctuary after undergoing the minor inconvenience of this biopsy. However, at least one prominent in vitro meat scientist indicated that 'he would not like to see the field dominated by the animal welfare issue, since environmental and public health issues are such important drivers for his research' (Schwartz, 2008). The in vitro meat technology even led some meat culturing biotechnologists to organize an 'international alliance of environmentally concerned scientists', in an effort to get funding for research to produce muscle tissue on an industrial scale (Stephens, 2010).

The in vitro meat proposal thus managed to reconfigure its central actors, sometimes almost beyond recognition. It led them to take up moral positions and commit to practices that otherwise would seem far removed from their public stances. Even the nature of the moral subject and its embodied experience of moral concerns was at stake. A common first response on the idea of eating the lab-grown meat was one of physical disgust (Van der Weele, 2011). Often this initial gut reaction, which was interwoven with moral judgments, was later articulated in more rational terms that stressed the benefits of avoiding the suffering of future farm animals. During debates on in vitro meat, the moral relevance of this embodied form of appreciation was discussed and the appropriate bodily response was reimagined. The expression of disgust over eating in vitro meat recalls the 'yuck-factor' in bioethics, but proponents of the technology imagined that it would eventually be overcome through rational assessment of the moral situation and the character of normal meat. Accordingly, the sense of disgust was treated as a cultural convention to be transcended (Pluhar, 2010) or a response that could just as well be redirected at conventional meat. Here (moral) agency emerged as a matter of deliberation on how to be bodily affected.

With this third aspect of moral world-disclosure, in which technological designs afford the development of particular forms of moral subjects, it is clear that the subject/object divide is as much an outcome of the process of grappling with new technologies as it is the self evident starting point for assessing something new. However, this does not necessarily mean that political positions are materially determined, or that moral subjects are completely dissolved in processes of technological development. In the following

section we delve into the work of Dewey and Heidegger in order to understand the normative and ontological processes occasioned by in vitro meat and pig towers.

Dewey, Heidegger and the dynamics of moral world disclosure

Heidegger and Dewey help us to highlight several aspects of the deeply ambiguous process of world disclosure brought about by the two technologies. By now it should be clear that there are various ways to understand the pig towers and in vitro meat and their societal meanings. An initial, superficial understanding of these controversies can be summarized in terms of Dewey's and Heidegger's philosophies. First, the designs can be thought of as thoroughly pragmatic solutions to the problematic situation of intensive pig farming. Accordingly, the towers would provide the animals with a slightly better life than they have now – the pigs could be housed in a system that, in an ironic term derived from the tourism industry, has been labelled 'comfort class' (Bos et al., 2006). Dewey and Heidegger have previously been called upon to interpret the peculiar nature of politics concerned with scientific controversy and technological change (Latour, 2005). Dewey is helpful for highlighting the ways in which issues 'bring their own publics into being by affecting them somehow' (Bohman, 2000; Dewey, 1954 [1927]; DiSalvo, 2009; Marres, 2007). In the technological proposals we discuss, 'being affected' can be found to include being intrigued, fascinated, repulsed, or in some other way moved into action beyond directly being harmed. Accordingly, the designs can be thought of as 'things' in the Heideggerian sense in which material objects are considered as *gatherings* of relations, etymologically connected to the 'thing' as a pre-modern communal parliament (Heidegger, 1971; Latour, 2005: 23; see also, Harman, 2009: 138; Storni, 2012).

Technologies that render Heideggerian thinking as mainstream

In Heidegger's terms, both designs are essentially the same: extreme instances of technological optimization that subsume everything to the 'enframing' (*Gestell*) mode of thought, in which our entire existence is to be optimized and turned into a 'standing reserve'. Even though the pig towers and in vitro meat may be the wrong way of responding to the place and the moral quality of farming, in a pragmatic sense they allow for the containment of industrial optimization in a few locations, whether in labs or in towers. Heidegger would probably reject the possibility of spatial – as well as mental or philosophical – compartmentalization, but this way of localizing the *Gestell* mode of calculative thinking on some remote and uninhabited spaces would leave abundant room in the rest of the world for conserving nature in a pristine state and cultivating a more authentic relation to the land. One could say, though, (arguably in a fashion consistent with Heidegger) that our commitment to these technologies would still mean our world is disclosed as standing reserve in terms of the hubristic desire for total control inherent in modern technology. While arguments in favour of the proposals are overtly 'pragmatic', the critiques of both the pig towers and in vitro meat tend to align with the Heideggerian style of dismissing modern technology on metaphysical grounds. In this vein, for critics (such as

those who voiced opposition to PETA's prize), culturing meat is 'just the wrong kind of thinking', as it emphasizes that meat is for human consumption. It reduces animals to being 'mere bioreactors', as Donna Haraway (2008) has argued. In Heideggerian terms, the pig tower would mean radically unearthing the peasant, who was the model 'dweller', essentially connected to the environment; a human being who had a true and authentic, immersive (*zuhanden*) relation to (handicraft) technologies and to the land. Several media responses to the pig tower scheme equated the plan with the holocaust, thereby expressing a mainstream variant of an infamous remark by Heidegger, in which he compared the holocaust with modern agriculture.[9] Indeed, the implication is that, with this type of design for total control, humankind is at stake in the debates over both technologies. So, why not also integrate humans into the industrial ecology to fully complete the substance cycle? A columnist with a major Dutch newspaper made a cynical suggestion to include a home for the elderly in the pig tower, calculating that 1 million pigs could heat the homes of 30,000 elderly citizens (Knip, 2000). And why not eat lab cultured human cells, since the taboo on cannibalism would be lifted for such meat without an organism? An advantage would be to shortcut substance cycles, to render our own flesh as part of the optimizing calculative rationality. By extrapolating the technologies to include the way we relate to human nature, the unsettling character of the proposals is emphasized and the audience is shocked into questioning the mode of thinking behind them. Through their unsettling character these technologies allowed for – or even rendered mainstream – radical critiques that normally are dismissed as irrational or utopian.

In line with both Dewey and Heidegger, the particular worlds disclosed by these technologies are highly specific for a certain space and time: the early 21st century (and particularly Dutch) cultural experience, media landscape and political as well as technoscientific institutions around agriculture and meat. In a different 'meat culture', in vitro meat using stem cells might be so alien as to do little to unsettle an ontological and moral order. Or, in a different farm culture, a pig tower would seem too outrageous to propose. For instance, Dickson Despommier in the US proposed a 'vertical farm' including chickens, but decided against including pigs.[10] Or, as with the 'Greenport Shanghai', projecting 1 million pigs housed in a single facility may seemingly not produce any moral unease.

On actively relating to processes of world disclosure

When the critiques of in vitro meat and pig towers are redirected towards existing industrial agricultural practices, the non-neutrality of the purely technological way of thinking is disclosed. In Heidegger's terms, these technologies are revealed as merely the final versions of a metaphysics that turns everything, including living animals, into material for efficient use. But they actually disclose a world by revealing how this works to a wide public. The designs make explicit that technology is not merely a neutral set of objects we can choose to use, but also comprises a way of thinking and discloses a particular world. The public grappling with these technologies then moves towards an appreciation of how in contemporary agricultural practices and debates, we are already thinking completely in terms of efficiency and optimization, and that can be contrasted with other, more meaningful modes of engaging with agricultural concerns.

Heidegger warned that technology tends not only to reveal our world and ourselves in a particular way, but also hides the fact that it is a particular way of revealing (Heidegger, 1977). The technological projects we discussed instead highlighted not only their own extremity, but also a mode of thinking of which they are the endpoint. We may thus be witnessing what Heidegger calls 'the unfolding of the essence of technology'; an essence that contains the 'saving power' within itself (Riis, 2008). Many have wondered how to understand the puzzling fragment from the poet Hölderlin: 'But where the danger is, grows the saving power also' that Heidegger quoted in his 'questioning' of technology (1977: 28). We could understand it to mean that we need to take the calculative technological rationality to its extreme in order to disclose our haphazard ontological predicament of being enframed by technological reason. Technology then is deeply ambiguous: on the one hand it completely turns the world into a standing reserve, at the same time this total enframing taken to the extreme can make us aware of the process and open up ways to 'gain a free relation to technology' (Heidegger, 1977: 33).

With Dewey, we can understand the process of world disclosure in a to-some-extent similar vein. The proposals could be considered part of an experimental form of creative inquiry, which integrates technological design, scientific research, and artistic imagination (Dewey, 2005 [1934]). Rather than remaining locked up within the old routines of thought, these technologies provide an opportunity for 'dramatic rehearsal': trying out fresh attitudes towards our everyday practices, which may result in a collective exploration of long-called for solutions to pressing societal problems. In this process, and with his concept of experience, Dewey offers a way to understand the bodily, affective nature of the publics that emerge around issues, as it is not so much shared interests that give rise to new collectives, but shared experiences (Bennett, 2010: 100). This type of understanding of the embodied political subject would promote, for example, taking the 'yuck' response to in vitro meat not as a merely subjective feeling in the face of a new object, but as a relevant response to a shared cultural commitment. Politics of this material kind is an ongoing process of public experimentation (Gross, 2010; Latour, 2004), in which ethical concerns are dealt with in part by practical tinkering rather than through discussing and applying moral principles to new situations (Korthals, 2004; Mol, 2002).

Often Dewey is treated as a champion of deliberative democracy, and contrasted with Heidegger, the anti-democratic or even anti-political mystic in discussions of their work (Bohman, 1994; Kompridis, 1994; Rorty, 1976, 2005).[11] Is dismissal of these technologies a mere gut reaction to be overcome by rational debate, or an expression of deep seated moral concerns that are central to people's understandings of the world and of themselves? The broad public consensus that emerged about our two examples appeared to be that in vitro meat is a case of the former, while the pig tower was a case of the latter. The reception to these technological proposals thus comprised a struggle over which arguments were relevant, and which contributions to consider appropriate for debate (Davies, 2006). With Dewey and Heidegger, we can overcome the tendency to treat these reactions as either emotional or rational, a dichotomy based on an absolute and static subject/object distinction. Different types of 'arguments' are brought to the fore, and their relevance is decided in an ad hoc way. And, as was the case with the public rejection of the pig towers, even a (Heideggerian) refusal to engage in logical argumentation and propositional thinking can be broadly agreed upon.

Technologies functioning as art

Both Dewey and Heidegger consider art to be the primary or ideal form of disclosing our moral world. For Dewey, subjects emerge from partaking in culture, in imaginative experience. 'The sum total of the effect of all reflective treatises on morals is insignificant in comparison with the influence of architecture, novel, drama, on life' (Dewey, 2005 [1934]: 359). Dewey, as opposed to Heidegger, does not contrast art and techno-science as mutually exclusive modes of world disclosing, but describes his ideal of integrating both modes. 'Even technological arts, in their sum total, do something more than provide a number of separate conveniences and facilities. They shape collective occupations and thus determine direction of interest and attention, and hence affect desire and purpose' (Dewey, 2005 [1934]: 359). For Heidegger, integrating art with technology requires a return to the classical Greek meaning of *techne*, in which poetry and crafts were not yet separate. The high-tech works of art we discuss here open up worlds, though not by evoking the rich experience of farm life the way Van Gogh's peasant shoe did for Heidegger (1971), but by overtly reducing agriculture to the efficient conversion of nutrients into easily digestable proteins.

Besides being techno-scientific research projects, our two examples both also have functioned as works of art, making the distinction and the difference between these forms of world disclosure less clear cut.[12] Lab based bioartists performing in a museum (Catts and Zurr, 2002), and architectural designers extrapolating existing practices into evocative designs (MVRDV, 2001), have managed to blur the boundaries between art and technology. It is through art projects that the proposals are extrapolated to the extreme, but art and design also generate newly meaningful ways of relating to late modern meat production. Especially in these creative explorations of the two technological proposals, both technologies can be envisioned, not as cases of utter alienation from agriculture situated in a remote industrial zone or invisible lab, but as renewed and perhaps hermeneutically embedded relationships to food production. A variant of the pig tower scheme is then projected as an example of 'urban agriculture', bringing city dwellers back in touch with how their food is produced (Bos et al., 2006; Stroom, 2009). Could a well-designed pig tower then not merely function as a way to optimize agricultural logistics, but also as a way to involve a variety of publics in agricultural practices, all the while improving the situation for the pigs as well? And, could in vitro meat production, for instance when designed as a kitchen appliance (Electrolux, 2009), function as a 'focal thing' (Borgmann, 1984) that brings us closer to food production and gives rise to new meanings in shared practices? Perhaps these possibilities could even lead us to imagine the ultimate form of hospitality, enabling us to prepare and offer our guests a 'piece of ourselves', thus allowing for the creative development of new rituals that resonate with various religious practices. If designed well, these may be high tech ways to overcome the means–ends and subject–object divides in the metaphysics of modern technology, while at the same time they avoid reverting to the nostalgia that merely idealizes traditional farm practices, thereby deepening debates and expanding moral imaginations. We may not agree with the desirability of these proposals, whatever form they will take, but with Dewey and Heidegger, we can appreciate how these things offer occasions to discuss existing moral concerns in a new light, forge new political coalitions and develop new moral identities.

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Notes

1. The 'precautionary principle' is mainly invoked to argue against accepting new technologies, rather than against putting up with the risks of continuing with the status quo (Latour, 2011; Van den Belt, 2003).
2. The current Dutch pig farm contains on average about 3000 pigs, which is more than double the number of pigs per farm in 1995. In other sectors of livestock husbandry, the average farm also grows continuously, with similar trends in other countries.
3. In 1997, a Master's student at the faculty of Architecture of Delft University of Technology had come up with a similar design, also including a slaughterhouse and deducing its rationale from spatial planning and its dimensions from the internal logic of intensive pig farming (Berghauser Pont, 1997).
4. This public reception had been foreseen in the original report: 'The husbandry system described above requires considerable changes in (social) views: provinces and municipalities should be prepared to allow pig flats in agri-industrial areas; the public opinion should consider such a system of production and housing animal friendly; the public and agrarian sector should accept the change of family farms to really industrial production of pig meat. Currently these conditions are not met' (Thinktank, 2000: 34). In analyses of the public response, it was thought to have 'an image problem with consumers' (De Wilt et al., 2000: 18) or, in hindsight, a matter of 'communication not adequately dealt with' (InnovatieNetwerk, 2004).
5. For the most part, the challenge is not considered a matter of producing the right taste. The meat industry has developed ways of infusing tastefulness into meat products of all kinds. One way of using this technique in meat production is not marketing it as such, but mixing it with normal meat in products such as sausages, thereby creating an object with an even more ambivalent moral character.
6. The deadline was extended from the initial date of June 2010 and has been extended again to 2013.
7. See, for example, Langelaan et al. (2010): 'the production process can be monitored in detail in a laboratory, which could result in the elimination of food borne illnesses, such as mad cow disease or salmonella infection'.
8. See, for example, Haagsman et al. (2009) for a discussion of the possibilities for producing a plant based growth medium: 'by using recombinant-DNA technology it has become possible to let plant cells produce such animal proteins'.

9. 'Agriculture is now a mechanized food industry, in essence the same as the manufacture of corpses in the gas chambers and death camps . . . ', runs the infamous quote in translation, though in German it says *Ackerbau* for agriculture, thus pointing at arable rather than animal farming (Schirmacher, 1983). The character Elizabeth Costello in Coetzee's (2003) novel by that name makes a similar comparison between the slaughter of animals and the holocaust. It is therefore remarkable that with the arrival of the Pig Tower proposal, what was a marginal and highly controversial position (Patterson, 2002) suddenly becomes broadly considered as a plausible and widely accepted analogy through which to understand and discuss industrialized farming.
10. 'You can't raise – well, you can raise pigs inside [the vertical farm] if you'd like. A lot of animal rights people would object to that so we've eliminated that as a possibility. But no one objects to chickens. I don't know why' (Despommier, 2009).
11. Though, for others, it is Dewey who poses a threat to democracy, with his 'equation of inquiry with scientific experimentation', thereby being 'excessively optimistic about enlightenment rationality', while 'lacking a dystopian sensibility for the technocratic threats of science' (Feenberg, 2003).
12. For more examples of how conjunctions of art and science can produce shifting definitions and practices of politics, see Gabrys and Yusoff (2011).

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