Chapter 31

Comment: Evolution 2.0—Rewriting the Biosphere

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CRISPR-Cas9 was only discovered in 2012, but this new genome editing tool immediately raised high expectations about the virtually unlimited range of applications it brought into view as it turned previously remote possibilities into realistic options. Apart from applications in human medicine and industrial biotechnology, its most obvious uses are in the genetic improvement of crops and domestic animals, where it can replace the older, more cumbersome and less versatile techniques of genetic modification (aka recombinant-DNA technology). But CRISPR also aims at applications beyond conventional agriculture. It makes the prospect of reconstructing extinct species ('de-extinction') as a new approach to conservation seem more feasible and also lies at the basis of the ingenious 'gene drive' technique, which enables us to quickly spread desired traits through wild populations. As co-discoverer Jennifer Doudna declares with no false modesty: "CRISPR gives us the power to radically and irreversibly alter the biosphere that we inhabit by providing a way to rewrite the very molecules of life any way we wish" (Doudna and Sternberg 2017, 119).

Environmental philosopher Christopher Preston considers de-extinction and gene drives, alongside nanotechnology, synthetic biology, geo-engineering and the creation of so-called novel ecosystems, as pre-eminent technologies of the Anthropocene or Synthetic Age, as he prefers to call the new era (Preston 2018). What these technologies have in common is that they all reach very deeply into the 'metabolism' between man and nature: processes that are basic to the functioning of terrestrial systems are increasingly replaced by processes that are directly controlled by humans. Evolution, for instance, is no longer left to the blind process of random mutation and natural selection but becomes an object of deliberate 'evolutionary engineering' through synthetic biology, de-extinction efforts and gene drives; the earthly climate

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is no longer exclusively determined by the amount of solar irradiation but becomes an object of direct manipulation through geo-engineering.

Standing at the threshold of these unprecedented possibilities, many would counsel caution and urge to pause for reflection before rushing headlong into the brave new world of Synthetic Age technologies. However, there is also a very influential group of technology optimists known as ecomodernists who eagerly embrace the ‘good Anthropocene’ and cannot wait to go full speed ahead with the new technologies, as these in their view hold out the promise of continued increase in human wellbeing while simultaneously addressing environmental problems like climate change and biodiversity loss. Given its prominence in contemporary debates, it is not surprising that all chapters in this section engage with and confront ecomodernism in one way or another, even if only implicitly. This engagement will also provide the red thread in my commentary to connect the various themes discussed in the chapters under consideration.

31.1 Gene Editing, Gene Drives and De-extinction

In his contribution to this volume Preston has chosen a different approach than in *The Synthetic Age*. In his book he attempted to define the epochal significance of the new technologies that might enable us to take over some of Nature’s most basic operations, accepting the sweeping claims made by the protagonists of those technologies and their ecomodernist supporters more or less at face value. Now he takes a different tack. Following Alfred Nordmann’s criticism of ‘speculative ethics’, he focuses on the credibility and tenability of the claims made with regard to the potential performance of de-extinction and gene drives, concluding that these claims are overblown and that “the discourse around gene drives and de-extinction is creating a harmful speculative ethics”. Such a discourse might lead to a premature fixation on highly speculative technologies, thereby obscuring alternative, less glamorous but ultimately more promising approaches from view.

Preston explains that the success of de-extinction and gene drives in actual practice crucially depends on a key assumption of reductionist molecular science, to wit, that it is possible to obtain *predictable* effects on the level of the behaviour of organisms within their natural environments by intervening on the level of their genomes. He adduces many findings from biological research which indicate that this assumption of control and predictability may not actually hold. Although CRISPR has been advertised as an extremely accurate and precise gene editing tool, in practice researchers have meanwhile been confronted with many unpleasant surprises like off-target effects, unforeseen genomic deletions and rearrangements, and other unpredicted changes in the genome. It is also well-known that there is no one-to-one correspondence between genotype and phenotype; a single genetic alteration may have more than one phenotypic effect. Preston mentions a Chinese attempt to use gene editing for promoting muscle growth in pigs, which also resulted in the unforeseen appearance of extra vertebrae. Furthermore, the stability of the altered genome may

also be problematic. Neither should we forget that constructed life forms, despite their man-made origin, become subject to the Darwinian pressures of mutation and selection after environmental release. There is also no guarantee that a gene drive can be confined to the target population, as hybridization with related species remains a realistic possibility. For all these and other reasons, Preston holds that gene drives and de-extinction (and also gene editing in general) are far more questionable than they are usually held to be. He gleefully cites the sobering conclusion of the IUCN ‘de-extinction taskforce’ of 2014 that modern biotechnology cannot actually bring back a faithful replica of a lost species but at best only a ‘proxy species’ or approximation.

The main problem behind the enthusiasm for gene drives and de-extinction as conservation tools, Preston suggests in his chapter, is the delusion of predictability and control to which their protagonists and supporters fall so easily prey, and the pretence that *agency* is exclusively located on the side of humans and that the rest of living nature constitutes no more than *passive* matter. This emphasis on epistemological (and also ontological) criticism is slightly at odds with the thrust of Preston’s earlier analysis in his book. There he was mainly concerned about the potential loss of the ‘otherness’ of Nature (or her genuine ‘wildness’) as a consequence of our unremitting attempts to impose our own designs on her workings. In the end, however, there is no real contradiction, as wildness not only refers to the autonomy of animals and landscapes beyond human endeavours, but also connotes an essential lack of predictability:

In its fickleness, its unpredictability, and its capacity continually to exceed our expectations, wildness will ensure that remaking the earth will always remain a game of high chance. When we insert ourselves so deeply into the workings of a planet, we are unlikely to be able to predict all of the consequences of our actions. There are serious risks to letting ourselves be seduced by the sublime beauties of technology. (Preston 2018, 178)

31.2 Resurrecting the Heath Hen

In her contribution Jennifer Welchman offers a detailed scrutiny of the so-called reparations argument in favour of de-extinction by extensively considering the case of the heath hen, a ground-dwelling bird that went extinct in 1932. The heath hen has been adopted by the Revive and Restore organization as a candidate for a de-extinction project on Martha’s Vineyard, an island before the coast of Massachusetts. Revive and Restore was founded in 2012 by the self-declared ecomodernists Stewart Brand and Ryan Phelan as a nonprofit organization for the “genetic rescue” of endangered and extinct species. The name of the organization suggests that it is actually possible to “revive” an extinct species. As it explains on its website, “the trick [with de-extinction] will be to transfer the genes that define the extinct species into the genome of the related species, effectively converting it into a living version of the extinct creature” (Revive and Restore, n.d.). The fact that a “revived” species can at best be only a proxy or approximation but not a faithful replica of the extinct animal is somewhat downplayed here. Various rationales are invoked to justify de-extinction

projects, among which we can also recognize the reparations argument: “to undo harm that humans have caused” (Brand 2014). However, this argument is just briefly mentioned but not further elaborated and expanded upon.

Welchman rightly notes that the reparations argument, unlike many of the other, mostly utilitarian or consequentialist reasons invoked for de-extinction, is not forward-looking but backward-looking. In fact there is something odd about the fact that de-extinction has been embraced as a worthy ‘conservation’ goal by ecomodernists, because the aim of bringing back extinct species from the dead looks itself extremely backward-looking. It appears to run counter to the usual ecomodernists’ appeal to the Anthropocene as a new dispensation that precludes any possibility of returning to the ecological past. Yet, as Ronald Sandler duly observes, “de-extinction aims to recapture something lost and [...] is *highly nostalgic*” (Sandler 2017). Thus we find Stewart Brand feeling thrilled by the prospect of recreating the majestic spectacle of “clouds of passenger pigeons once again darkening the sun” (Brand 2014)—a spectacle famously evoked earlier by conservationist Aldo Leopold to mourn the loss of this characteristic American bird (Leopold 1947). But we may wonder whether the thrill is really about the possible return of a scene of natural sublimity or rather about the technological marvels of human ingenuity. The new ‘resurrectionists’ seem intent on stealing the thunder from the old conservation movement and turning the unceasing succession of sad news stories on the loss of one species after another into some kind of good news show. Indeed, Brand sees huge strategic advantage in a more positive approach to conservation: “The conservation story could shift from negative to positive, from constant whining and guilt-tripping to high fives and new excitement” (Brand 2014).

More traditional conservationists like Paul Ehrlich are understandably worried that an emphasis on de-extinction will create a moral hazard leading to diminished public support for conventional efforts to prevent extinction: “The problem is that if people begin to take a ‘Jurassic Park’ future seriously, they will do even less to stem the building sixth great mass extinction event” (Ehrlich 2014). This moral hazard would be another illustration of Alfred Nordmann’s speculative ethics that was discussed by Preston. Environmental philosopher Ben Minteer maintains that ‘resurrectionists’ refuse to accept natural limits and that their projects reflect “a new kind of Promethean spirit that attempts to leverage our boundless cleverness and powerful tools for conservation” (Minteer 2014).

In her chapter Welchman touches only indirectly on these ‘ideological’ background disputes. Her focus is on the reparations argument and her main aim is to constructively elaborate the rather rudimentary version of this argument as it is found in the literature into a more full-fledged and defensible form, so as to provide a normative standard by which to judge the particular case of the de-extinction project around the heath hen. The argument that ‘we’—or in practice some collective agency like the United States or the State of Massachusetts—have a moral duty of (restitutive) justice to undo the harm of anthropogenic extinction by creating a replica of the extinct species, though often invoked, is much more difficult and problematic than might appear at first sight. Even if it is granted (against Clare Palmer) that humans can have duties of justice vis-à-vis wild animals, the reparations argument is still

confronted with many challenges. A key question is *who* could be owed reparations. In comparable cases of historical injustice inflicted on certain human populations (e.g. colonialism and slavery), it is in principle possible to right such wrongs by compensating the descendants of the dead victims. But extinct animals are all dead and have no living descendants. However, reparations might also be owed to the few remaining members of a severely endangered species, e.g. when the breeding population size is no longer viable. Thus in the case of the northern white rhino and of the black-footed ferret, it would be appropriate (or perhaps even morally obligatory) to create additional mating partners by using cloning techniques (which are also used in de-extinction programs). Strictly speaking, of course, this is not an instance of de-extinction. As Welchman writes, “when we are responsible for driving a species into an extinction vortex for lack of viable reproductive partners, we could in principle owe it to that species to ‘bring it back’ – albeit from extinction’s door rather than extinction proper.” She holds that the reparations argument most suitably applies to such rare and somewhat atypical cases.

Interestingly, Welchman also contemplates the possibility that the duty to undo the harm of extinction might be owed to humans who mourn the loss of extinct animals: “It is a standing grief to many that they will never enjoy the sight or sound of Heath Hens strutting and booming on their breeding grounds as earlier generations did.” Welchman cites the views of a local naturalist from Martha’s Vineyard, Tom Chase, who mourns the progressive loss of a rich bird life since his early childhood and is enthusiastic about the prospect of genetically replicating the heath hen: “[A]s a conservatonist, I’m tired of fighting for things and always losing. I want to get on the proactive side and not on the reactive side” (quoted in Welchman). Another local naturalist, Stephen Kellert, sees in the heath hen de-extinction project an extraordinary opportunity for the communities on Martha’s Vineyard to restore their connection to nature and to deepen their relation with the larger community of life.

Such views have been severely criticized by Ben Minteer. He condemns de-extinction as a technological fix that cannot “atone” for the harm that has been done by driving the heath hen to extinction. It is, in his judgment, a Promethean celebration of human technological prowess. By pursuing high-tech species revival technologies, the protagonists and supporters of de-extinction undermine our responsibility for preventing mass extinction by promoting the dangerous illusion that any harms we might have inflicted and are still inflicting can ultimately be fixed again.

Welchman holds that Minteer’s criticism is unduly dismissive and also based on a misinterpretation. The replication of the heath hen as a technical achievement would not as such “atone” for past abuses. Rather, it is seen as providing an opportunity for the communities on Martha’s Vineyard to reconnect with nature; the focus is on what would happen *after* successful replication, when the islanders must learn to live *with* (replicas of) heath hens. To succeed, they “would have to develop new virtues of care for this species and its environment”.

Welchman is also sceptical of the moral hazard argument. She claims that there is no empirical evidence for the expectation that the public would become indifferent to the continuing loss of biodiversity because of the erroneous belief that extinctions can

always be remedied. By contrast, she points out that there is strong evidence to suggest that the public's feeling of powerlessness in the face of large-scale environmental problems (such as anthropogenic extinction) can easily lead to apathy, disengagement and denial. Thus she cautiously and partly subscribes to the ecomodernists' stress on the need for some positive message. For her, however, the focus is not primarily on the technical achievement of replication. De-extinction of the heath hen would enable the residents of Martha's Vineyard to find out what they can do themselves in concrete ways to mitigate, if ever so slightly, the colossal problem of anthropogenic extinction. If they succeed in learning to live with heath hens and to grant these fellow creatures the chance to flourish on their island, this example might stimulate other de-extinction and conservation efforts. Perhaps the best thing the islanders can do is simply give it a try. But here Welchman notices that she has moved beyond the reparations argument and entered the domain of forward-looking reasons for replicating extinct species.

31.3 Cultured Meat

Cor van der Weele's chapter is about cultured meat (or 'clean meat', as it is sometimes labelled). It is proposed as a technological solution for the huge environmental and animal welfare problems created by our current mode of meat production through the raising and slaughtering of livestock. If successfully rolled out on a global scale, it would fundamentally alter the human-animal relationship. Van der Weele points out that the impetus to the development of cultured meat is more a matter of 'ethical pull' than of 'technology push'. However, it would also neatly fit the tenets of ecomodernism: "Cultured meat is a clear example of *decoupling* [as favoured by ecomodernists] since it attempts to employ technology to produce the same vast amounts of meat with significantly less environmental damage" (Anthos 2018, 20). According to some early estimates, the potential for reduced resource use is enormous, allegedly allowing 7–45% lower energy use, 78–96% lower greenhouse gas emissions, 99% lower land use, and 82–96% lower water use (Tuomisto and Teixeira de Mattos 2011). Another key ethical argument for cultured meat is that it would put an end to the massive suffering of livestock on 'factory farms'.

The current scale of 'industrialized' farming can itself be seen as indicative of the Anthropocene epoch: "Livestock now constitute 60% of the mammalian biomass and humans another 36%. Only 4% remains for the more than 5000 species of wild mammals" (Baillie and Zhang 2018). In terms of avian biomass, poultry currently makes up 70% of all birds on earth, leaving only 30% for wild birds (Carrington 2018). These incredible percentages show the inordinate size of human claims on the biosphere. It is important to point out that the present size of the human footprint has been made possible only through a whole series of scientific and technological advances in the areas of animal and plant breeding, nutrition science, microbiology, antibiotics, etcetera (Boyd 2001). One important aspect is the immensely increased use of nitrogen fertilizer to grow feed crops, enabled by the fixation of nitrogen

through the Haber-Bosch process, which led to a huge rechanneling of the nitrogen cycle on planet Earth—itself a major indicator of the Anthropocene (Elser 2011).

It is clear that animal farming in its current size and form, the end result of a long process of technological advance and modernization, is simply unsustainable. Ecomodernists, however, hold that we need more technology to solve the problems created by earlier technology. Thus Nordhaus and Shellenberger declare: “The solution to the unintended consequences of modernity is, and has always been, more modernity – just as the solution to the unintended consequences of our technologies has always been more technology” (Nordhaus and Shellenberger 2012). Cultured meat seems to ideally fit the ecomodernists’ bill. No wonder, then, that commercial projections optimistically forecast that by 2040 some 35% of the demand for ‘meat’ will be covered by cultured meat (and 25% by plant-based vegan replacements) (Carrington 2019).

One may wonder whether the technology of ‘culturing’ meat can be considered a Synthetic Age technology in Christopher Preston’s sense insofar as it entails a fundamental change in the ‘metabolism’ between humans and nonhuman nature. Compared to more conventional animal husbandry, it surely involves a radically new step by taking control down to the cellular level, virtually amounting to a “second domestication” (Shapiro 2017). However, it can also be seen as a further continuation of the ongoing industrialization of animal farming, culminating finally in a Hegelian sublation and negation of the animal itself. While in current systems of factory farming, animals are increasingly reduced to living protein machines in order to maximize the production of edible meat, ‘culturing’ meat would take this development to its ultimate conclusion of “just a protein machine, without the animal” (Galusky 2014, 932). For Simon Fairly, an advocate of sustainable (and modest) meat consumption, cultured meat also lies at the end of a road to factory food and human alienation from nature, away from the trend in the organic sector towards “slow food, real meat and fresh local produce” (quoted by Van der Weele).

Critics like Anthos and Galusky question whether the expected benefits of cultured meat will ultimately be realized and also point out that this new technology requires an extreme level of human control over the biological processes of muscle tissue growth—a level of control that might well be illusory (compare Preston’s critique of gene editing and gene drives). Somewhat paradoxically, however, their biggest fear seems to be that this technology might nonetheless ultimately prove feasible. For this would mean that we could ‘solve’ our problematic relationship with animals and the natural environment by a simple ‘technofix’, without changing our lifestyle. In that case, Galusky holds, “the ethical questions surrounding eating meat are not so much engaged as eliminated” (Galusky 2014, 937). Anthos similarly remarks that “[o]ut of concern for the animals, the relationship to the farm animal disappears, reduced to a more abstract idea that sentient beings are no longer suffering for this meat” (Anthos 2018, 38). The disappearance of our relationship with farm animals would in his view amount to a further stage in the alienation of humans from nonhuman nature.

In her contribution, Cor van der Weele aims to save cultured meat from ecomodernism (as the title of her chapter indicates), but also from its detractors. She very much deplores the dualistic way of thinking that appears to hold sway whenever

we reflect on the future of agriculture and humanity's relation to nature, as manifested, for instance, in the polarization between 'wizards' and 'prophets' described by Charles Mann. This characteristic opposition of views, pitting optimistic faith in technological progress against an emphasis on lifestyle changes, is also found in the polarization between the ecomodernists, on the one hand, and the subscribers to the Dark Mountain Manifesto, on the other. Van der Weele points out that both parties have their own accounts of mechanisms of selective attention, which are held to explain why the other party is seemingly blind to the obvious truth. These two accounts are almost each other's mirror image and they are used in a rather self-serving way to bolster belief in one's own view of the world (illustrating the biblical saying that you look at the speck in your brother's eye but fail to notice the beam in your own eye). Van der Weele holds that selective attention is indeed an extremely important phenomenon and that its underlying mechanisms are worthy of in-depth study. However, this study should be done in a more impartial and less asymmetric way. She also emphasizes that a dualistic way of thinking is itself a very influential mechanism of selective attention, which may have paralysing effects.

To criticize the dualism between technology and lifestyle, Van der Weele argues against the ecomodernist framing of cultured meat as the only plausible scenario of the future. In her research with focus groups, an interesting alternative scenario has been suggested by one of those groups, dubbed "the pig in the backyard". In this scenario, humans would still have relations with farm animals: "Participants who had started out being quite hesitant about the idea of cultured meat at some point started to envision its production through a local and small scale industry: cells from free ranging pigs, in backyards or urban farms, would be taken through biopsies every now and then and cultured into meat in neighbourhood factories. The idea immediately warmed the participants to cultured meat." In an ongoing follow-up project, Van der Weele further elaborates this scenario with farmers who see opportunities to combine small-scale farming with free-ranging animals, better connections with consumers and society, and production of local kinds of cultured meat.

Van der Weele is far from claiming that these alternative scenarios necessarily point the way to the future. They are rather inspiring images of a desirable future that in the end may still flounder on the dominant constraints of economic efficiency. But meanwhile they can break the hold that the ecomodernist framing of cultured meat has on our minds.

31.4 Enhancement, Disenhancement and Animal Welfare

Adam Shriver does not explicitly engage with ecomodernism, but the topic of his chapter is very relevant given the increasing levels of technological control humans exercise over ever more animal lives, especially through new technologies of gene editing. With much analytical finesse, Shriver attempts to develop a rigorous account of animal (dis)enhancement. He argues that popular intuitions about what constitutes

animal disenchantment—e.g. the widespread view that it involves taking something away from the animal that would otherwise be present—are unreliable and misleading. Such notions are invoked, for instance, in ethical debates about blind chickens and polled cattle and about more futuristic examples like ‘dino-chickens’ and ‘football birds’. Shriver holds that we need a holistic rather than domain-specific conception of (dis)enhancement and that at first sight there are three possible candidates for such a conception, to wit, the evolutionary fitness, the normal species functioning and the welfarist account. He dismisses the former two accounts rather unceremoniously as irrelevant for dealing with animals under direct human supervision, thus leaving the welfarist definition of (dis)enhancement as the only tenable option.

It is not hard to see why evolutionary fitness is deemed irrelevant for domesticated animals held in controlled environments. While a trait like aggression may once have been conducive to the survival of their wild ancestors, it no longer is for animals living under conditions determined by humans. It would therefore make no sense, Shriver claims, to call an unusually aggressive animal ‘enhanced’ or an unusually passive animal ‘disenchanted’. Similar considerations pertain to the normal species functioning definition, which obviously begs the question to which population the standard of normalcy applies. Shriver’s reasoning thus looks unobjectionable. However, by rejecting the two alternative accounts of animal (dis)enhancement, he thereby also declares the evolutionary past of kept animals to be radically irrelevant for judging their present situation. Or so it seems. Is this apparent break with previous evolutionary history just another manifestation of the advent of the Anthropocene?

Take the well-known example of the chickens that have been genetically modified to make them blind, so as to mitigate problems resulting from pecking and debeaking. One might perhaps concede that under confined conditions such an intervention would increase chicken welfare, but still hold that it shows little respect for the (evolved) ‘nature of the beast’ and not hesitate to use the term ‘disenhancement’ in this connection. But, of course, it is precisely this usage that is proscribed by Shriver’s reasoning, which seems to justify any further technological erasure of the genetic heritage passed down to our domesticated animals.

Shriver’s welfarist account of animal (dis)enhancement is not without its own problems, some of which he duly mentions. His definition of disenchantment is as follows: “Any change in the biology or psychology of an animal which decreases the chance of leading a good life in the relevant set of circumstances”. The reference to the relevant set of circumstances constitutes, in his view, an essential component of the definition. However, it also illustrates a crucial weakness of Shriver’s welfarist approach, beyond the problems he himself signals. In searching for a proper account of (dis)enhancement that is relevant for the situation of domesticated animals, he apparently accepts the actual conditions in which animals are held simply as given, or as “the relevant set of circumstances”. In this way, it would seem, he robs the concept of animal welfare of its normative bite, as the inserted clause ensures that it can no longer function as an independent basis from which to criticize actually existing husbandry conditions.

It is significant that in 5 of the 6 concrete cases of more or less radically changed animals discussed by Shriver, the answer whether the change under consideration amounts to an enhancement or a disenchantment is: “It depends”. Indeed, the answers vary, depending on what particular circumstances are assumed. But this shows that his conception lacks the normative power to judge the circumstances themselves.

Only in the extreme case of the ‘football birds’ is there a definite answer. This case would neither count as an example of enhancement nor of disenchantment, simply because these hypothetical ‘birds’ would by definition be completely insentient and thus have no welfare at all. (One might consider them as a logically transitional stage toward cultured meat, although the actual development looks bound to skip this transitional stage.) But even this clear answer is later qualified. Taking up Preston’s suggestion that the creation of ‘football birds’ might involve a loss of agency on the part of the animal and therefore still constitute a case of disenchantment, Shriver appears ultimately willing to accept this conclusion by incorporating agency into his concept of welfare. By considering such remote futuristic cases as serious possibilities, however, we are indulging in speculative ethics.

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