

*A visit to Biotopia: genre, genetics and gardening in the early
twentieth century*

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Abstract: The early decades of the twentieth century were marked by widespread optimism about biology and its ability to improve the world. A major catalyst for this enthusiasm was new theories about inheritance and evolution (particularly Hugo de Vries' mutation theory and Mendel's newly rediscovered ideas). In Britain and the USA particularly, an astonishingly diverse variety of writers (from elite scientists to journalists and writers of fiction), took up the task of interpreting these new biological ideas, using a wide range of genres to help their fellow citizens make sense of biology's promise. From these miscellaneous writings a new and distinctive kind of utopianism emerged – the biotopia. Biotopias offered the dream of a perfect, post-natural world, or the nightmare of violated nature (often in the same text), but above all they conveyed a sense that biology was – for the first time – offering humanity unprecedented control over life. Biotopias often visualised the world as a garden perfected for human use, but this vision was tinged with gendered violence, as it became clear that realising it entailed dispossessing, or even killing, 'Mother Nature'. Biotopian themes are apparent in journalism, scientific reports and even in textbooks, and these non-fiction sources shared many characteristics with intentionally prophetic or utopian fictions. Biotopian themes can be traced back and forth across the porous boundaries between popular and elite writing, showing how biology came to function as public culture. This analysis reveals not only how the historical significance of science is invariably determined outside the scientific world, but also that the ways in which biology was debated during this period continue to characterise today's debates over new biological breakthroughs.

Biotopia

In 1908, the US literary magazine, the *Atlantic Monthly*, published a prominent review of new books on evolution and heredity; its writer, Edwin Tenney Brewster, observed that their sheer number was evidence of ‘the world’s perennial interest in the topic’. According to Brewster, the public was intrigued because organisms were proving increasingly malleable as science showed us ‘the means by which they may be made something else’. He offered two quotations, from two very different authors, as evidence of biology’s new capacities. The first was by the British biologist, Reginald C. Punnett, from *Mendelism* (1907), the second edition of his brief introduction to what would soon be called genetics. Punnett listed various questions that geneticists had been unable to answer just a couple of years earlier, but to which they had been confident that ‘experiment would give us the solution’; he concluded triumphantly, ‘our confidence has been justified’. Brewster reinforced Punnett’s view with a quote from an ‘Illinois farmer writing in a farm paper’ who claimed that, by applying Mendel’s laws, the stock breeder could ‘obtain any character you desire from any breed and graft this character on to your favorite breed’.¹ In Brewster’s view, these examples proved that just ten years earlier, ‘organic evolution was one of the speculative sciences’, whereas today’s farmer could demand such things as that ‘his wheat must ripen by such and such a date’ and the modern scientific breeder could ‘build ... him the plant to order’.² The expectation that plants – and eventually other living things – could be built to order is central to this story, but equally important is the fact of that promise being made by such different writers, addressing quite distinct audiences, with the *Atlantic Monthly* then ensuring it spread to an even wider audience. As a result, many who would never study the new biology came to know about the kinds of futures it offered.³

One source of the breeders’ new confidence was the newly rediscovered theories of Gregor Mendel. However, while Mendelism was important to the emergence of biotopianism,

it has been so extensively studied by historians that other important theories of the period tend to be overlooked.⁴ Brewster's review, like many of the other sources considered here, stressed the importance of Hugo de Vries' mutation theory, which is now all but forgotten but was at least as important than Mendelism in fuelling early-twentieth-century biological speculations.⁵ Brewster reviewed de Vries' most recent book, *Plant-Breeding*, calling its author 'the world's first authority in his field', and encouraging the *Atlantic's* readers to read his works for themselves, since of 'his three general works, [*Plant Breeding*] is much the briefest and least technical'.⁶ (The apparent accessibility of the new biology was also important to its appeal.) Thanks to Mendel and de Vries, evolution was rapidly becoming an experimental science that promised not merely to *improve* existing plants and animals (including human ones), but to *invent* entirely new ones, at a time when America's rapidly growing population gave added urgency to the interest in improving agricultural techniques.⁷ Thanks to what was usually called 'experimental evolution', many of the writers whose works Brewster reviewed shared a 'living faith in the power of science to transform humanity and thereby to make men happy', because they believed that someone using science could 'transform himself into the kind of man who will be happy amid his own handiwork'.⁸ The utopian claim that science, particularly biology, could 'make men happy' implied (as one of Brewster's biologists put it), that 'the scientific philosopher must not think of existing human nature as immutable, but must try to modify it for the advantage of mankind'.⁹ In Brewster's view such biological transformations were inevitable; scientists had already begun remaking the whole organic world – including humanity – and the future would belong to 'that nation which does it first'.¹⁰

Brewster's confidence was characteristic of the early decades of the twentieth century, when many believed that a new kind of utopia was imminent. Defining 'utopia' is notoriously complex, but for present purposes, I will follow J. Colin Davis and assume that, unlike other

kinds of ideal societies (such as Arcadias), utopias are created by human effort.¹¹ As a result, Davis argued, a utopia is the only kind of ideal society that could be created using science (including applied science/technology). And the specifically *scientific* utopia (of which Francis Bacon's *New Atlantis*, 1627, was the first) assumes that 'nature is deficient or unaccommodating and must be altered' – and that science could achieve that.¹² Taking Davis' definition as a starting point, I would add that – as numerous scholars have noted – utopia is also, primarily, a literary genre, which invites its readers to imagine alternatives to the existing world.¹³

Prior to the early twentieth century, the physical sciences tended to provide the basis for scientific and technological utopias (particularly in the USA): for example, by imagining how new machinery would bring material abundance and leisure to all.¹⁴ Such forecasts shared a premise with earlier utopias (whether scientific, religious, political or legal), that nature – including human nature – was largely immutable; we could no more change ourselves than we could persuade flowers to bloom in the desert. That assumption resulted from the Christian origins of the modern utopian tradition, most of whose writers took it for granted that human nature was deeply flawed, as the expulsion from Eden proved. That same supposition persisted in a secularised form as the Malthusian fear that overpopulation made utopia impossible. Of course, the idea that evolution was a doctrine of perfectibility was a key reason for its initial nineteenth-century popularity (particularly among progressives and early socialists), but for other thinkers original sin was simply secularised, re-imagined in the claim that evolution had burdened us with an insatiable instinct to reproduce and compete with one another; the explanation for human nature had changed, but not the belief that we were inherently flawed.¹⁵ Since most utopias shared this assumption, they focused on minimising humanity's failings with such reforms as better laws or moral codes.

However, the early twentieth century saw the advent of a new utopian hope; biologists came to believe that humans might reverse the Fall and remove the last traces of even this secularised form of original sin. The hope that biology could recreate Eden by making the world a utopian garden was apparent in a new mode of writing that became widespread in both the USA and Britain, as a few examples will show.¹⁶ In 1901, Charles Howard Shinn, Inspector of Experiment Stations at the University of California, described recent pioneers of scientific plant-breeding, such as California's Luther Burbank, as explorers. Their discoveries, he claimed, 'when rightly understood shall in due season release brain-tired men from gray city pavements, sending each one to his own well-watered, fruit-giving, life-supplying acre'. This, he announced, was now possible as a result of the 'marvellous gospel of plant-evolution', which was inspiring 'a new literature' that is 'fresh, bright, helpful, more fascinating than any novel'.¹⁷ (The claim that evolution was a 'marvellous gospel' is a reminder that, for many, evolution became central to a secular faith in progress during these decades.¹⁸) Burbank and his contemporaries also inspired the popular US horticultural writer William Harwood to describe the promise of American scientific agriculture in *The New Earth* (1906). He argued that 'the Old Earth was far from paradise... [a] cheerless, desolate home, often untidy and usually cursed with food unfit to eat'. However, science had produced such achievements as the 'creation of new and better cereals, one of the master acts of the men of the New Earth'; they would ensure a future characterised by '[b]road acres, well kept and well stocked;... a modern home with its good cheer, its books, its music, its culture; a close touch with progress; ... the pride of strong men and sensible women in a calling as old as the human race, but never until now come into its own'. Altogether these were 'the tokens of the New Earth'.¹⁹ (Harwood's vision directly inspired Vladimir Lenin to inaugurate scientific agricultural research in the infant Soviet Union.²⁰)

As crop-breeders like Burbank began to create new plants and a new garden of Eden, it seemed that science might also create new people to populate it. In 1907, the Washington *Evening Star* ran the story ‘New Species to Order’, accompanied by sub-headings that announced ‘Man in his new role of inventing creator’ thanks to ‘EXPERIMENTAL EVOLUTION’. The story began by telling its readers that ‘The dream of [Francis] Bacon, who saw in the New Atlantis gardens a land devoted to the modification of animals and plants at man’s will, is being realized by the Carnegie Institution at its new “Station for Experimental Evolution”’. The paper quoted the laboratory’s director, Charles Davenport, as saying ‘when we know the law we may control the process, the principles of evolution will show the way to an improvement of the human race’.²¹ (Again, evolution is equated with progress.) In similar vein, the US feminist, Charlotte Perkins Gilman, imagined a women-only utopia, *Herland* (1915), whose inhabitants had used scientific crop-breeding and forestry, to make ‘a pleasant garden’ of their country. Herland’s people had been improved as much as its crops; its children were like ‘perfectly cultivated richly developed roses compared with—tumble weeds’.²² On the other side of the Atlantic, H.G. Wells offered a utopia ‘where ill-bred weeds, it seemed, had ceased to thrust and fight amidst the flowers’ (*Men Like Gods*, 1923). Wells’ utopians were as orderly as their garden-like world, which (like Gilman’s *Herland*) had undergone ‘a great cleansing... from noxious insects’.²³ And the British biologist J.B.S. Haldane (*Daedalus*, 1924) imagined a future where deliberately modified alga fed the world and had turned the oceans purple, yet the colour had come to seem ‘so natural’.²⁴

These and other examples will be analysed in more detail below. Despite their different genres they share characteristic tropes: the world would become a scientifically cultivated garden; non-human nature would be changed to suit human needs; and, human nature itself would be transformed. All these claims were built on the idea of accelerating and directing

evolution by understanding heredity more fully. Despite some continuities with earlier scientific utopias, using the new life sciences rather than the old physical ones gave these utopias distinctive characteristics. For example, many featured the deliberate eradication of certain species, an aspect that is profoundly jarring to twenty-first century ecological sensibilities, as are other features of these supposedly perfected worlds. Even to their original readers, they were sometimes read as biological *dystopias*, so I will refer to them simply as ‘biotopias’, not least because their ambiguity, so often characteristic of the utopian genre, helped ensure both their original impact and lasting influence.²⁵

‘This old Hag, our Mother’

Two utopian novels, published within a decade of each other, exemplify the main characteristics of the biotopian mode: Charlotte Perkins Gilman’s *Herland* (1915) and H.G. Wells’ *Men Like Gods* (1923). *Herland* originally appeared in serial form in Gilman’s magazine *The Forerunner*, but appears not to have been reviewed at the time, so its initial readership would have been modest (the *Forerunner*’s circulation never exceeded 1,500).²⁶ By contrast, Wells was world-famous and his new novel was widely reviewed. One American reviewer, Howard Shinn (the same writer who espoused the ‘marvellous gospel of plant-evolution’ so enthusiastically, above) believed the book would be added to the list of ‘Wellsian masterpieces’ and be read ‘as long as time endures’ because it offered imaginative solutions to ‘problems which we must solve if we would salvage our civilization’.²⁷ The *New York Times* concurred, telling its readers that ‘utopia’ had long been a synonym for impossibility, but that today ‘many believe’ that ‘we might arrive there, land and take possession’. It credited Wells for this change.²⁸ Gilman knew and admired Wells’ work, but praised him not so much for his fiction (she was critical of the attitudes towards women some of his books displayed), but for ‘electrifying the world’s slow mind to the splendid

possibilities of life as it might be'.²⁹ Although Gilman was not as famous as her British contemporary, she was a well-known writer and lecturer on women's rights and economics and – for present purposes – an important example of how biology was read and interpreted by non-biologists. The similarities between these two writers' work also suggest that, to some degree, a common Anglo-American culture framed the discussions of contemporary biology's potential (and was shaped by such discussions); for example, many of the books discussed here were published reviewed and discussed on both sides of the Atlantic. However, there were also important differences in British and American responses, as will become clear.

Herland (like many other utopias) is constructed as a traveller's tale, a 'Lost World' narrative that describes the discovery of an isolated country amid unidentified jungles.³⁰ Three men – Van, Terry and Jeff – use an aeroplane to reach the previously unattainable country and are immediately struck by its being 'a land in a state of perfect cultivation, where even the forests looked as if they were cared for; a land that looked like an enormous park, only it was even more evidently an enormous garden'. After making contact with the country's inhabitants – all of whom are women – the visitors learn its history. Two thousand years earlier, while most of the men were away at war, an earthquake blocked the only accessible pass. The only men left were slaves, who revolted and killed the remaining masters, intending to enslave the women. But the women slew their would-be oppressors and so, as Gilman's narrator, Van, puts it, only women remained 'on this beautiful high garden land'. Farming was their first concern, and Van comments 'they worked out a system of intensive agriculture surpassing anything I ever heard of, with the very forests all reset with fruit or nutbearing trees'. The image of paradise as a garden was not, obviously, a new one, but *Herland's* utopian garden had been deliberately created through scientific plant-breeding. For example, the women decided to grow only trees with edible fruits or nuts, to make the best use of their small country, but there was one tree they loved for its beauty that produced

nothing they could eat, so they had spent 900 years patiently breeding it until it bore an edible crop. As Van summarised, the women ‘had made a pleasant garden’ of their land, ‘a very practical little heaven’.³¹ That image of a garden as a *practical* heaven, created by conscious effort, recurs in biotopian writing.

{ Insert figure one about here }

As noted, *Men Like Gods* also featured a garden-like landscape devoid of ‘ill-bred weeds’. The story centres on Mr Barnstaple, a disillusioned journalist who finds himself (along with an assortment of other ‘Earthlings’) in ‘Utopia’, a parallel earth into which they have been accidentally pulled by some Utopian physicists. Wells’ hero was immediately struck by ‘a band of greensward, of a finer grass that Mr Barnstaple had ever seen before – and he was an expert and observant mower of lawns’. Catapulting a little lawn-mowing suburbanite into a sublime utopia was a characteristic piece of Wellsian wit that also emphasised the horticultural work that had created this new world. When the Earthlings are taken to meet a council of Utopians, they are flown over a landscape that is described as ‘garden pasture’, complete with ‘extensive farming or dairying establishments’ and other evidence of modern farming. As in *Herland*, this is not an unspoilt arcadia but a cultivated, technological landscape: ‘[p]lants and flowers, always simpler and more plastic in the hands of the breeder and hybridiser than animals, had been enormously changed in Utopia’ and the plants ‘had been trained and bred to make new and unprecedented secretions, waxes, gums, essential oils and the like, of the most desirable quality’.³² As with biotopianism more generally, the Utopians’ work had begun by exploiting the ‘plasticity’ of plants, but had been successfully extended to other animals, including themselves, an achievement Wells (and others) hoped would eventually be emulated in reality.

After he had explored more thoroughly, Barnstaple reflected that ‘[h]e knew enough of Utopia now to know that the whole land would be like a garden, with every natural tendency

to beauty seized upon and developed and every innate ugliness corrected and overcome'.³³

The Earthlings discover that 'correcting' nature's 'innate' ugliness has indeed been one of the Utopians' long-standing concerns – and some of them hate it. Freddy Mush (a 'gentleman of serious aesthetic pretensions') objects to the destruction of the 'Balance of Nature', exemplified by the absence of swallows; Wells explains 'there were no swallows to be seen in Utopia' because of 'an enormous deliberate reduction of insect life', which had largely destroyed the birds' food supply.³⁴ The Utopians had engaged in 'a systematic extermination of tiresome and mischievous species' and, in contrast to Mush, Barnstaple regards this 'revision and editing, this weeding and cultivation of the kingdoms of nature by mankind', as (paradoxically) 'the most *natural* and necessary phase in human history. 'After all,' he said to himself, 'it was a good invention to say that man was created a gardener'.³⁵

The 'revision and editing' of nature was the heart of Mush's objection to Utopia ('I hold by the swallows', he explains). In response to the Earthling's criticisms, a Utopian called Urthred tells the Earthlings to look objectively at Mother Nature:

she is purposeless and blind. She is not awful, she is horrible. She takes no heed to our standards, nor to any standards of excellence. She made us by accident; all her children are bastards – undesired; she will cherish or expose them, pet or starve or torment them without rhyme or reason. She does not heed, she does not care. She will lift us up to power and intelligence, or debase us to the mean feebleness of the rabbit or the slimy white filthiness of a thousand of her parasitic inventions. There must be good in her because she made all that is good in us but also there is endless evil. Do not your [*sic*] Earthlings see the dirt of her, the cruelty, the insane indignity of much of her work?

He explained how before the Utopians 'took this old Hag, our Mother, in hand', more than half the species on the planet were 'ugly or obnoxious, insane, miserable, wretched, with

elaborate diseases, helplessly ill-adjusted to Nature's continually fluctuating conditions'. They had to suppress 'her nastier fantasies', to wash and comb her and teach her. As a result they are no longer 'the beaten and starved children of Nature, but her free and adolescent sons. We have taken over the Old Lady's Estate. Every day we learn a little better how to master this planet'.³⁶

This language of male mastery over 'Mother Nature' is, of course, a longstanding feature of Western science. Wells' very title and the misogynistic image of the 'adolescent sons' calling Mother Nature an 'old Hag' and taking over her 'estate' epitomise science as a form of gendered violence, in which active and arrogant men interrogate or even torture passive nature, in order to extract knowledge from 'her' (usurping God's power in the process).³⁷ This makes the similarities between the ideas in Wells' and Gilman's books disturbing, and may explain why many Gilman scholars have failed to note that the women of Herland are as intent on the 'revision and editing' of nature as Wells' Utopians. Gilman's main female character, Ellador, is a forester whose interest in forestry began in childhood when she caught a strange butterfly and learned it was an Obernut moth, potentially very destructive of one of Herland's cherished trees. The teacher who identified it added, '[w]e have been trying to exterminate them for centuries', so Ellador and the other children are promptly set to work to find and kill all that survive.³⁸ However, these are not urbanised children, who have grown up swatting intrusive insects; Herland's children 'grew up as naturally as young trees' and were raised largely out of doors, 'naked darlings playing on short velvet grass, clean-swept'. Their education took place 'in an environment which met their needs; just as young fawns might grow up in dewy forest glades and brook-fed meadows. And they enjoyed it as frankly and utterly as the fawns would'.³⁹ The image of the 'naked darlings', supposedly as 'natural' as trees or fawns, setting out on a systematic ecocide captures the same biotopian paradox as Barnstaple's description of 'editing' nature as 'most natural'. This is the paradox at the heart

of the biotopian mode: nature is both exalted and manipulated. Instead of adapting themselves to nature's constraints and limited resources, the inhabitants of biotopia are constantly forcing nature to adapt to them; the language of gardening, of 'cultivating' a plot of waste ground to make it beautiful and fertile, helps collapse the distinction between nature and culture.⁴⁰

The biotopian mode emerged from the new biological theories of the early twentieth century that prophesied human control over nature.⁴¹ Wells' biological expertise – rooted in his time as a student of Thomas Henry Huxley – is well-known.⁴² And *Herland* demonstrates how well-informed about contemporary biology Gilman was.⁴³ For example, when the Herlanders explain how they have survived for 2,000 years without men, they tell their visitors that after the last men were killed one of the women began, quite suddenly, to give birth parthenogenetically, and that all her daughters inherited her ability. Parthenogenesis was widely discussed in the biological community at the time, primarily because of the publicity around the Chicago biologist Jacques Loeb's successful induction of artificial parthenogenesis in sea urchins around 1900.⁴⁴ Gilman demonstrated her knowledge of these continuing discussions when she wrote in the *Forerunner* that some 'subscribers have asked if there is any foundation in biology for the condition of parthenogenesis—virgin birth—alleged in Herland'. She explained that it was quite widespread in various insects, including bees and aphids, and gave details.⁴⁵ In the novel Terry argued that there must be men somewhere, since if the Herlanders 'were parthenogenetic they'd be as alike as so many ants or aphides' [*sic*], a point Gilman made when explaining to *Forerunner's* readers that parthenogenesis was regarded as a primitive form of reproduction, because it reduced the variability of a species.⁴⁶

Gilman's novel also referred to de Vries' mutation theory; when the men ask the Herlanders 'how they accounted for so much divergence without cross fertilization', they are

told that the women attributed it ‘partly to the law of mutation. This they had found in their work with plants, and fully proven in their own case’.⁴⁷ Like the Herlanders, de Vries had experimented with plants to understand how inheritance and evolution worked, and improving crops was one of his goals. He found a species of Evening Primrose, *Oenothera lamarckiana*, that appeared to be generating new species overnight by mutating (just as the women in Herland became instantly parthenogenetic), rather than through the slow, gradual selection of minute variations associated with conventional Darwinian natural selection. Gilman was aware of the ferment of excitement surrounding de Vries’ theory – indeed, as a progressive intellectual with an interest in biology, she could hardly have avoided learning about it. The theory was discussed regularly in the *Atlantic Monthly* (which she both read and wrote for). For example, Brewster (in a roundup of the latest science books that appeared three years before the one discussed above) proclaimed that de Vries had ‘seen the origin of a really new species by one clean jump’ and that as a result his *Species and Varieties* was ‘clearly the book of the year’.⁴⁸ Gilman also read the *Popular Science Monthly (PSM)*, which covered the theory extensively, including its possible applications to human society.⁴⁹ These and other general interest publications (such as *The Nation* and *Harper’s Monthly*) not only discussed de Vries’ ideas, but also explored their application to human society.⁵⁰ For example, an article on ‘Industrialism’ in the *PSM* asserted that ‘As the biologist might say, the Industrial Age is a period of rapid mutation.... It is a day of hope and of optimism, such as the world has not hitherto known’, a claim that epitomised the mutation theory’s appeal.⁵¹

{Insert figure 2 about here}

Lamarckian inheritance (and the challenge to it mounted by August Weismann) are also discussed explicitly in *Herland*. Gilman’s eclectic use of biological ideas reflected her broad belief in the need to ‘have faith in evolution’ (which she also equated with progress). She argued that ‘many people nowadays’ had lost their faith in providence and so (like Wells’

Utopians) were inclined to 'discuss the merits' of each organism 'according to its "use" to us'. According to Gilman, we should no longer assume each creature has a divinely ordained purpose, but instead ask whether it is 'a step up, or a step down'. In her view, 'the force called Evolution ... is always pushing, pushing, upward and onward', and so '[y]ou can count on it. It is always there'. Part of Gilman's argument for trusting evolution was that doing so had clearly worked for plant and animal breeders who had 'already done wonders' in creating new organisms. Their principles could just as easily be applied to humans; 'we must provide right conditions', she asserted, then 'that great pushing life-force of Evolution [will do] the rest'.⁵² Plant- and animal-breeding as a model for improving the whole of nature, including humans, was a recurring theme in Gilman's work, and one of her inspirations was the work of Luther Burbank. As she argued (in an article tellingly entitled 'Assisted Evolution'), Burbank had already done more than nature had managed. Even though it had 'taken Mother Nature long, long ages to turn fierce greedy hairy ape-like beasts into such people as we are', humans could be sure that if they were to model themselves on Burbank and take charge of evolution, it would only require 'two or three close-linked generations to make human beings far more superior to us than we are to the apes'.⁵³

Herland imagined how nature could be reshaped by emulating Burbank and trusting evolution. Perhaps the most significant change of all those Gilman envisaged was that animal instincts could be reshaped as readily as the trees. The Herlanders kept cats in order to control mice and similar 'enemies of the food supply', but had found the cats' meowing irritating. The narrator, Van, asks: 'What do you think these Lady Burbanks had done with their cats?'.⁵⁴ The answer was that they had reshaped feline nature and 'developed a race of cats that did not sing!'. The redesigned cats still purred, but no longer killed birds; their instincts had proved as plastic as the plants in Wells' utopia (which also featured tamed cats, notably a leopard). The same process has been applied to the Herlanders themselves; instincts of which

the Herlanders approved had been encouraged while antisocial impulses had been weeded out. As the men discover (to varying degrees of consternation), the instinct of ‘sex-feeling’ had atrophied from disuse in Herland; even the most fundamental of human instincts could be modified as readily as the cat’s meow.⁵⁵ The abolition of the sex instinct had allowed the Herlanders to escape the Malthusian trap; they had learned to control their parthenogenetic reproduction through sheer will-power, ensuring their population stayed at a level their country could support. (Wells’ Utopians had done the same in *Men Like Gods*, presumably through more conventional means.) And, of course, Gilman’s main reason for imagining a re-engineered nature was to show a world in which women’s supposedly natural inequality had also been abolished. Freed from the constraints of sex, marriage and the family, the Herlanders could invent their own, post-natural motherhood, which Gilman hoped her readers would find liberating, but which some of her contemporaries would doubtless have found repulsively unnatural.⁵⁶

Both the Herlanders and their cats had been cleansed of original sin; the Malthusian instincts to reproduce, compete and kill had all been subdued by science. Revising and editing nature had become a ‘natural’ approach, and allowed them to reinvent the most seemingly natural category of all, gender; and to do rapidly what ‘Mother Nature’ did slowly (or could not do at all). And the description of the Herlanders as ‘Lady Burbanks’ is a reminder that for Gilman – as for many of her contemporaries, particularly in America – the biotopian promise was particularly vivid in writings about (or by) Burbank.

Burbank in Biotopia

As Katherine Pandora has demonstrated, the horticulturalist Luther Burbank, of Santa Rosa, California, became the most famous plant-breeder in the world during the early decades of the twentieth century, partly because he seemed to exemplify a series of distinctly American

virtues (he even lived behind a white picket fence).⁵⁷ His fame also rested on a rapidly expanding population and press market; Burbank's new crops promised to feed America's many mouths and stories about them helped fill the ever-increasing number of newspaper pages. And he was a master publicist, at a time when there was widespread excitement about American inventiveness, who promoted his achievements in a series of catalogues with the eye-catching title *New Creations in Fruit and Flowers*. Hyperbole was common in nursery catalogues, but Burbank's *New Creations* outdid its rivals, implying that he had overtaken the original Creator.⁵⁸ Some regarded such claims as blasphemous, but many more were willing to participate in the quasi-religious aura that surrounded Burbank; when California's State Board of Trade gave a banquet in his honour in 1905, the toastmaster stressed that Burbank's work to 'make the earth more fruitful and its bloom more radiant has been part of the religious life of the honored guest of the evening'.⁵⁹ The sacred aura surrounding Burbank reminded readers of the Judaeo-Christian tradition's belief that humanity had been given dominion over nature. As one US magazine asked its readers in 1905, why 'should anybody marvel at the achievements of Luther Burbank?' since 'control over the life of this globe... is the birthright of humanity', according to the book of Genesis.⁶⁰ And in Britain (where Burbank was generally received with more scepticism than in the US) the broadly evangelical British magazine, *The Quiver*, announced that 'The links which unite science and religion have been strengthened by the testimony recently given by that wonder-worker of California—Luther Burbank'.⁶¹ Articles like these (and there are dozens more) treated Burbank as an almost religious figure.

Perhaps surprisingly, at a time when many (particularly in the USA) believed science and religion to be in conflict, Burbank was also routinely praised for being a true disciple of Darwin who had (as numerous commentators put it) 'evolved' new plants.⁶² A key part of Burbank's appeal was democratic; as Pandora has noted, numerous periodicals told their

readers that they should not only accept Burbank as scientist, but should emulate him by conducting experiments and making their own discoveries.⁶³ As I have argued elsewhere, some recognised members of the scientific community acknowledged such claims, and attempted to enlist Burbank in their arguments over the interpretation of evolutionary theory that were so prevalent at the time. Others rejected his claims, and some changed their minds – initially accepting Burbank’s scientific claims, but later rejecting them.⁶⁴ Burbank’s contested status made him an obvious point of reference in public debates over experimental evolution. As the new approach developed, many in the scientific community became confident that biology was shedding ever-more light on life’s origins promising more control over its future, statements that struck opponents of Darwin as arrogant and contributed to the anti-evolutionary backlash that was one of the factors in the Scopes Trial.⁶⁵ (It is a mark of how complex Burbank’s reputation was that he was invited to testify by *both* sides in Tennessee.⁶⁶) The promotion of experimental evolution gave added interest to Burbank’s experiments, just as the publicity around Burbank fed curiosity about mutation and Mendelism. Yet the more one reads about Burbank, the more the contradictions multiply: he was depicted as both a highly trained expert and an untaught innocent; as an altruistic benefactor to mankind and an important ally of commerce (his famous Burbank potato was supposedly worth millions of dollars a year to the US economy); and, most importantly of all, he was invariably described as living and working in harmony with nature, yet was also celebrated for his ability to master Mother Nature, correcting her mistakes, curbing her wastefulness and teaching the old lady ‘new tricks’.⁶⁷

The contradictory meanings that attached to him prove central to understanding what the wider public believed ‘Burbank’ signified. As we have seen, for Gilman he embodied the promise of human control over nature (including human nature), and her interpretation was a common one because Burbank’s name began to be used as a verb: the *Atlantic Monthly*’s

1908 review of recent biology books (see above), commented that the advances they described implied that ‘a benevolent and all-powerful despot backed by a scientific commission could ‘Burbank’ the soberness of Jew or Chinaman into the most drunken of races, and make the saloon as innocuous as the public library’, a presumably light-hearted example that nevertheless demonstrates the potentially dystopian aspects of applying Burbank’s methods (at least for saloon-keepers).⁶⁸

A comprehensive survey of the press coverage of Burbank would fill several volumes, but as Pandora has noted, there was considerable repetition (and some plagiarism) that helped spread the ideas analysed here, making a brief sample sufficient to demonstrate the key themes.⁶⁹ For example, the widely read general-interest monthly, *The Century Magazine*, published a two-part article on Burbank by William S. Harwood, one of the most prolific and successful writers about Burbank (his articles were expanded into a successful book, *New Creations in Plant Life* later that year and he also wrote *The New Earth*, mentioned above).⁷⁰ Harwood’s articles offered ‘an authoritative account’ under the title ‘A Wonder-Worker of Science’, which began by quoting a fulsome tribute to Burbank by de Vries.⁷¹ Yet Harwood emphasised the complexity of Burbank’s relationship to the scientific community, claiming that only a decade earlier Burbank had been ‘denounced by scientific men as little less than a charlatan, a producer of spectacular effects, a seeker for the uncanny and abnormal, an enemy to all true scientific progress’.⁷² However, as Burbank’s fame grew many who had come ‘to scoff’ now ‘stayed to pray’ (evoking the science/religion paradox again).⁷³ Being a ‘wonder worker of science’ who was ‘denounced by scientific men’ was not the only contradictory aspect of Burbank’s scientific standing. Although Harwood quoted evidence of the scientific community’s approval, he also stressed that Burbank had ‘no laboratory at all, save that of the earth and the air and the sun.... He has had the seeds, he has had the generations of plants, he has had the earth’.⁷⁴ Burbank’s success was simply the result of ‘his masterly judgment,

backed by a wonderful intuition, enabling him to accomplish that which indeed seems little short of a miracle'.⁷⁵ An earlier account (by Liberty Hyde Bailey, professor of Practical and Experimental Horticulture at Cornell University), commented that Burbank 'has not studied the books. He has not been taught. Therefore he is free'.⁷⁶ Clearly, Burbank's status as a natural, untaught genius was at least as important as his scientific standing to the expectations he embodied.

Paradoxes recur in writings about Burbank. When the noted zoologist David Starr Jordan, president of Stanford University, came to describe what he called the 'scientific aspects' of Burbank, he wrote that 'Burbank's ways are Nature's ways, for Burbank differs from other men in this, that his whole life is given to the study of how Nature does things'. Yet Jordan also emphasised what might be called Burbank's 'engineering' aspect, by claiming that he had produced plants 'which but for him, would have existed only among the conceivable possibilities of creation'.⁷⁷ He had, in effect, helped Nature do what she could not have done unaided. Similar points were made by the *Cosmopolitan*, which published its own two-part article on Burbank in 1905, many of the details of which seem to have been lifted from *Century*'s earlier pieces. (The constant repetition between different articles is a reminder of how widely circulated these portrayals of Burbank were.) *Cosmopolitan*'s writer, Garrett P. Serviss (also a pioneer of pulp science fiction), claimed that only a man of Burbank's character, 'can get close to nature, and in his closeness to nature lies his whole secret. He does not create, but he guides nature in creating'. Yet once again the natural/unnatural paradox was emphasised, since – thanks to Burbank – 'the face of the landscape may be made a mirror of the human mind' because '*man* can produce species and do it in a dozen summers!'. The first article's title explained that Burbank 'Shows How Man Can Govern Evolution', and encapsulated the contradiction of his being in harmony with nature yet exercising power over it. As Serviss wrote, Burbank's plants 'can only be

described as new creations. Some of them bridge the supposed impassable chasms between species, and between genera'. This implied a violation of the natural order, emphasised by the claim that every aspect of 'the life and growth of plants' was in reach of 'human *interference*' and could 'be made to follow the *dictates* of man's wishes' (emphasis added). Yet at the same time, Burbank's plum-apricot hybrid, the plumcot, was not 'in any sense, an un-natural product. Mr. Burbank did not create the tendencies that gave birth to it; he simply discovered and guided those tendencies'.⁷⁸ Another Serviss article emphasised Burbank's respect for nature by claiming that he had learned a lesson from one of his mistakes, namely that 'nature often knows better than man what ought to be done'.⁷⁹ Yet such claims were undermined by comments such as that 'nature might never spontaneously have turned ... in the direction' which Burbank had chosen.⁸⁰

The engineering facet of Burbank's work made plants seem unexpectedly unnatural, giving them a startling quality that made them particularly attractive to newspaper writers. When the *Los Angeles Times* previewed the city's Pacific Lands and Products Exposition, it did so under the headline 'Plant Freaks to be Shown', adding that 'Wizard Burbank Will Exhibit Some Queer Ones'. Plant 'freaks' or 'monsters' were not new, of course, but in earlier centuries they had always been described as 'freaks of nature', whereas Burbank's were deliberate, human creations. The paper told its readers that 'the greatest single attraction' of the show would surely be the Burbank exhibit. One of the organisers had apparently 'solemnly stated' that Burbank would exhibit 'a tree, part palm and part oak, on which will be growing simultaneously oranges, apples, bread fruit, mangelwurtzels, [*sic*] watermelons and sweet potatoes'. Edward H. Brown, secretary of the Santa Rosa chamber of commerce, admitted that this was an exaggeration, but asserted that 'plant freaks almost as inconceivable would be on exhibit'. The journalist noted that among the 'Burbankisms' on display would be his new, spineless cactus and commented: 'the possibilities of such an idea are of course

staggering—most things Burbankesque are’. The cactus could be safely eaten by both cows and people, so that visitors to the exhibition would be able taste the future – both candy and cake made from Burbank’s cacti would be on sale. The writer speculated that the ‘thrifty housewife’ of the future would avoid expensive meat and head ‘blithely out onto the desert and lay in a supply of cacti’.⁸¹ Articles like this border on parody, and routinely comic examples of ‘Burbanking’ nature emerged in impossible claims, such as that one might ‘Burbankize a breed of roosters that lay three eggs a day’.⁸²

{ Insert figure 3 around here }

The borderlines between journalistic exaggeration and full-blown fiction became very porous around Burbank; roosters that laid eggs might seem no more unlikely than cacti without spines – or Gilman’s cats that did not wail. The ‘Burbankesque’ promised some strange, but enticing possibilities. And yet joking about ‘freaks’ and ‘queer ones’ might also hint at a slight anxiety about various kinds of perversity; the disapproving use of the word ‘unnatural’ sometimes haunted the writing around Burbank (and, as we shall see, provides a link to other biotopian writings).⁸³ The faint fear that scientific breeders like Burbank might violate the natural order helps explain why writers found it necessary to stress his saintly image (he worked from his home and lived with his elderly mother), which perhaps helped domesticate his uncanny power over nature.⁸⁴ Yet the homely details of Burbank’s life and work produced an uncomfortable contrast with the hints of violence the ran through descriptions of his methods for ‘correcting’ nature’s mistakes.

In 1895, Burbank had told an audience of fruit growers that if they wanted to know ‘[h]ow to produce new trees, fruits and flowers’, they should listen ‘patiently, quietly, and reverently to the lessons,... which Mother Nature has to teach’. He counselled: ‘[s]he conveys her truths only to those who are passive and receptive, accepting truths as suggested, wherever they may lead’.⁸⁵ The idea of simply following nature’s lead had a wide appeal

(particularly at a time when rapid industrialisation and urbanisation were cutting many Americans off from what they thought of as nature).⁸⁶ Unsurprisingly, Burbank's words were often repeated by his admirers. Harwood quoted Burbank as explaining that '[n]ature will do her part always. She never lies; she never deceives', and yet 'in the sight of man and from his standpoint, she fails'. So, in addition to listening 'close to her great heart' it was also necessary to 'come to her aid' with 'all haste and power'. In the case of the cactus, Burbank claimed that nature had 'wasted' her energy on producing thorns; 'I have simply helped her... and have left her free to put all her energy upon producing food'.⁸⁷ And when the Governor of California, George Cooper Pardee, spoke at the 1905 banquet, he praised Burbank as 'a genius capable of playing tricks with Nature' who had 'set the seal of his disapproval upon much that to him and us seems wrong in Nature's handiwork'.⁸⁸ Clearly Mother Nature did *not* always know best.

Almost every writer who described Burbank emphasised his ability to control and manipulate plants – that, after all, was the most arresting fact about him. The *Scientific American*, for example, claimed he had proved that 'plants could be made to respond to a dominant will'; every aspect of the plant 'might be controlled or altered' to produce new types, 'never dreamed of or imagined'.⁸⁹ Yet, however wonderful and natural it seemed, Burbank's ability to transcend nature invariably hinted at a kind of assault. For example, when he described how he redeemed a plant 'from among a race of vile, neglected orphan weeds', he acknowledged that a plant might need 'the overpowering shock of re-creation', and 'must irrevocably break with the past'.⁹⁰ His method was to cross a plant with as many others as possible, so as to 'break up its life tendencies'. Harwood noted the unpleasant consequences of these shocks and breaks:

In the breaking-up it may produce a whole series of monstrosities, the most strange and grotesque plants that ever took root in the soil of the earth. Some of these plants are hideous, and all such are put to death.⁹¹

If imitation is indeed the highest form of flattery, Serviss flattered Harwood mightily when he acknowledged that Burbank's experiments sometimes created 'strange monstrous forms', so 'useless', 'repellent' and 'horrible even, that instantly he destroys them as things unfit to live'. The faint hint of anxiety conveyed by the reference to Burbank's plants as 'queer' or 'freaks' seems a little stronger here, which may explain why Serviss tried to absolve Burbank of blame: the monsters emerged, he explained, 'from the deep of the past' and 'nature's past, like that of a human life, is not made up entirely of beautiful and desirable elements'. It was nature, not Burbank who was to blame: '[s]he has had her tragedies and her sins'.⁹² Luckily for nature, the world-famous Californian breeder was ready to 'put to death' her more shameful progeny.

Cosmopolitan's readers would surely have been struck by the language with which Serviss described Burbank discovering possible new plants that nature had neglected: until Burbank recognised them they were like 'dim eager faces, hidden behind nature's draperies—starved, neglected children for whom there is no room and no hope, whose mother amid a multitude of pressing duties has no time, no thought and no place for them'. Here (as in *Men Like Gods*), Mother Nature is an uncaring parent; whenever one of her 'neglected children... peeps forth with momentary boldness', Serviss wrote, they were 'rudely thrust back', unless lucky enough to catch Burbank's eye.⁹³ Burbank has effectively become an alternative mother to the hapless plants and his media image often focused on what would then have been regarded as feminine qualities (such as gentleness and love of children); the childless Burbank often referred to plants as his children, especially in his celebrated book, *The Training of the Human Plant*, which directly applied some of his horticultural techniques to

childrearing. Burbank's post-natural garden also challenged conventional gender roles, albeit not as radically as *Herland* did.

The image of Burbank as a kind of mother was used by Serviss in a newspaper article about Burbank: in creating a red Californian poppy, Burbank had given the flower 'the chance that nature denied it', because – he explained – 'nature usually frowns upon departure from her customary lines. She stamps out independence' and 'has little mercy for the nonconformist among her children'.⁹⁴ Burbank had stepped in when mother nature failed, but the implicit feminising of Burbank added to the discomfort when his work was described in faintly violent terms; for example, another writer explained that Burbank tried to direct each plant's evolution and to govern any 'outlaw tendencies' that appeared. However 'the blood of atavism' would sometimes reassert itself once the plant's 'persistent type is ruptured'. Such 'outlaw' plants were dealt with harshly. 'Of the mass which give no definite or hopeful perturbations, there is a massacre'; they were burnt in large numbers.⁹⁵ Harwood, too, stressed the violent way in which Burbank treated his failures: 'the rejected plants, shrubs or trees are gathered in large bonfires and burned,... In a single year as many as fourteen of these huge bonfires have been lighted... consuming hundreds of thousands of plants'.⁹⁶ And an earlier article described Burbank as using his 'keen eyes and capable mind' to examine '[m]illions upon millions of cross-bred seedlings', assessing their worth and then 'choosing, destroying; their very god incarnate'.⁹⁷ Burbank was depicted as both a creator and as a rather vengeful, Old Testament deity who sat in judgement on his creation. The paradox of the gentle, almost feminine, Burbank correcting nature's mistakes (with cleansing fire if necessary), is reminiscent of Wells' Mr. Barnstaple describing the Utopians' 'revision and editing' of nature as 'most natural and necessary', or of Gilman's 'naked darlings' exterminating unwanted insects and growing up to correct nature's mistakes by replanting entire forests. Experimental evolution was not straightforwardly utopian, but invariably

contained hints of a darker, oppressive side to the control of nature (as, perhaps, all utopias do).

Perversion and 'radical indecency'

The natural/unnatural paradox that was the core of the biotopian mode was presented in its most vivid and unsettling form in 1924, in a small book called *Daedalus, or Science and the Future*, by the British biologist John Burdon Sanderson (J.B.S.) Haldane. *Daedalus* demonstrates continuities between British and American biotopianism, but also highlights some stark differences. Haldane made the striking claim that 'every biological invention is a perversion', but – far from condemning such violations of the natural order – he celebrated their 'profound emotional and ethical effect' on humanity. His examples of biological inventions included the domestication of plants, animals and fungi, and 'the artificial control of conception'.⁹⁸ Some of these breakthroughs were so familiar that Haldane suspected his readers would no longer notice how profoundly 'indecent and unnatural' they were, so he invited them to consider the dairy industry, built on stealing a cow's milk (symbol of the 'intimate and almost sacramental bond between mother and child'), in order that it could be 'drunk, cooked, or even allowed to rot into cheese'. (Interestingly, Gilman's vegan Herlanders have no dairy industry; the only milk in Herland is their own.) Haldane observed 'We have only to imagine ourselves as drinking any of its other secretions, in order to realise the radical indecency of our relation to the cow'. Not only was such 'indecency' tolerated, but he observed that while every biological invention 'tends to begin as a perversion' over time it often becomes 'a ritual supported by unquestioned beliefs and prejudices'.⁹⁹

Haldane argued that 'a sentimental interest' in Prometheus had distracted us from 'the far more interesting figure of Daedalus', who created the minotaur, the monstrous hybrid of human and cow that symbolised the ability of humans to remake nature. Titling the book after

the monster-maker was a celebration of perversion (whereas, as we have seen, Burbank's supporters generally sought to distance him from any hint of the monstrous or unnatural). Haldane was unafraid to link the mythical monster and the achievements of twentieth-century genetics, arguing that if only 'the housing and feeding of the Minotaur [had] been less expensive' Daedalus might 'have anticipated Mendel'. (Though perhaps, he pondered, an annual sacrifice 'of 50 youths and 50 virgins [was] excessive as an endowment for research'). The modern biologist was heir to Daedalus, able to pervert nature to serve human needs and so, despite being 'a poor little scrubby underpaid man' (a distinctly Wellsian figure), Haldane was convinced that 'the biologist is the most romantic figure on earth at the present day'.¹⁰⁰

To justify his claim, Haldane borrowed a familiar narrative device used in utopian and science fictions and presented a report from the future, in the form of an undergraduate essay written '150 years hence' that described the scientific breakthroughs that had created a much perfected future world. (In another borrowing from the utopian/science fictional genre, Haldane made his essay as believable as possible, sprinkling it with the names of the imaginary scientists who had made the various breakthroughs, and making it as brief, under-referenced and laden with generalisations as a real Cambridge undergraduate essay.) But before presenting his forecast in this science-fictional form, Haldane felt that 'a word on Mr. H. G. Wells might not be out of place', since the 'very mention of the future suggests him'. Haldane asserted that Wells' forecasts in *Anticipations* (1902) were all 'singularly modest', such as the prediction that heavier-than-air flying machines would be used for war by 1950, and Haldane promised to make 'no prophecies rasher' than these. Adding that Wells was 'a generation behind the time', having been raised when flying, radio and telegraphy were scientific problems, Haldane observed: '[n]ow these are [merely] commercial problems, and I believe that the centre of scientific interest lies in biology'.¹⁰¹ (Haldane had perhaps been too

busy to read *Men Like Gods*, but *Daedalus* had originally been a talk given in Cambridge in February 1923, before Wells' novel was published.)

Daedalus forecast drugs that would modify human moods, artificial foods synthesised directly from inorganic chemicals, and coal and oil being replaced by renewable energy. However, it was the biological inventions that took centre stage in the 'undergraduate essay' portion of the book. An artificially modified alga had been invented that fixed nitrogen so efficiently that global food gluts resulted. When a strain escaped into the ocean, fish stocks increased so much that they became the world's main source of protein, finally abolishing hunger. The artificiality of this future world is emphasised in various asides, such as noting that it was after the alga's escape that 'the sea assumed the intense purple colour which seems so natural to us, but which so distressed the more aesthetically minded of our great grand-parents who witnessed the change' (anything, Haldane implies, can come to seem natural in time, from eating cheese to purple oceans).¹⁰² Haldane's undergraduate narrator described another biological invention, a new lichen, that stabilised the drifting sands of deserts, allowing them to support crops. This well-fed world with its newly created plants and cultivated deserts sounds distinctly Burbankian, and the 'naturalness' of purple seas, the products of laboratories working to feed the world, is the epitome of biotopia. Yet so is the distress of 'the more aesthetically minded' who witnessed its creation; one person's biotopia is another's ecocatastrophe – a world without swallows.¹⁰³

The most famous of Haldane's future biological inventions was ectogenesis; babies grown outside human bodies in artificial wombs. Haldane's book was a key source for Aldous Huxley's *Brave New World*, but while the latter is usually considered a dystopia, Haldane's narrator depicted ectogenesis in strongly utopian terms, arguing (perhaps with tongue in cheek) that it had allowed for the scientific selection of the best men and women as parents, with 'very startling' results, including both an 'increased output of first-class music'

and ‘decreased convictions for theft’. Moreover, had ectogenesis not been invented, the undergraduate narrator was in no doubt that civilisation would have collapsed very rapidly ‘owing to the greater fertility of the less desirable members of the population in almost all countries’. The fears of human degeneration that haunted these decades were clearly present in Haldane’s book, but he was contemptuous of the common solutions on offer at the time, describing the widely proposed eugenic official as a compound of ‘the policeman, the priest and the procurer’.¹⁰⁴

With the undergraduate essay complete, Haldane resumed the narrator’s role and drew a few conclusions from the future he had imagined. The theme that united these was that both human biology and ethics would prove as malleable to the biologist as the colour of the oceans. ‘We can already alter animal species to an enormous extent’, he noted and ‘it seems only a question of time before we shall be able to apply the same principles to our own’.¹⁰⁵ Sex and reproduction will be permanently separated, changing family and personal relationships completely. Haldane was apparently uninterested in the impact such changes would have on supposedly natural gender roles, but the implications of ectogenesis were enthusiastically explored by some women.¹⁰⁶ He also forecast that in the post-natural world, ageing and disease would be controlled to the point where death becomes ‘a physiological event like sleep’, causing both the fear of death and the resulting ‘desire for an afterlife’ to fade away; drugs, hypnosis and hormones would modify human behaviour and multiply sources of pleasure (ectogenesis was not the only idea *Brave New World* took from *Daedalus*).

{ Insert figure 4 around here }

Science, in Haldane’s view, could be defined as ‘man’s gradual conquest, first of space and time, then of matter as such, then of his own body and those of other living beings, and finally the subjugation of the dark and evil elements in his own soul’. Banishing these

demons would free humans to reflect rationally on moral questions, but that did not imply their choice of ethical system would then become arbitrary. On the contrary, scientific knowledge imposed new moral obligations, he argued, because ‘an alteration in the scale of human power will render actions bad which were formerly good’. Increased medical knowledge had ‘transformed resignation and inaction in the face of epidemic disease from a religious virtue to a justly punishable offence’.¹⁰⁷

Haldane’s claim that scientific discoveries shaped new moral standards led him to take issue with Thomas Henry Huxley (grandfather of Aldous) for assuming that ‘traditional morals were sacrosanct and impregnable’ to the challenge of science; on the contrary, Haldane argued ‘[w]e must learn not to take traditional morals too seriously’.¹⁰⁸ Huxley senior had asserted that evolution epitomised the ‘cosmic process’, indifferent to human interests or goals, whereas ‘[s]ocial progress means a checking of the cosmic process at every step and the substitution for it of another, which may be called the ethical process’. Since nature really is red in tooth and claw, it contains no ethical guidance for us; thus Huxley argued that late Victorians must instead rely on traditional moral codes (including those drawn from Christianity). He asserted that ‘the ethical progress of society depends, not on imitating the cosmic process, still less in running away from it, but in combating it’ and the telling image he used to describe civilisation was a garden hacked out of a wilderness.¹⁰⁹ By contrast, Haldane asserted that science could never accept any ‘unalterable moral tradition’. (He argued that only a religion whose ‘...mythology and morals are provisional.... would satisfy the scientific mind’, and added that it was ‘very doubtful’ whether such a faith ‘could properly be called a religion at all’.¹¹⁰) The contrast with the quasi-religious celebration of Burbank is obvious; Haldane rejected any notion of natural morality, arguing instead that ethical standards must evolve as scientific knowledge did. *Daedalus* is a short book, epigrammatic in style, and Haldane did not devote much space to this topic, but he clearly did

not endorse a simplistic version of the naturalistic fallacy (e.g. that we can be happy by simply following nature's laws), but nor does *Daedalus* endorse the kinds of traditional moral codes that Huxley saw as a barrier to the heartless cosmic process.¹¹¹ Indeed, Haldane does not endorse any fixed moral code at all, only the idea that as science changes – and particularly as it changes *us* – our moral codes will be forced to change too.

Haldane left his readers with a rather chilling image of the 'scientific worker of the future' who, he predicted, would 'more and more resemble the lonely figure of Daedalus as he becomes conscious of his ghastly mission, and proud of it'.¹¹² That pairing of 'proud' and 'ghastly' reaches deep into the uncomfortable heart of biotopianism. Over the previous few centuries, a central strand of traditional Christian thinking (particularly in the English-speaking world) had regarded nature as evidence of its divine Creator's limitless benevolence. Alternatively, some Enlightenment thinkers implied that Nature could provide an alternative to a traditional deity; a source of 'good laws, of useful arts, of the sweetest pleasures and of happiness', as one French revolutionary put it.¹¹³ In Huxley's view, Darwin had fatally undermined both these approaches, demolishing both God and a benevolent vision of Nature. All that was left was for us to create a little garden within which to preserve whatever ethical values we could accept.¹¹⁴ However, Huxley's humanist garden was – he acknowledged – doomed to fail; the wilderness must ultimately win and he concluded that 'the prospect of attaining untroubled happiness, or of a state which can, even remotely, deserve the title of perfection, appears to me to be as misleading an illusion as ever was dangled before the eyes of poor humanity'. For Huxley, there could be no utopia because, like many of his contemporaries, he assumed that the legacy of humans' evolutionary struggles was that every person sought to maximise pleasure and minimise pain with no thought for the needs of society as a whole:

That is their inheritance (the reality at the bottom of the doctrine of original sin) from the long series of ancestors, human and semi-human and brutal, in whom the strength of this innate tendency to self-assertion was the condition of victory in the struggle for existence.

Humans must, of course, struggle against these innate tendencies as hard as we can, but Huxley argued they could not finally triumph ‘unless men’s inheritance from the ancestors... their dose of original sin, is rooted out by some method at present unrevealed’.¹¹⁵

Thomas Huxley’s beliefs were largely built on orthodox Darwinian natural selection, which was more widely accepted in Britain than in the USA, and thus one factor that distinguishes British biotopianism from its American counterpart. For Huxley, as for most nineteenth-century thinkers, the prospect of removing our ‘dose of original sin’, that ‘innate tendency to self-assertion’, was impossible; natural selection relied on competitiveness and over-abundant breeding – without them, all progress would stop. Like most Victorians (but, again, perhaps even more strongly in the old country of Britain) he tended to imagine heredity in terms of what humans brought with them out of the past; for a fortunate few, it was a valuable inheritance (land, a title, or just a healthy constitution), but for many it was a burden (usually of debt or disease). However, this understanding began to change around 1900 as heredity was increasingly seen as a set of *future* possibilities rather than of *past* burdens, and the optimism of the dawning American century helped make this interpretation more widespread there.¹¹⁶ Experimental evolution – which initially grew out of de Vries’ mutation theory and Mendelism – offered the possibility of speeding up, improving and above all *controlling* the evolutionary process. Remaking nature meant, of course, that humans could no longer turn to it for guidance, but perhaps they would be able to finally root out that last trace of secularised original sin. Haldane clearly believed that, and so did Huxley’s one-time pupil, H.G. Wells (at times, at least): in *Men Like Gods*, another of the

Earthlings who objects to Utopia is Father Amerton, a Catholic priest who is ‘dreadfully outspoken about the sins of society and all that sort of thing’ and is condemned by Mr Barnstaple for embodying all that is ‘wrong and ugly and impossible in Catholic teaching’.¹¹⁷ There is no organised religion in Wells’ Utopia and no belief in original sin, even its secularised form. Since population is carefully regulated and managed, there is no need for struggle and humanity’s ‘innate tendency to self-assertion’ has apparently been ‘rooted out’. And, as we have seen, Gilman’s Herlanders had made the same breakthrough.

Daedalus shocked many readers when it was first published, but was widely reviewed. Many reviewers offered religious objections, not least because Haldane had called the scientific worker a deicide (in sharp contrast to the almost religious biotopianism embodied by Burbank). One writer in the *Washington Post* was appalled by Haldane’s vision of a ‘dehumanized humanity’ ... ‘wholly mechanical, with love and religion outgrown’.¹¹⁸ By contrast, the *New York Times* commented that he proposed the remodelling ‘not of life’s paraphernalia, but of life itself’, and enthusiastically recommended a book it believed would ‘send off the thoughts of the average educated layman into entirely new directions’.¹¹⁹ In Britain, the authoritative scientific weekly *Nature* argued that Haldane ‘is right’ to suggest that ‘we are on the verge of scores of new inventions of a biological nature’, and predicted that readers would find in *Daedalus* ‘not only entertainment but also food for much thought’.¹²⁰ Many readers of such reviews would have assumed that the biologically inspired future predicted by Haldane was – for good or ill – both possible and imminent.

Conclusion

Daedalus was a sensation, selling 15,000 in its first year and its success prompted other scientists to try their hand at prophecy.¹²¹ Just three years later Haldane’s fellow Cambridge academic, John Desmond Bernal, produced *The World, the Flesh and the Devil: An Inquiry*

into the *Future of the Three Enemies of the Rational Soul*, which was inspired by (and shared many themes with) *Daedalus*.¹²² { Insert figure 5 around here } Similar ideas emerged in *Out of the Night*, by the US geneticist Hermann J. Muller, which featured a prominent promotional blurb from Haldane, describing Muller as ‘one of the world’s leading biologists’, and adding that ‘his proposals, whether or not they are desirable, are entirely practicable. If they are adopted, the results will be as important as those of the industrial revolution’.¹²³ By the early 1930s, the claim that biology would reshape humanity and its world was both widespread and credible. Overt fictions were produced in parallel to these serious, prophetic works and they shared common elements; as we have seen, Howard Shinn referred to work like Luther Burbank’s as embodying the ‘marvellous gospel of plant-evolution’ and also reviewed Wells’ *Men Like Gods*, commenting that it offered solutions to ‘living problems which we must solve if we would salvage our civilization’.¹²⁴ The latter comment could just as easily have been referring to Burbank, illustrating the rich web of connections between apparently very different genres of writing.

However, Shinn’s reference to the problems that threatened civilization is a reminder that a sense of biological crisis was at least as widespread as the optimism that has been analysed here. The secularised version of original sin that motivated various forms of the Malthusian fear reached a crescendo in the decades around 1900, as diffuse but pervasive fears of degeneration became increasingly widespread.¹²⁵ The most common form was the fear that what Thomas Huxley had called ‘the cosmic process’ (natural selection) had been softened by the ‘ethical process’ of civilisation, allowing the weaker members of society to survive and breed, indeed to breed more prolifically than their supposed betters, leading to a sharp (perhaps terminal) decline in human intelligence and morals. The most popular response to this fear was, of course, eugenics, the catch-all title for various schemes to selectively breed human beings, that was typically divided into negative eugenics (reducing the reproduction of

the unfit) and positive schemes to encourage the allegedly superior to breed faster. Eugenics and biotopianism were, to varying degrees, both indebted to recent biological science and their concerns and goals intersected in various ways. For example, Haldane explicitly saw ectogenesis as sharing the goals of eugenics, but as providing a more effective means of achieving them (as did Muller's euteleogenesis in *Out of the Night*). Positive eugenics had a popular appeal that clearly overlapped with that of biotopianism (for example, Burbank's *Training of the Human Plant* espoused his own, typically idiosyncratic, version of eugenics focused on child-rearing).¹²⁶ In its more biotopian mode, eugenics offered the chance to help make better people, whereas negative eugenics was more often linked to the earlier sense of heredity as a burden from the past that needed to be eliminated. (A fuller understanding of these connections might produce a more sophisticated understanding of the popular appeal of eugenics, particularly among women, in these decades; the topic requires too much space to be discussed here and will be treated in a forthcoming book on biotopia.)

The overlap between eugenics and biotopianism was also apparent in many American and British biology textbooks, which culminated in *The Science of Life*, a massive (and hugely popular) textbook that appeared first in serial form, as a series of magazines with attractive colour covers, and then as a book that was widely reviewed and sold well on both sides of the Atlantic.¹²⁷ It ended with an optimistic section called 'Life Under Control', in which the three authors (H.G. Wells, his son G.P. Wells, and Julian Huxley, brother of Aldous) assured their readers that 'our species will survive and triumph over its present perplexities', as long as 'Man' was willing to 'take control not only of his own destinies but of the whole of life'. The 'clumsy expedients of the old-time animal and plant breeder' would be 'replaced by more assured and swifter and more effective methods'. There was a clear echo of the utopian ideals of Wells' earlier *Men Like Gods*, when *Science of Life* assured its readers that 'every species of plant and animal man may judge, whether it is to be fostered,

improved or eliminated. No species is likely to remain unmodified'. As a result, 'the wilderness' would become 'a world-garden'. The image of the garden remained the most potent embodiment of biology's hopes and was a reminder that gardening is a creative art, as well as a practical one; Wells and his co-authors suggested that once humans had learned to manipulate the germ-plasm of plants, animals and people directly, man would master 'a new art, with living protoplasm as his medium'. The book ended on a biotopian crescendo, that (to borrow Wells' earlier famous phrase) hurled humanity into futurity:

these mightier experiences and joys of the race to come will be in a sense ours, they will be the consequence and fulfilment of our own joys and experiences, and a part, as we are a part, of the conscious growth of life, for which no man can certainly foretell either a limit or an end.¹²⁸

The varied nature of the network of texts analysed here shows that to fully understand science's cultural impact and its historical significance we have to look beyond the lab and the conventionally defined scientific world. The history of twentieth-century biology, in particular, is often tightly focused on the technicalities of theory and practice – and thus on science's ideas, institutions and individuals. As a result, it tends to overlook the *interpreters* of science, yet I would argue that scientific facts and theories are of very limited interest to historians until they leave the lab and are interpreted for wider publics; this is when they take flight and become part of society's wider conversations. The historiography of public science in the twentieth century is still rather dominated by the unhelpful assumption that such science is merely 'popularised' – diluted, misunderstood, and over-simplified – and that it seeps out into the public mind through a passive process of diffusion. The many careers of experimental evolution reveal a very different kind of story, whose tellers appropriated whatever bits of science they found useful and adapted them to new and unexpected ends. Conventional historians of biology might dismiss these imaginative interpretations as

mistakes, part of the catalogue of errors that today's scientists constantly battle to eradicate from the public's mind, but their historical importance is indisputable when we examine biotopianism's lasting influence.

The biotopian tradition reached its peak in the early 1930s; although its echoes are apparent whenever the public grapples with biology's implications, the optimism and excitement of these early decades would never be recaptured. There are complex reasons for this, which need fuller analysis, but there is little doubt that the depression, mass unemployment and the rise of both fascism and Stalinism blunted the optimism that was characteristic of the century's early decades. Changes within biology were also important: as I have argued elsewhere, de Vries's mutation theory held the wider public's interest long after biologists had largely abandoned it.¹²⁹ (And it has continued to exercise an influence over popular culture: the successful movie franchise, the *X-Men* (f.2000), is just one of several examples of the way in which the de Vriesian sense of mutation, a new species in a single, optimistic jump, has persisted.) Nevertheless, one important aspect of biotopianism was the apparent practicality of creating a utopian garden, and of doing so rapidly – and the original meaning of mutation was central to that. During the 1920s and 30s, geneticists gradually redefined mutation to mean genetic changes that could be small and were often deleterious; even though these new definitions spread slowly and unevenly (especially to non-scientists), the early excitement engendered by de Vries' theory gradually faded. As Luis Campos and Helen Curry have shown, new approaches to modifying plants and animals developed, using mutagenic chemicals, such as colchicine, and radioactive materials, such as radium.¹³⁰ These new techniques allowed biotopianism to persist into the thirties and beyond, but as the geneticists' new understanding of mutation spread, the hopes of speeding up and controlling evolution gradually faded, and – of course – radioactivity began to acquire less positive associations after WWII.

Brave New World (1932) might be called the last biotopia, but its well-deserved fame has somewhat overshadowed the complex web of texts out of which Aldous Huxley's novel grew and with which it is effectively in dialogue.¹³¹ For example, *Brave New World* is, amongst other things, an Englishman's reaction to the spectacle of modern America; it satirises its excesses but is also unwillingly entranced by this sexy world of technological and biological innovation. A key topic that I will return to in future is the differences between Britain and America, which are central both to Huxley's novel and to nature and fate of biotopianism, but even from this brief, preliminary discussion, it is evident that there were important contrasts between Britain and America's different faiths – in God, evolution and progress. And America's vision of itself as a new, growing country whose best years lay ahead of it also contrasted sharply with Britain, where in 1900, the *London Times* told its readers that 'An Empire such as ours requires as its first condition an Imperial Race – a race vigorous and industrious and intrepid.... The survival of the fittest is an absolute truth in the modern world'.¹³² Britain's near-defeat during the Boer War left many Britons doubting their fitness and the emergence of a shell-shocked generation after WWI reinforced these doubts, while the USA emerged stronger than ever, confident that it had saved the old countries of Europe from chaos.

A fuller analysis of the sources to which *Brave New World* was indebted recaptures their original context and is important because the biotopian mode continues to shape the ways in which we talk, write and think about biology's likely impact on the future. An obvious example is that *Brave New World* is invariably referred to whenever some new breakthrough in genetics is announced (when it is usually interpreted as unmistakably dystopian, despite being as ambiguous as any of the texts analysed here). And the promise of new crops, blooming deserts and an end to hunger remain the stock-in-trade of today's biotechnology companies; despite the changes over the twentieth century, we are still living with the

biotopians' legacy. However, the interpretation of *Brave New World* as a straightforward dystopia may partly be explained by the fact that when molecular biology reawakened biotopian hopes, it was in a very different postwar atmosphere, after a sea change in public attitudes had severely eroded public confidence and trust in science.¹³³ It was much harder to have 'faith in evolution', or in the idea of scientists directing it. Yet despite this, the biotopian vision of a post-natural garden persisted, for example in novels such as Marge Piercy's *Woman on the Edge of Time* (1976), in which ectogenesis is used to create a 'perverse' but liberating re-engineering of gender roles (including men who breastfeed), or in the film *Silent Running* (1972), which concludes with a stunning image of an artificial garden of Eden, a post-human paradise, cleansed of sin (and of humans; the artificial robot life we have created having succeeded us). In the twenty-first century, re-examining the complex and contradictory legacy of biotopianism might help us think more clearly about our ecological responsibilities. Instead of pretending to be preserving a mythical 'nature', we should perhaps be asking ourselves what kinds of gardeners we want to be.

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¹ E.T. Brewster, 'Nature against Nurture,' *The Atlantic Monthly* 102, no. 1 (1908): pp.120–1.

² Brewster, op cit. (1), 121.

³ Although the term 'biology' dated back to around 1800, it was really the rise of laboratory and experimental biology in the late nineteenth century that really caught the public's imagination. See: Garland E. Allen, *Life Science in the Twentieth Century*, Reprint of 1st ed. Cambridge: Cambridge University Press, 1978.; Jim Endersby, *A Guinea Pig's History of Biology: The Plants and Animals Who Taught Us the Facts of Life* London: William Heinemann, 2007.

⁴ For the reception of Mendelism, see: Robert Olby, 'Mendel No Mendelian?,' *History of Science* xvii (1979), Robert Olby, *Origins of Mendelism*, 2nd ed. Chicago: University of Chicago Press, 1985, Paolo Palladino, 'Wizards and Devotees: On the Mendelian Theory of Inheritance and the Professionalization of Agricultural Science in Great Britain and the United States, 1880-1930,' *History of Science* xxxii, no. 3 (1994), Diane B. Paul and Barbara A. Kimmelman, 'Mendel in America: Theory and Practice, 1900–1919,' in *The American Development of Biology*, ed. Ronald Rainger, Keith R. Benson, and Jane Maienschein Philadelphia: University of Pennsylvania Press, 1988, Marsha L. Richmond, 'The 1909 Darwin Celebration: Reexamining Evolution in the Light of Mendel, Mutation, and Meiosis,' *Isis* 97 (2006), Alan R. Rushton, 'Bateson and the Doctors: The Introduction of Mendelian Genetics to the British Medical Community 1900–1910,' in *History of Human Genetics: Aspects of Its Development and Global Perspectives*, ed. Heike I. Petermann, Peter S. Harper, and Susanne Doetz Chamonix, Switzerland: Springer, 2004.

⁵ I discuss mutation theory in more detail in Jim Endersby, 'Mutant Utopias: Evening Primroses and Imagined Futures in Early Twentieth-Century America,' *Isis* 104, no. 3 (2013).

⁶ Brewster, op cit. (1), p.121.

⁷ Philip J. Pauly, *Fruits and Plains: The Horticultural Transformation of America*, 1st ed. Cambridge, Mass.: Harvard University Press, 2007.

⁸ In this review, Brewster used the term 'bionomics' to describe the novel approach, as did other writers. However, 'bionomics' was only used occasionally and has since acquired a much narrower, technical meaning (referring to the ecology of a particular species of organism), so I have preferred the broader and more widely used term 'experimental evolution'.

⁹ Elie Metchnikoff, *The Prolongation of Life: optimistic studies* (1908), p. 235. Quoted in: Brewster, op cit. (1), p.124.

¹⁰ Brewster, op cit. (1), p.124.

¹¹ Overviews of utopianism include: George Kateb, *Utopia and Its Enemies* London: The Free Press of Glencoe, 1963.; Marie Louise Berneri, *Journey through Utopia* Schocken 1971.; Frank E. Manuel and Fritzie P. Manuel, *Utopian Thought in the Western World*, 1st ed. Cambridge, Mass.: Harvard University Press, 1979.; Tom Moylan, *Demand the Impossible: Science Fiction and the Utopian Imagination*, 1st ed. London: Methuen, 1986.; Krishan Kumar, 'Aspects of the Western Utopian Tradition,' *History of the Human Sciences* 16, no. 1 (2003).; and, Howard P. Segal, *Technological Utopianism in American Culture*, 2nd ed. Syracuse, NY: Syracuse University Press, 2005.

¹² J.C. Davis, 'Science and Utopia: The History of a Dilemma,' in *Nineteen Eighty-Four: Science between Utopia and Dystopia*, ed. Everett Mendelsohn and Helga Nowotny Dordrecht: Reidel, 1984, pp.26–7.

¹³ For example: Darko Suvin and Gerry (ed) Canavan, *Metamorphoses of Science Fiction: On the Poetics and History of a Literary Genre*, [New edition]. ed. 1979 (2016).; Peter Ruppert, *Reader in a Strange Land: The Activity of Reading Literary Utopias* Athens, Ga.: University of Georgia Press, 1986.; Krishan Kumar, *Utopia and Anti-Utopia in Modern Times*, 1st ed. Oxford: Basil Blackwell, 1987.; and, Chris Ferns, *Narrating Utopia: Ideology, Gender, Form in Utopian Literature*, ed. David Seed, *Liverpool Science Fiction Texts and Studies* Liverpool: Liverpool University Press, 1999.

¹⁴ Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* Oxford; London: Oxford University Press, 1972.; Howard P. Segal, *Future Imperfect: The Mixed Blessings of Technology in America* Amherst, Mass.: University of Massachusetts Press, 1994.; Segal, *Technological Utopianism in American Culture*.

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- ¹⁵ Piers J. Hale, *Political Descent: Malthus, Mutualism, and the Politics of Evolution in Victorian England* Chicago; London: University of Chicago Press, 2014. For the socialist/progressive appeal of evolution, see: Mark Pittenger, *American Socialists and Evolutionary Thought, 1870–1920*, 1st ed. Madison: University of Wisconsin Press, 1993.; David Stack, *The First Darwinian Left: Socialism and Darwinism, 1859-1914* Cheltenham: New Clarion Press, 2003.
- ¹⁶ Space prohibits an exploration of these themes in other countries, but – for reasons I will explore – I suspect that these were particularly Anglo-American concerns.
- ¹⁷ Charles Howard Shinn, ‘A Wizard of the Garden [Reprinted as *Intensive Horticulture in California*],’ *The Land of Sunshine: the Magazine of California and the West* 14, no. 2 (1901): pp.3–5.
- ¹⁸ David Stack, *The First Darwinian Left: Socialism and Darwinism, 1859-1914*, Cheltenham, 2003.
- ¹⁹ William Sumner Harwood, *The New Earth: A Recital of the Triumphs of Modern Agriculture in America* New York; London: Macmillan, 1906, pp.49, 1–2.
- ²⁰ Nikolay Ivanovich Vavilov, *Origin and Geography of Cultivated Plants* C.U.P., 1992, pp.284–5.
- ²¹ John Elfreth Watkins Jr., ‘New Species to Order,’ *The Evening Star (Washington D.C.)* (1907). The story was reprinted in other papers, e.g. John Elfreth Watkins Jr., ‘Creation of Species: Work Done at Station of Experimental Evolution,’ *New-York Daily Tribune* (1907).
- ²² Charlotte Perkins Gilman, *Herland* New York: Pantheon Books, 1915 (1979), pp.94, 71–2.
- ²³ Herbert George Wells, *Men Like Gods* Thirsk: House of Stratus, 1923 (2002), pp.32, 85–6.
- ²⁴ J.B.S. Haldane, *Daedalus, or, Science and the Future*, 1st ed. London: Kegan Paul, Trench, Trubner & Co., Ltd., 1924, pp.61–2, 6. The idea of ‘genetic engineering’ did not really exist at this time, but the idea was beginning to be discussed by geneticists. The US geneticist Albert Blakeslee may well have been the first to call himself a ‘genetics engineer’, see: Luis Campos and Alexander von Schwerin, ‘Transatlantic Mutants: Evolution, Epistemics, and the Engineering of Variation, 1903–1930,’ in *Heredity Explored: Between Public Domain and Experimental Science, 1850–1930*, ed. Staffan Müller-Wille and Christina Brandt Cambridge, Mass.: MIT Press, 2016, p.402.; Luis Campos, *Radium and the Secret of Life* Chicago: University of Chicago Press, 2015.
- ²⁵ The term ‘biotopia’ has been used occasionally by ecologists and as the name of a couple of contemporary natural history/ecology museums (e.g. in Uppsala), but not (to the best of my knowledge) in the sense that I am using it here.
- ²⁶ *The Forerunner* got a few reviews, in the *Chicago Evening Post*, the *Chicago Dial*, and the *Vegetarian Magazine*. And the leading US socialists Eugene Debs and Upton Sinclair both quoted from it in public, Gary Scharnhorst, *Charlotte Perkins Gilman*, 1st ed. Boston: Twayne Publishers, 1985, p.85.
- ²⁷ Charles Howard Shinn, ‘Men Like Gods: Well’s Utopian Novel of Earthlings Who Find a New World,’ *Overland Monthly and Out West Magazine* LXXXI, no. 5 (1923): pp.44–5.
- ²⁸ Henry James Forman, ‘H.G. Wells Skids into Utopia [Review of] *Men Like Gods*,’ *New York Times* (1923): p.1.
- ²⁹ Charlotte Perkins Gilman, ‘Comment and Review,’ *The Forerunner* 1, no. 3 (1910): p.28.
- ³⁰ Ferns, op. cit. (13), pp.13–4.
- ³¹ Gilman, op. cit. (21), pp. 68, 78–80, 94.
- ³² Wells, op. cit. (22), pp.17, 36, 85–6.
- ³³ Wells, op. cit. (22), p.155.
- ³⁴ Wells based the character on Eddie Marsh, secretary to Winston Churchill (who is also caricatured in the novel), Richard Toye, ‘H.G. Wells and Winston Churchill: A Reassessment,’ in *H.G. Wells: Interdisciplinary Essays*, ed. Steven McLean Newcastle: Cambridge Scholars, 2008, p.150. Marsh (1872–1953) was an art collector and patron of painters and poets, particularly Rupert Brooke, C. V. Hassall, ‘Marsh, Sir Edward Howard (1872–1953),’ rev. Mark Pottle, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [<http://www.oxforddnb.com/view/article/34892>, accessed 27 Nov 2017]

³⁵ Wells, op. cit. (22), pp.84–5, 7. (emphasis added). Interestingly, in Wells' *The Time Machine* (1895), the Time Traveller discovers a future in which people had created 'air free from gnats, the earth from weeds or fungi; everywhere were fruits and sweet and delightful flowers; brilliant butterflies flew hither and thither. The ideal of preventive medicine was attained. Diseases had been stamped out' (Wells 1895, 24). However, in 1895, the resulting absence of adversity had led to humanity's degeneration; by 1923, Wells – like the other biotopians – had become more optimistic.

³⁶ Wells, op. cit. (22), p.98.

³⁷ For a fuller discussion, see: Carolyn Merchant, *The Death of Nature : Women, Ecology, and the Scientific Revolution* London: London : Wildwood House, 1982.; Peter Pesic, 'Proteus Rebound: Reconsidering the 'Torture of Nature', ' *Isis* 99, no. 2 (2008).

³⁸ Gilman, op. cit. (21), pp.100–1. Some scholars have even described *Herland* as an ecological utopia, but recent criticism has challenged this interpretation, see: Janna Knittel, 'Environmental History and Charlotte Perkins Gilman,' *Foundation: International Review of Science Fiction* 35, no. 96 (2006).; Andrew G. Christensen, 'Charlotte Perkins Gilman's *Herland* and the Tradition of the Scientific Utopia,' *Utopian Studies* 28, no. 2 (2017).

³⁹ Gilman, op. cit. (21), pp.95, 103.

⁴⁰ My thinking on this point is indebted to Philip J. Pauly's discussion of 'culture', which – he notes – meant 'tillage' before it meant art and literature. Both meanings retain a sense of improvement through the activity of cultivating; plants and people are similarly improved by careful cultivation, Philip J. Pauly, *Biologists and the Promise of American Life: From Merriweather Lewis to Alfred Kinsey*, 1st ed. Princeton: Princeton University Press, 2000, pp.8–9. See also: Sherry B. Ortner, 'Is Female to Male as Nature Is to Culture?,' *Feminist Studies* 1, no. 2 (1972). and Donna Haraway, *A Cyborg Manifesto*, ed. Donna Haraway, 1st ed., *Simians, Cyborgs and Women* London: Routledge, 1991.

⁴¹ See: Philip J. Pauly, *Controlling Life : Jacques Loeb and the Engineering Ideal in Biology* New York: Oxford University Press, 1987.; Jon Turney, *Frankenstein's Footsteps: Science, Genetics and Popular Culture*, 1st ed. New Haven: Yale University Press, 1998.

⁴² See, for example, David C. Smith, *H.G. Wells: Desperately Mortal*, 1st ed. New Haven and London: Yale University Press, 1986, pp.3–25.; Peter Kemp, *H.G. Wells and the Culminating Ape: Biological Imperatives and Imaginative Obsessions* Basingstoke: Macmillan, 1996.

⁴³ For Gilman and biology, see: Pittenger, op. cit. (15), pp.9–10.; Larry Ceplair, ed., *Charlotte Perkins Gilman: A Nonfiction Reader*, 1st ed. New York: Columbia University Press, 1991.

⁴⁴ For Loeb see: Nathan Reingold, 'Jacques Loeb, the Scientist: His Papers and His Era,' *Quarterly Journal of Current Acquisitions* 19, no. 3 (1962).; Pauly, op. cit. (45); and, Turney, op. cit. (45), pp.67–72.

⁴⁵ Charlotte Perkins Gilman, 'As to Parthenogenesis and Humanity,' *The Forerunner* VII, no. 3 (1916): p.83. She may have derived the information from Patrick Geddes and J. Arthur Thomson, *The Evolution of Sex*, 2nd, revised ed. London: Walter Scott, 1901, pp.192–3., a book she mentioned as one she found most important, Ceplair, op cit. (47), pp.88–9.

⁴⁶ Gilman, op. cit. (49), p.83.

⁴⁷ Gilman, op. cit. (21), p.77. Given the date, 'law of mutation' is a reference to De Vries, not Mendelism. The biologist Ernst Mayr recalled that as a young student in the 1920s, he and his fellow students still thought of mutation only in the de Vriesian sense, Ernst Mayr, 'Prologue: Some Thoughts on the History of the Evolutionary Synthesis,' in *The Evolutionary Synthesis: Perspectives on the Unification of Biology*, ed. Ernst Mayr and William B. Provine Cambridge, Mass.: Harvard University Press, 1998, p.20.

⁴⁸ E.T. Brewster, 'Significant Books of Science,' *The Atlantic Monthly* (1905): p.684. For Gilman and the *Atlantic Monthly*, see: Charlotte Rich, 'From near-Dystopia to Utopia: A Source for *Herland* in Inez Haynes Gillmore's *Angel Island*,' in *Charlotte Perkins Gilman and Her Contemporaries*, ed. Cynthia J. Davis and Denise D. Knight Tuscaloosa: The University of Alabama Press, 2004, p.155. See also: E.T. Brewster, 'Some Recent Aspects of Darwinism,' *The Atlantic Monthly* (1904), pp. 513–521.

⁴⁹ For Gilman and PSM, see: Pittenger, *American Socialists and Evolutionary Thought, 1870–1920*, p.73. Articles on mutation included: Hugo De Vries, 'On the Origin of Species,' *Popular Science Monthly* LXII, no. 6 (1903).; Ambrosius Arnold Willem Hubrecht, 'Hugo De Vries's Theory of Mutations,' *Popular Science*

Monthly LXV (1904).; Charles Abiathar White, 'The Mutations of *Lycopersicum*,' *Popular Science Monthly* 66, no. 7 (1905).; Daniel Trembly MacDougal, 'Discontinuous Variation in Pedigree Cultures,' *Popular Science Monthly* 69, no. 3 (1906).

⁵⁰ For example: Anon., 'Some Books on Evolution,' *The Nation* 95, no. 2475 (1912).; Hugo De Vries, 'A New Conception Concerning the Origin of Species,' *Harper's Monthly Magazine* CX, no. DCLVI (1905).

⁵¹ Charles S. Slichter, 'Industrialism,' *Popular Science Monthly* 81, no. 22 (1912): p.363. I discuss the reception of the mutation theory more fully in Endersby, op. cit (5).

⁵² Gilman 'Having Faith in Evolution' (*Forerunner*, 6.11, November 1915: 299–300, and in: Beth Sutton-Ramspeck and Charlotte Perkins Gilman, eds., *Herland and Related Writings* 2013, pp.234–5.

⁵³ Charlotte Perkins Gilman, 'Assisted Evolution,' *The Forerunner* VII, no. 1 (1916): p.5.

⁵⁴ Gilman, op. cit. (21), pp.49–51.

⁵⁵ Gilman, op. cit. (21), pp.91–3.

⁵⁶ As noted, *Herland* does not appear to have been reviewed, but Gilman was publicly pilloried as 'unnatural' for relinquishing the care of her daughter to her husband and second wife following their divorce, Jennifer S. Tuttle, 'New England Innocent' in the Land of Sunshine: Charlotte Perkins Gilman and California,' *Western American Literature* 48, no. 3 (2013): pp.300–1.

⁵⁷ My thinking on Burbank is greatly indebted to Pandora's lucid and original analysis of his public significance. See Katherine Pandora, 'Knowledge Held in Common: Tales of Luther Burbank and Science in the American Vernacular' *Isis* 92, no. 3 (2001). For the picket fence, see: Liberty Hyde Bailey, 'A Maker of New Fruits and Flowers,' *The World's Work* II (1901): pp.1209–10.

⁵⁸ Jane S. Smith, *The Garden of Invention: Luther Burbank and the Business of Breeding Plants* New York: The Penguin Press, 2009, pp.108-12.

⁵⁹ Various, *Complimentary Banquet in Honor of Luther Burbank. Given by the California State Board of Trade, Palace Hotel, San Francisco, 14 September 1905* San Francisco: California State Board of Trade, 1905, pp.6–7, 18, 40.

⁶⁰ Garrett P. Serviss, 'Transforming the World of Plants: The Wonder-Work of Luther Burbank, Which Shows How Man Can Govern Evolution,' *The Cosmopolitan; a Monthly Illustrated Magazine* 40, no. 1 (1905): p.65.

⁶¹ Norman Howard, 'Dr. Luther Burbank, the Magician of Plants. The Life-Story of an Explorer into the Infinite,' *The Quiver: An Illustrated Magazine for Sunday and General Reading* 220 (1906): p.451.

⁶² 'Evolved' was regularly used as a transitive verb at this time, e.g. *The World To-Day* described Burbank's Shasta daisy as a plant 'which he evolved', George Ethelbert Walsh, 'Prizes in Plants (the Making of to-morrow),' *The World To-Day: A monthly record of human progress* XX, no. 2 (1911): p.232.

⁶³ Pandora, op. cit. (61), p.497. Jane Smith has made the same point, that the excitement around what she calls Burbank's garden of invention was 'the possibility, for a time, that anyone could enter and see what might take root', Smith, op. cit. (62), p.9.

⁶⁴ Endersby, op. cit (5), pp.476, 84, 87–92.

⁶⁵ Smocovitis has argued that later anti-Darwinian backlash in the 1950s was also in part a reaction against the perceived arrogance of biologists, flushed with their success in creating what they called the Modern Evolutionary Synthesis, see: Vassiliki Betty Smocovitis, 'The 1959 Darwin Centennial Celebration in America,' *Osiris* 14 (1999).

⁶⁶ Burbank did not appear at the trial, but wrote a strong letter in support of the teaching of evolution. Smith, op. cit. (67), pp.263–4.

⁶⁷ Burbank referred to 'teaching these old dogs of the vegetable world the new tricks' in his autobiography, Luther Burbank and Wilbur Hall, *The Harvest of the Years: An Autobiography, Edited, with a Biographical Sketch, by W. Hall* Boston; New York: Houghton Mifflin Co., 1927, p.88.

⁶⁸ Brewster, op cit. (1), p.123. An entry for 'burbank' (lower-case) as verb was included in the second edition of Webster's, where it was defined as meaning both to 'modify and improve (plants or animals)' and 'figuratively, to improve (anything, as a process or institution) by selecting good features and rejecting bad', as well as one for

‘burbankian... Produced by burbanking; resembling the act or product of burbanking’, *Webster’s New International Dictionary*, Springfield, MA: Merriam-Webster, 1934 : 357.

⁶⁹ For an overview of Burbank and the press see: Walter L. Howard, ‘Luther Burbank: A Victim of Hero Worship,’ *Chronica Botanica* 9, no. 5–6 (1945). and Pandora, op. cit. (61).

⁷⁰ William Sumner Harwood, *New Creations in Plant Life: An Authoritative Account of the Life and Work of Luther Burbank* New York; London: Macmillan, 1905.; Harwood, op. cit. (18). For *Century Magazine*, see: William B. Cairns, ‘Later Magazines,’ in *The Cambridge History of English and American Literature in 18 Volumes (1907–21)*, ed. Adolphus William Ward, et al. New York: G.P. Putnam’s Sons, 1907–21 (2000).; Marcel C. LaFollette, *Making Science Our Own: Public Images of Science, 1910–1955*, 1st ed. Chicago: University of Chicago Press, 1990, p.33.

⁷¹ For Burbank’s relationship with de Vries, see: Endersby, op. cit. (5).

⁷² William Sumner Harwood, ‘A Wonder-Worker of Science: An Authoritative Account of Luther Burbank’s Unique Work in Creating New Forms of Plant Life (First Paper),’ *The Century Magazine* LXIX, no. 5 (1905): pp.656–7.

⁷³ Harwood, op. cit. (76), p.657.

⁷⁴ Harwood, op. cit. (74), p.336.

⁷⁵ Harwood, op. cit. (76), p.669.

⁷⁶ Bailey, op. cit. (60), p.1213.

⁷⁷ David Starr Jordan and Vernon L. Kellogg, eds., *The Scientific Aspects of Luther Burbank’s Work* San Francisco: A.M. Robertson, 1909, p.x.

⁷⁸ Serviss, op. cit. (64), p.68.

⁷⁹ Garrett P. Serviss, ‘Some Great American Scientists: Ix. Luther Burbank,’ *The Chautauquan; A Weekly Newsmagazine* 50, no. 3 (1905): p.411.

⁸⁰ Serviss, op. cit. (64), p.68.

⁸¹ ‘Plant Freaks to Be Shown: Wizard Burbank Will Exhibit Some Queer Ones,’ *Los Angeles Times*, 16 March 1911 1907.

⁸² J.F. Meagher, ‘Nadfratities,’ *The Silent Worker* 31, no. 10 (1919): p.204.

⁸³ My thinking on this is much-indebted to Luis Campos, particularly: Luis Campos, ‘Mutant Sexuality: The Private Life of a Plant,’ in *Making Mutations: Objects, Practices, Contexts*, ed. Luis Campos and Alexander von Schwerin Max-Planck-Institut für Wissenschaftsgeschichte, 2010. In the light of Campos’ analysis of the ‘queerness’ of *Oenothera*, it is intriguing that the OED records the earliest uses of ‘queer’ as an adjective to mean homosexual in the *LA Times* (where this report on Burbank appeared) just three years later, ‘He said that the Ninety-six Club was the best; that it was composed of the ‘queer’ people. He said that the members sometimes spent hundreds of dollars on silk gowns, hosiery, etc. At these ‘drags’ the ‘queer’ people have a good time’ (1914 *Los Angeles Times* 19 Nov. ii. 10/5). The word was used as a noun in Britain slightly earlier.

⁸⁴ Pandora, op. cit. (61), pp.498–9.

⁸⁵ Luther Burbank, ‘How to Produce New Trees, Fruits and Flowers,’ in *Proceedings of the 24th Session of the American Pomological Society, Sacramento, Ca., 16-18 January 1895*, ed. Horticultural Society of New York Topeka, Kansas: American Pomological Society, 1895. The paper was read on Burbank’s behalf.

⁸⁶ One context for the emergence of Biotopia would be the US ‘Country-Life movement’, to which Liberty Hyde Bailey was an important contributor. See: Liberty Hyde Bailey, *The Country-Life Movement in the United States* New York; London: Macmillan, 1911.; Jeffrey Brian Motter, ‘Tending the Garden: The Country Life Movement between Productivity and Sustainability’ Indiana University, 2009. My thanks to Helen Curry for drawing this to my attention.

⁸⁷ Harwood, op. cit. (76), pp.672, 61.

⁸⁸ Various, *Complimentary Banquet in Honor of Luther Burbank. Given by the California State Board of Trade, Palace Hotel, San Francisco, 14 September 1905*, p.16.

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- ⁸⁹ Enos Brown, 'Luther Burbank and Plant Breeding,' *Scientific American* XCIII, no. 2 (1905): p.220.
- ⁹⁰ Harwood, op. cit. (74), pp.167–8.
- ⁹¹ Harwood, op. cit. (76), p.669.
- ⁹² Serviss, op. cit. (83), p.415.
- ⁹³ Garrett P. Serviss, 'How Burbank Produces New Flowers and Fruit: The Illimitable Field of Plant-Production Opened by Crossing and Selection,' *The Cosmopolitan; a Monthly Illustrated Magazine* 40, no. 2 (1905): pp.164–5.
- ⁹⁴ Serviss, op. cit. (83), p.412.
- ⁹⁵ Charles H. Woodbury, 'The Work of Luther Burbank' *The Open Court* 1910, no. 5 (1910): p.307.
- ⁹⁶ Harwood, op. cit. (74), p.39.
- ⁹⁷ Shinn, op. cit. (17), p.10.
- ⁹⁸ J.B.S. Haldane's confidence in the liberating possibilities of contraception would be challenged by his wife, Charlotte Haldane, in a biotopian novel that emphasised the oppressive misogyny that could result from 'man' controlling nature, Charlotte Haldane, *Man's World*, New York, 1927.
- ⁹⁹ Haldane, *Daedalus, or, Science and the Future*, pp.42–5.
- ¹⁰⁰ Haldane, op. cit. (102), pp. 46–7, 77.
- ¹⁰¹ Haldane, op. cit. (102), pp.9–10.
- ¹⁰² Haldane, op. cit. (102), pp.24, 59–62.
- ¹⁰³ Haldane also conveys a faint hint of contempt for the 'aesthetically minded', just as there was in Wells' description of Freddy Mush.
- ¹⁰⁴ Haldane, op. cit. (102), pp. 66–7, 40–1.
- ¹⁰⁵ Haldane, op. cit. (102), p.69.
- ¹⁰⁶ E.g. Vera Brittain, *Halcyon: Or, the Future of Monogamy*, 1st ed., *To-Day and to-Morrow* London: Kegan Paul, Trench, Trubner & Co., Ltd., 1929.; Shulamith Firestone, *The Dialectic of Sex: The Case for Feminist Revolution* London: Women's Press, 1979. See: Susan Merrill Squier, *Babies in Bottles: Twentieth-Century Visions of Reproductive Technology* New Brunswick, N.J.: Rutgers University Press, 1994. Ectogenesis – and the end of traditional families – are also discussed by Charlotte Haldane, but in much more sceptical terms, C. Haldane, op. cit. (98).
- ¹⁰⁷ Haldane, op. cit. (102), pp.71–7, 82, 89.
- ¹⁰⁸ Haldane, op. cit. (102), p.90.
- ¹⁰⁹ Thomas Henry Huxley, 'Evolution and Ethics,' in *Evolution and Ethics: T.H. Huxley's 'Evolution and Ethics' with New Essays on Its Victorian and Sociobiological Context*, ed. James G. Paradis and George C. Williams Princeton, N.J.: Princeton University Press, 1894 (1989), pp.138–9, 41.
- ¹¹⁰ Haldane, op. cit. (102), pp.90, 2.
- ¹¹¹ For a brief overview of the naturalistic fallacy and its historical use, see: Lorraine Daston, 'The Naturalistic Fallacy Is Modern,' *Isis* 105, no. 3 (2014).
- ¹¹² Haldane, op. cit. (102), p.93.
- ¹¹³ Antoine-Clair Thibaudeau, 1795. Quoted in Emma C. Spary, *Utopia's Garden: French Natural History from Old Regime to Revolution*, 1st ed. Chicago: University of Chicago Press, 2000, p.10.
- ¹¹⁴ James G. Paradis, 'Evolution and Ethics in Its Victorian Context,' in *Evolution and Ethics: T.H. Huxley's 'Evolution and Ethics' with New Essays on Its Victorian and Sociobiological Context*, ed. Thomas Henry Huxley, James G. Paradis, and George C. Williams Princeton, N.J.: Princeton University Press, 1989, pp.10–1.
- ¹¹⁵ Huxley, op. cit. (116), pp. 102, 85.

¹¹⁶ I am indebted to Staffan Müller-Wille and Christina Brandt whose work first made me recognise this point. However, they suggest that the ‘view that sees (cultural as well as biological) inheritance as a common stock of dispositions seems to lie in the association of heredity with the future rather than the past’; they associate its twentieth-century meaning with the broad idea of progress, but don’t offer a specific causal account of the shift, Staffan Müller-Wille and Christina Brandt, ‘From Heredity to Genetics: Political, Medical, and Agro-Industrial Contexts,’ in *Heredity Explored: Between Public Domain and Experimental Science, 1850–1930*, ed. Staffan Müller-Wille and Christina Brandt Cambridge, Mass.: MIT Press, 2016, p.17.

¹¹⁷ Wells, op. cit. (22), pp.31, 110.

¹¹⁸ William T. Ellis, ‘Today’s Tremendous Testing (International Sunday School Lesson),’ *The Washington Post* (1925).

¹¹⁹ Eugene S. Bagger, ‘Haldane Looks into the Future: What Marvels Science Will Achieve for Human Life – Impending Urbanization of the World,’ *New York Times* (1924): pp.1, 27.

¹²⁰ Anon. “Science and the Future”, *Nature*, 113, No. 2847, 24 May 1924: 740–741.

¹²¹ Krishna R. Dronamraju and J. B. S. Haldane, eds., *Haldane’s Daedalus Revisited* Oxford ; New York: Oxford University Press, 1995, p.1.

¹²² Andrew Brown, *J.D. Bernal: The Sage of Science* Oxford: Oxford University Press, 2005, pp.72–3.

¹²³ Hermann Joseph Muller, *Out of the Night: A Biologist’s Views of the Future*, 1st ed. London: Victor Gollancz Ltd, 1936. Although Muller’s book was not published until 1936, it was mostly written much earlier (as Muller makes clear in its text).

¹²⁴ Shinn, op. cit. (26), p.45.

¹²⁵ The literature on degeneration is immense, and growing constantly, but for an overview see: Edwin Ray Lankester, ‘Degeneration: A Chapter in Darwinism,’ in *The Advancement of Science: Occasional Essays & Addresses* London: Macmillan and Co., 1879.; Max Simon Nordau, *Degeneration*, 9th ed. London: Heinemann, 1896.; Daniel Pick, *Faces of Degeneration: A European Disorder, C.1848–1918*, ed. Quentin Skinner, 1st ed., *Ideas in Context* Cambridge: Cambridge University Press, 1989.; Richard A. Soloway, *Demography and Degeneration: Eugenics and the Declining Birth Rate in Twentieth-Century Britain*, 2nd ed. Chapel Hill and London: University of North Carolina Press, 1995.; and, Sally Ledger and Roger Luckhurst, eds., *The Fin De Siècle: A Reader in Cultural History, C.1880–1900*, 1st ed. Oxford: Oxford University Press, 2000.

¹²⁶ Luther Burbank, ‘The Training of the Human Plant,’ *The Century Magazine* LXXII, no. 1 (1906).

¹²⁷ Smith, op. cit. (46), pp.262–3.

¹²⁸ H. G. Wells, Julian Huxley, and G. P. Wells, *The Science of Life. A Summary of Contemporary Knowledge About Life and Its Possibilities*, 3 vols. London: Amalgamated Press (Waverley Book Company Ltd). 1929–1930, pp.973, 6. I will be analysing textbooks in more detail in the book I am currently completing.

¹²⁹ Endersby, op. cit (5).

¹³⁰ Campos, *Radium and the Secret of Life.*; Helen Anne Curry, *Evolution Made to Order: Plant Breeding and Technological Innovation in Twentieth-Century America* Chicago: University of Chicago Press, 2016.

¹³¹ My thinking on these points has been influenced by the work of Mikhail Bakhtin, e.g. Mikhail M. Bakhtin, ‘From *Discourse in the Novel*,’ in *The Norton Anthology of Theory and Criticism*, ed. Vincent B. Leitch, et al. New York; London: W.W. Norton & Company, 2010.; and, Michael Holquist, *Dialogism: Bakhtin and His World*, 2nd ed., *New Accents* London: Routledge, 2002. *Brave New World*’s antecedents and sources are discussed in: Squier, op. cit. (112); and, Charlotte Sleight, ‘Brave New Worlds: Trophallaxis and the Origin of Society in the Early Twentieth Century,’ *Journal of the History of the Behavioral Sciences* 38, no. 2 (2002).

¹³² Lord Roseberry, quoted in: David Trotter, ‘Modernism and Empire: Reading the Waste Land,’ in *Futures for English* ed. Colin MacCabe Manchester: Manchester University Press, 1988, p.150.

¹³³ Jon Agar, ‘What Happened in the Sixties?,’ *The British Journal for the History of Science* 41, no. 4 (2008).