Fashion, Sustainability and the Anthropocene

Andrew Brooks (King's College London), Kate Flectcher (London College of Fashion), Robert Francis (King's College London), Emma Rigby (London College of Fashion), and Thomas Roberts (University of Surrey)

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Abstract

The unbridled consumption of clothing threatens the environment. In fashion communities, a discussion is developing around the adoption of new materials and economic models to reduce the impacts of clothing production and use. We discuss these emergent technologies in the wider historical setting of the Anthropocene, a geological term that denotes the global scale environmental changes brought about by agricultural and industrial activity. The long history of human-environmental interactions is inter-woven with the development of international garment economies that have shaped biological and physical systems. This article provides an account of how changes in clothing manufacturing and consumption patterns have effected environmental systems over time, with a particular focus on laundry practices in Britain. We draw on one technical solution that has emerged in recent times – closed loop recycling – to discuss how the forward-looking corporate fashion ideas privilege the status quo and incremental change. Optimistic solutions to fashion and sustainability challenges are a signal example of mechanisms that are responding to a 'good Anthropocene', a utopian ecomodernist argument that human systems can adapt and prosper in a changing world. Such flawed solutions hide from view more radical visions to transform the relationships between fashion, technology and the environment.

Introduction: Nature and the Anthropocene

To be concerned about the future is to be preoccupied by environmental change. In response to fears about the environmental impacts of clothing production and consumption a new approach – closed loop recycling – has gained prominence among forward-looking industry leaders. Rather than a discrete chain of clothing manufacturing, retail, use and disposal; proponents envisage that unwanted garments can provide the raw materials for subsequent cycles of production and consumption. Clothes are to be re-made from the same matter in a perpetual series of commodified social relations: 'Circular principles will be at the heart of the new textile system with the ultimate goal of generating growth that benefits citizens and businesses while phasing out negative impacts such as waste and pollution.'[1] C&A, H&M, and Nike, among other fashion labels, are popularising a 'Circular Fibres Initiative'.[2] Whether such a system is technically feasible and if business will choose to implement the technology is uncertain, but examining the logic that underpins such models can shed light on how societies are grappling with environmental change in this new age defined as the Anthropocene.[3]

Global environmental change is ongoing and unavoidable.[4] Human induced transformations of ecosystems are widely recognised, but poorly understood, and the Anthropocene has arisen as a concept for contextualising both the extent and severity of contemporary environmental change. Fears over irreversible damage have spawned a generation of environmentalists. While concerns surrounding the biological and physical processes are discussed by influential voices, including John Bellamy Foster, Naomi Klein, Jason W. Moore and Nicholas Stern, the idea of the Anthropocene is contested and debated.[5] The notion of an Anthropocene challenges what type of world we want to live in, and is moulding the production of new technological and social futures, with some highlighting the opportunities that the age represents and calling for a 'good Anthropocene'.[6] In the second half of this article the role of sustainable approaches to

fashion in the age of the Anthropocene are explored with particular reference to the challenges of synthetic fibre production and microfibre pollution in marine environments and the proposed solution of closed loop recycling. To understand the utopian concepts embedded within the Anthropocene first requires an appreciation of the social construction of *nature*.

Knowing nature helps us understand the Anthropocene. Nature is one of the most complex words in the English language, used differently in varied contexts.[7] Beyond the immediate purview of environmental studies, it may refer to the essential character or quality of something, or an inherent force which directs action. In contrast, here we are concerned with 'traditional' arguments that treat nature as the 'biophysical' world outside of human control. When nature is used in this way it is held to be a 'pure' biological and physical domain that exists independent of the influence of society, modernity and industry.[8] Researchers from both the physical and social sciences have long depended upon this idea of *nature*. Pioneers of ecology and environmental science posited that there was a 'default setting' for the bio-physical world. The influential ecologist Frederic Clements argued in the early twentieth century that ecosystems reached a natural 'climax' community in a given climatic region, an inevitable trajectory of change that would continue once anthropogenic stressors were removed.[9] This conceptualisation of nature became an appealing concept beyond science, especially for conservation movements that wanted to restore 'pristine nature'; but nature is a concept that is as ahistorical as it is inaccurate.[10] The binary cleavage between a natural world and a human-made world neglects the socioecologically-mediated hybrid landscapes that have been developed through millennia of human-environmental interactions. All landscapes are co-produced by social activity and environmental processes. Humans are part of the natural world, not separate from it. The emerging concept of the Anthropocene can help to destabilise the false dichotomy between humans and nature, and the idea can frame both an understanding of how industrial society shapes ecosystems, and how best to respond to environmental concerns.

The Anthropocene arrived as a way of conceiving of the ecological predicament of the Twenty First century. It emerged from the geo-sciences, but had been cautiously embraced by critical social science and humanities as a rallying point for a politics to confront the problem of environmental crisis.[11] Initially, the concept of the Anthropocene came in response to observed, documented, and proven human-induced climatic change.[12] Since the onset of the industrial revolution the global environment has undergoing tremendous change as a result of human activity. Landscapes, ecosystem processes and species distributions are transformed by anthropogenic forces, sometimes irrevocably.[13] The extent of human-led change varies between places, but few, if any, environmental systems have escaped the impacts of modernity. Cumulatively the effect of humankind is so great that it will leave an indelible signature in the fossil record. This was recognised by the International Geological Congress in 2016, which officially designated the Anthropocene as an epoch that began in the mid-twentieth century. Leading geo-scientists argued humans have become a powerful and permanent geological force significant in the history of the earth.

Arguments that popularise the notion of the Anthropocene coalesce around the dominant issue of climate change. Emerging and unpredictable patterns of global warming, fuelled largely by hydrocarbon emissions affect the whole planet. The chemistry of the very atmosphere in which life is encompassed has been reformulated by human hands, demonstrating that there is no natural world outside of social influence. Yet the Anthropocene concept envelops more than a new mixture of climatic gases. Rather, it is the full spectrum of environmental changes led by anthropogenic action, many of which are disrupting environmental systems and crossing thresholds of dramatic and irreversible planetary harm.[14] Synthetic fertilisers have altered the nitrogen cycle, nuclear energy and weapons have produced radionucleotides changing the radioactivity of soils, and species extinction rates are around a thousand times greater than they would be without human activity.[15] Relentless material hyper-consumption, which goes

beyond fuctional use, has produced an abundance of waste. Aluminium, alloys and plastics are found in trace concentrations of sediments forming man-made 'technofossils' that will stain the geological record.[16]

The mass use of synthetic materials presents a particular threat to marine environments. A swirling flotsam of plastics is accumulating in the oceans. The Great Pacific Garbage Patch has become a *cause célèbre*. This place, with no fixed coordinates but extending almost across the width of the North Pacific, has gone from being a hidden phenomenon to a vortex of trash and a visible relic of global environmental change.[17] The uncertain eddies of the oceans and society's insatiable consumption of plastics have co-produced a novel water-scape, but as with climate change it is the as yet obscure, hidden and invisible disruptions to ecosystems that are among the most far-reaching and fearsome for many who anticipate a future global crisis. One such change is the micro-scale pollution that is harming life in rivers and oceans. Fish and other aquatic species are ingesting tiny plastic fragments, which includes artificial microfibres released when polyester garments are laundered.[18] Though the fibres themselves – smaller in diameter than a human hair – are all but invisible, the potential impacts upon sea life are substantial. Organisms of all sizes have been found to consume fibres and other microplastics that can take up space in the digestive system yet are unpassable, reducing both survival and reproduction, as well as increasing the uptake of chemical pollutants that bind to the fibres.[19] Such impacts can bioaccumulate through the food chain, including to humans through consumption of freshwater and marine organisms.

There is a diversity of physical markers of the new geological epoch defined by human activity, but while there is some consensus around the signals of the Anthropocene, the start date of the age is disputed.[20] Laying out the different arguments from the physical sciences for the onset of the Anthropocene falls outside the scope of this paper. Rather, in the next section we explore

how microfibre pollution is the latest in a sequence of Anthropocene moments associated with the evolving economy of garment production, consumption and laundry both globally and in Britain whch became an epicentre of garment manufacturing. The long history of clothing is briefly summarised in tandem with key moments in human-led bio-physical change. The changing relationship between garment economies and the environment epitomizes the dual advance of social progress and environmental degradation. Following on from this we discuss how socio-technical closed loop solutions to the problem of synthetic fibre consumption and pollution are being proposed within the utopian, techno-centric framework of a 'good Anthropocene'.

The co-development of modern clothing economies and the Anthropocene.

The last ice age ended 11,700 years ago and this heralded the start of the Holocene, the geological era that preceded the Anthropocene. However, scholars who favour an early starting point for the Anthropocene, over-lay the concept on to the Holocene and in effect replace that term in the geological record, arguing that human activity began to irreversibly alter planet earth 12 millennia ago.[21] Farming started after the last ice age, setting in motion global change. Along with growing food, farmers developed textile agriculture. Early farming cultures grew flax for linen in the Middle East and southwest Asia, hemp in China, and cotton in the Andes, Amazonia, India, Mesoamerica, West Africa and the Sahel.[22] Plants were selectively bred to produce new varieties and animal husbandry promoted favorable hides and wools. Domesticated livestock and plant species flourished, but agriculture simplified and destabilised existing environmental systems. Forests were cleared to make way for fields. River management was at the forefront of human transformation of the bio-physical world. Waterways were canalised, dammed, and fished, and floodplains were actively shaped by

farmers. In the pre-industrial era rivers beside settlements served as outlets for rubbish and sewage as well as vital routes for navigation and shipping. Laundry was another service provided by streams and other sources of running water, although the impacts of clothes washing on ecosystem processes was relatively minimal.

The next proposed starting point for the Anthropocene draws a line between the Holocene and the current epoch at 1492. European colonialism transformed the world.[23] The trans-Atlantic voyages of Christopher Columbus connected different ecological systems, enabling species of animals and plants and diseases that had evolved on divergent land masses to be exchanged between distant territories. Hundreds and thousands of new species were found in places where they were not endemic. Crops transplanted across the Atlantic included sugar, coffee and wheat carried from the Old World to the New and potatoes, tomatoes and peanuts in reverse. One of the most prized commodities traded from the Americas to Europe was cochineal, a beetle from which the rich red textile dye carmine is derived. Flora and fauna travelling in either direction often flourished because they were released from the presence of pests and parasites with which they had co-evolved in their native ecosystem. Ecology was globalized after 1492 providing another defining moment in the history of the Anthropocene. This Columbian exchange led to a massive transformation of what we think of as the 'natural environment', and the extent and impacts of ongoing species translocations are only now being understood.[24] In tandem with a changing ecology European colonialism transported eight million African slaves to the Americas, many of whom laboured on tyrannical cotton plantations.[25] The fibres they produced provided raw materials for European mercantilism and enabled the next key moment in defining the history of the Anthropocene.

Britain's clothing and textile factories were at the forefront of the industrial revolution. The spinning jennies of northern England, which depended on imported cotton, pump primed cycles

of clothing production and consumption that accelerated across the next two and a half centuries. James Watt's innovations in steam engineering helped launch a fossil fuel economy, which began with the first commercial use of coal steam power in a cotton mill in Nottinghamshire in 1786. This event provides another potential candidate for the start-date of the Anthropocene. The 'great acceleration' in economic activity and population growth of the eighteenth century set in motion the transformation of the global economy and ecology. The evolution of industrial capitalism, with its appetite for burning coal, oil and gas, which discharge carbon dioxide, sulphur and other emissions in to the atmosphere led to a logarithmic escalation in global environmental change. Industrial capitalism did not just bring factories, but produced new regimes of consumption, facilitated technological innovation, and drew different communities in to a single world market economy. Clothes laundry offers another vivid example of this. The mechanisation of the laundry industry began gradually at first but accelerated rapidily at the turn of the nineteenth century. As the number of independent laundrywomen went into steady decline, an increasing number of entrepreneurs set up laundry businesses as the steam and mechanised laundry trade flourished. The shift from manual to mechanical power not only changed the way laundry was done, but also altered the skills and know-how required to do it, and introduced standardised norms of what appropriately clean and pressed clothing should look like, which radically transformed the domestic life of many families as laundry was moved from the home to the factory.[26] With the infrastructures provided by industrial capitalism, laundry could be done in larger quantities and at faster speeds than ever before, helping to both reinforce standards and expectations for cleanliness and radically changing the way in which resources were consumed for clothes cleaning. The power of capitalism to transform the environment is so strong that authors such as Jason W. Moore have argued that the term 'Capitalocene' is more accurate than Anthropocene, because the

watershed when humanity's modern relation with the rest of the environment began was with the dawn of the age of capital.[27]

The merits of a Capitalocene heuristic framework and its inter-relationship with the Anthropocene have been picked-over elsewhere.[28] Where there is consensus among writers using new socio-geological terminology is that by 1850 the Industrial Revolution in Europe and North America, financed by capitalism, fuelled by coal, and often resourced by the outputs of slave and colonial labour, was changing the world. The modern factory system, and particularly clothing industries, were at the centre of nineteenth century society, in 1870 textile manufacturers operated more steam engines than any other sector of the economy.[29] In lockstep with an expansion in standard manufacturing techniques and retail came a new culture of garment use and fresh standards and regimes of bodily and clothing cleanliness. Soap is a relatively new addition to laundry practices as its widespread production and use have been historically restricted by monopoly and taxation. It was not until the mid-nineteenth century (1853) that Britain's soap tax was lifted. In 1884, W.H. Lever developed the first branded and packaged laundry soap called 'Sunlight'.[30] By the latter half of the nineteenth century nearly all laundry workers used soap, helping to remove stains from soiled clothing more easily and reducing the number of soaks required, and at the same time further re-producing social and cultural expectations for clothing and cleanliness. Clean clothes usefully facilitated public health, although laundering evolved into a preoccupation of using technology and detergents to work against entropy and reproduce wardrobe items as 'as new' garments. These changes led to the evolution of new laundary routines, which were far more resource intensive, to combat what Alan Warde describes as 'a new structural anxieties' around normal levels of cleanliness.[31] These emerged as a result of the co-evolution of the meanings associated with approporiate levels of cleanliness, developments in technology and the learning of new skills needed to operate these new devices.[32]

As well as scrubbing away some of the grubby marks and patina of social life, when the new soaps dissolved the outflow of solvents and suspended materials polluted watercourses. A new cocktail of man-made chemicals, also including industrial outputs alongside household rubbish and effluence, as well as laundry wastewater, choked rivers. In Britain legislation followed, cleaning up the more visible and odoriferous pollution, infamously following London's great stink of 1858. Further technological transformations catalysed the advance of modernity and helped produce new laundry practices and clothing materials. Gender roles were also re-produced as industrial laundry became coded as a feminine task. Commercial steam laundries were inherently allied to the Victorian class structures and the industry functioned on the dynamics between classes and genders.[33] Later, Fordist patterns of production, consumption and social re-production reinforced class and gender divides.

Nineteen forty-five was the year chosen by the International Geological Congress as the start date for the Anthropocene. The final year of world war two saw the first detonation of a nuclear weapon, in a test in New Mexico, and later in action with horrific effects in Hiroshima and Nagasaki. Humankind's mastery of nuclear physics demonstrated a step-change in our capability to devastate environmental systems; however it was the more mundane, yet rapid progression in hydrocarbon use after 1945, which had far-reaching impacts on the global environment. Burning fossil fuels for transport and energy generation has underpinned the escalating anthropogenic transformation of the environment. Historians identify a second phase of great acceleration associated with the oil-fuelled boom in global economic activity and phenomenal growth in population.[34] Global production of oil and natural gas oil consumption began around 1850 with the first commercial refining in Europe and North America and increased to 523 million metric tons in 1950, and to 4,185 million metric tons in 2013.[35] The exhausts from these emission contributed to carbon dioxide levels rising dramatically from 285

parts per million (PPM) in 1850, to 311 PPM in 1950[36] and making headline news when they passed 400 PPM in 2013.[37] This systemic-shock announced the Anthropocene.

Oil did not just beget economic growth and emissions; when liquid hydrocarbons were refined polymers were produced that enabled the manufacture of plastics and synthetic fibres. New textile materials such as acrylic, polyester and nylon were first synthesised in the 1920s, as was rayon (a regenerated cellulose fibre, sometimes called a 'half synthetic' due to the 'natural' origins of its wood pulp feedstock). The emergence of such materials was inter-connected to the expansion of an oil-based global economy. From the perspective of the parallel evolution of both global environmental change and an unsustainable international clothing economy, the growth in the use of oil derived synthetic fibres represented a fundamental shift in the relationship between fashion, humans and the environment. The development of synthetic fibres allowed clothes to be washed and dried more quickly at home, whilst the change in fashion and move away from heavy starching and other fastidious finishing processes meant that specialist services offered by laundries were no longer in demand. As Britain was becoming wealthier after World War Two, clothes were also becoming cheaper and more people could afford to buy the latest fashions. Post-1945, after the electrical standardisation of Britain and increase in the availability of consumer credit, households began using electric laundry appliances. The new materials now being worn were easier and quicker to wash than ever before, further increasing the amounts of laundry that were done and the energy and water demands of garment cleaning. This also led to another upward shift in perceived levels of acceptable cleanliness.

During this period there were many other transformations in the fashion industry, including the global shift in production away from the West to East Asia, the proliferation of manufactured obsolescence, declining qualities of garment construction, an acceleration in cycles of clothing

consumption and a breakdown in the Spring-Summer and Autumn-Winter seasons, the spread of branding and the increasing sexualisation of body types. Critical work on fashion and environmental sustainability has focused on a plethora of challenges such as water usage and water resource pollution in the production phases. This includes the unsustainable extraction of water to enable cotton growing in water scarce environments, such as around the Aral Sea region. Critical scholars have tried to budget the true 'virtual water' footprint of clothing production.[38] Environmentalists have focused attention on ecosystem degradation associated with garment manufacturing and have attempted, with limited success, to sway the opinions of consumers to consume less and consume differently. Interventions have had partial success because fundamentally changing consumption patterns represents a threat to one of the logics that underpins capitalism: the need for the market to grow and economic activity to ever expand or face crisis.[39]

Microfibre Pollution and Closed Loop Recycling

Ecological systems are impacted throughout the life-cycle of clothing products. This includes all *natural* and *synthetic* fibre garments. As discussed above, nothing is truly 'natural', but rather 'naturalness' is socially constructed. Cotton, linen and wool are all the product of generations of selective breeding, intensive farming and in many cases industrial and chemical processing, yet plant- and animal-derived fibres are objectively different to synthetics; significantly because of the ability of plant and animal fibres to be broken down by micro-organisms, light, air or water, and the nomenclature of 'natural fibres' is used in our argument. The difference is illustrated in the laundry. Domestic machine laundry involves a physical process that agitates as well as cleans fabrics. As heat, movement, detergents and water dissolve stains, they also weaken textiles. When clothes are laundered, fibres from the fabric

surface are abraded, break off and are released into the laundry water; they are then discharged from the washing machine, enter the sewerage network and can accumulate in waterways. Biodegradable natural fibres pose few problems in comparison to artificial fibres.[40] Tiny strands and coils of polyester and acrylic are flushed into aquatic and marine systems, contributing to the escalating problem of plastic pollution in seas and oceans. As well as ecological impacts through ingestion, deposition in river sediments has as yet poorly understood effects on aquatic ecosystems and the geo-chemistry of river, lake and ocean sediments, but is likely to increase chemical contamination of such locations at the very least.

The problem of artificial microfibre pollution is a signature example of the challenge of the Anthropocene. Its history is embedded within the co-development of agriculture, ecological globalisation, capitalism, and the post-1945 hydro-carbon economy. Modern life is underpinned by unsustainable patterns of resource use and consumption that are dictated by norms and values, such as the social desire for new and fashionable garments and the cultural necessity to dress in fresh smelling and unstained garments.[41] Furthermore, the effects are both changing the immediate bio-physical environment of rivers and seas and are leaving an impression upon geology that may be present in the earth's record alongside other markers of past and future epochs. The depositing of man-made microfibers, plastics and pollutants, in sediments has the potential to leave a permanent mark in the geological record. This could in the future become what geologists refer to as an epoch defining 'golden spike': a specific event marked in rock, sediment or glacier ice that denotes the on-set of the Anthropocene.[42]

Fashion is one of the world's largest economic and cultural sectors. It has complex geographies making it a difficult system to study.[43] The clothing industry has begun to respond to environmental crises, although the ideas emanating from business offer often flawed and partial solutions.[44] Here we are most interested in the problematic relationship between synthetic

fibres, laundry and water pollution, because of the particularly utopian vision that is promoted via new closed loop proposals, such as the Circular Fibres Initiative. This initiative proposes technological solutions to specific environmental problems, namely to reduce material waste. The famous yachtswoman Dame Ellen MacArthur is a high-profile proponent of the circular economy who has previously leant her celebrity status to supporting campaigns on plastics pollution in the oceans. MacArthur discusses the initiative in utopian terms: 'The Circular Fibres Initiative aims to catalyse change across the industry by creating an ambitious, fact-based vision for a new global textiles system'. Another advocate of a circular clothing economy is WRAP (The Waste and Resources Action Programme) who highlight the benefits that can be brought about by changes in laundry practice.[45] Closed-loop schemes recognise the damage caused by clothing manufacturing and laundry, but do not threaten the social relations on which capitalist market are predicted: namely continuing and growing cycles of consumption. This is demonstrated by the headline objectives of WRAP's 'Clothing Action Plan' of 'Cutting the environmental impact of clothing across the supply chain' while also 'Generating value for business through collaboration, measuring and sharing best practice'.[46] What is not on the agenda is challenging commercial interests, questioning high-tempo fast fashion models of production and consumption, or proposing alternative models of social relations that constrain the opportunities for market growth and profit accumulation. As yet the technological solutions of producing a circular system are uncertain. Various fibres have been proposed as suitable for closed loop recycling such as polyester, nylon, cotton and wool. Incentivising the public to return garments and putting widespread collections systems in place is one challenge. Other practical challenges include: finding cost effective methods to accurately identify and sort used garments. This is especially difficult when clothes tags are faded or missing as the identification of any treatments or finishings on the garments (which can make recycling

unfeasible), and separation of blended fibre garments all pose substantial technical obstacle to recycling.[47]

One of the features of closed loop recycling that makes it particularly appealing to fashion manufacturers with a business model based on high volume sales of low price goods, such as H&M – the world's second largest apparel retailer – is that it can enhance a rapid rhythm of purchase and disposal. Closed loop models often forge a connection between throwing away unwanted items and buying new ones, as recycling bins are located in retail stores. Every time a consumer wants to get rid of an item of clothing at a disposal point located in a H&M shop, they have to first navigate the sales floor and its many incentives to buy a new outfit. H&M have initiated a garment collection scheme across thousands of stores worldwide and 'customers are encouraged to bring in unwanted garments of any brand and in any condition to H&M stores in all 53 markets to be given a new life'.[48] Cecilia Brannsten, project manager in the UK Sustainability Team outlines H&M's aim: 'Basically, we want to change the mindset of the customer [so they] see their old clothes as a resource rather than throwing them into the garbage or letting them pile up at the back of their closet'.[49] When customers handover unwanted garments they get a money-off voucher in return. In the US, H&M offers a 15 percent discount voucher for every bag of used clothing, although it is worth noting the company routinely posts a gross profit margin of around 60 percent and a net profit margin of 15 percent.[50] Used clothing does not just go 'away', though it goes 'somewhere'. Waste clothing enters the secondary economy and H&M garments are sold to I:CO, a company which offers an international take-back system. Currently, second-hand garments are primarily exported to marketplaces in low-income countries as this provides the most profitable outlet.[51] However, the model is set to change in the near future, because a new recycling model offers great potential for a future business model couched in the language of sustainability.

Businesses are working towards prioritising the recycling of material. They imagine a future where 're-loved clothing and shoes would circulate in closed product and material cycles and be used continuously in the manufacturing of new products. At I:CO, we are committed to this vision. Our innovative take back system is helping make it a reality and is used successfully by many companies around the world today.'[52] H&M and I:CO are both companies driven by the underlying necessity to profit and expand their operations, therefore logic would dictate that they will want to maximise the throughput of materials, as this is where revenue is generated. Although it is not in their public business plans it is conceivable that retailers like H&M may become more of a subscription service akin to a Netflix or Uber for clothes. We can imagine a utopian future where customers might not own their garments, but subscribe to the opportunity to wear them, returning items for re-manufacturing once they are finished with them. Consumers become temporary custodians of new garments. In-between the garments would get re-made to a new design, re-fashioned to match changing trends and climatic seasons.

Shortening the duration or phase of possession and making fashion consumption faster, means people keep and use clothes for less time. In such a short-life scenario it is conceivable to imagine garments are returned and re-enter the circuit before they need to be laundered. This is where closed-loop recycling inter-sects with the problem of microfiber pollution from laundry; the discharge of microfibres amongst household sewage could, theoretically, be halted. Clothing re-manufacturing would be the domain of new clean remanufacturing plants run responsibly by companies like H&M and I:CO. While there is theoretical benefit from eliminating the domestic emission of microfibers, this could only be an ecologically sound system if the re-manufacturing processes yielded little pollution – of microfibers or other emissions – and consumed limited energy. Given the huge environmental impacts of clothing

production along with the complex physical and chemical processes and technical challenges associated with reusing textiles, this is an unrealistic proposal.

A closed loop model would be a shift away from the current pattern of clothing re-use popularised by organisations such as Oxfam and Marks & Spencer to one of recycling. Within environmental management the maxim ‘reduce, re-use, recycle’ is a neat turn of phrase that simply encapsulates how the best way to alleviate the impact of consumption is first to reduce purchases, secondly to re-use objects in the manner for which they were first intended, and thirdly to make a new thing by recycling the material. The third option represents much greater use of energy and physical process so is less favourable than re-using, which in turn is inferior to not producing and consuming the object in the first place. Re-use involves social change. In countries like the UK this means changing attitudes towards purchasing and wearing pre-worn clothing. But this type of social change represents a challenge to profitability, and therefore business has become attracted to a technical solution which turns the potential for global environmental crisis into a business opportunity.

Utopia and the Good Anthropocene

A utopia can be taken to be a non- or not-as-yet-existent society, which is described in considerable detail in literature and is located in a particular time and space.[53] Taking that definition, the Anthropocene, in general, is consistent with utopianism as the ‘Anthropocene reimagines the history of the past and the present by reference to an unrealized future’,[54] and particularly chimes with Erle Ellis’s somewhat controversial assertion that ‘we must not see the Anthropocene as a crisis, but as the beginning of a new geological epoch ripe with human-directed opportunity,’ and therefore utopian promise.[55] The particular place in which the Anthropocene is located is explicitly the global and although the temporal period of the

Anthropocene in the past, present or even the future is contested, proponents agree in proclaiming that it is irreversible. A strength and weakness of the Anthropocene approach is the way in which it can shock audiences to think about what a future world will look like, while also painting a picture of inevitabile change and recognising the 'godlike agency' of humans. And yet, one of the most problematic issues with the Anthropocene is it homogenises humanity. Modern life is depoliticised, reducing the accountability of, for example, those in North America and Europe, who have done most to shape global environmental change through enjoying the benefits of hyper-consumption since the 1950s. While there is a growing consensus around the inevitability of global change there is little appetite to challenge the politics that underpin environmental crises. Instead policy makers and especially business leaders turn to modernisation, science and engineering for a solution. This was even the case in the IPCC's 5th Assessment Report, where, out of the 1000 emissions pathways considered, 87% of the scenarios consistent with limiting warming below 2°C required net negative emissions delivered by supply-side carbon sequestration technologies (i.e. technological rather than behavioural solutions).[56] A salient example of a technocentric 'magic bullet' approach to the 'classic' Anthropocene issue of climate change is geoengineering.

Proponents of geoengineering argue that the environment can be re-made through technical interventions that enable business to carry on as usual. A popular example of such a 'magic bullet' being injecting aerosols into the stratosphere to reduce the amount of solar radiation that reaches the earth. While it seems unlikely that humans can escape the spectre of climate change without adopting new technology in some way, what is problematic about the geoengineering perspective is the post-political narrative. Stefan Schäfer *et al.* argue that stratosphere injections are a 'change-inhibiting project that prolongs an unsustainable and unjust status quo, or even intensifies existing inequalities and may hinder progress toward a de-carbonization of the economy.'[57] Mike Hulme supports this, noting that such

geoengineering efforts have little co-societal benefits beyond the reduction of planetary heating, and do nothing to address the main drivers of the problem.[58] Climate change, like all environmental change, is political and techenological innovations have become the default answer to managing the future problems rather than social change. There is a strong draw to ecomodernism, which sees the capitalist market and new technology as the solution rather than the most important driver of change in the Anthropocene. There is a fethisitic appeal to new technolobgy which compels policy-makers to look for magic bullets rather than questioning the validity of the current economic model and embracing new political ideas. Many geoenginners, buisnessess, policy-makers and other advocates of ecomodernisation have become associated with the so-called 'Good Anthropocene'; the utopian idea that a changing planet produces opportunities for new businesses, and for a flourishing of humanity. 'Let's not let a good crisis go to waste' might serve as an unofficial slogan, echoing Ellis' assertion. A 'Good Anthropocene' response to the challenge of climate change represents a new horizon and opportunity for profit making and enables the continuation of the oil-based economy. Importantly, for the fashion industry this would have a knock on effect of a continuing supply of petrochemical derived synthetic materials providing little incentive for clothing businesses to adopt new approaches to material use in garment construction.

The history of the Anthropocene is intertwined with the development of the capitalist mode of production. As the global market economy has grown, ecosystems have become irreversibly damaged. Capitalism thrives on innovation and new opportunities for profit making; this includes past innovations such as cotton plantations worked by slaves, coal powered textile mills, industrial steam laundries, and synthetically produced fibres, as well as ill-conceived ecomodern schemes to reflect sunlight in the stratosphere. In the realm of clothing the answers to problem such as synthetic fibre production and microfibre pollution are closer at hand than the problem of climate change, but ideas such as closed loop recycling follow the same flawed

logic and do not acknowledge the problem of the social relations of capitalism, the relentless profit-logic, and the flawed epistemology of conventional geoengineering approaches. Closed-loop recycling, while on a much smaller scale, offers a similar 'magic bullet' akin to injecting aerosols into the stratosphere. In this case the broader system and social relations that underpin fast fashion consumption are not changed so the larger impacts will remain. Closed loop recycling places upmost faith in modernisation and buisnesses' ability to draw upon technology to create new market opportunities while enabelling the restoration of ecosystems.

The philosophical and natural sciences have long explored how humanity is different to other organisms and we are surely the only species aware of our ability to produce different natures. The world no longer has a stable Holocene. This knowledge is only practical if it helps us politicise environmental change rather than scrubbing away the social relationships. The Anthropocene concept can be useful as it forces us to see how entangled the future of humanity is with the social production of a new bio-physical environment or even a new *nature*. Further, it forges a view of humans actively engaged in nature, not standing apart from it, and with it an increasing openness to other species and appreciation of the intrinsic value of nature that goes beyond its usefulness as a resource. Challenges to existing ecosystems that are biodiverse, dynamic, and enriching to social life require answers that acknowledge that what comes next will be socially produced, rather than an unrealistic utopian aspiration to reset landscapes to an imagined pre-human 'Natural' state.

The utopian project of finding a different way of organising social reality seems more vital than ever in the context of global environmental change, and yet the answer lies not only in a transformation of technology, but in the social and economic mode of production and the creation of new sustainable ideas and propositions for living differently. Both technology and social change are part of the future. As this critique is embedded within the discussions that

surround the Anthropocene and the global environmental challenges that are of an almost incomprehensible order of magnitude, the aspiration is not to here produce 'solutions' to the worldwide problems of hydro-carbon fuelled regimes of synthetic textile production or high-energy production and laundry practices, but the challenge is to think of a different future. Indeed the clothing industry offers potential to be an important test case, but not by following the optimistic 'good anthropocene' approach. Rather, many of the 'solutions' we could draw upon in this future may already be present in existing technologies, for example a shift to woollen clothing to avoid the hazards of microfibre release from polyester clothing like fleece jackets; or the development of sustainable design solutions to production problems and the creative use of garments.[59] What is imperative is to both shift away from the mind-set of a 'business as usual' approach and to reject aspirations to restore a pristine nature, and instead embrace the reality that future human agency will produce new cultural rather than natural landscapes. Radical visions of the future are required to help launch change, but utopian ideas need to embrace different social futures and a revolutionary transformation of the relationships between fashion, consumption, technology and the environment.

Notes

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