Accumulation

The material politics of plastic

Edited by
Jennifer Gabrys, Gay Hawkins
and Mike Michael

12 Plastic and the work of the biodegradable

Jennifer Gabrys

The seas and oceans have become a slurry of plastic. There are now estimated to be up to 100 million tons of debris in the five gyres where plastic debris collects in still ocean currents from the Pacific to the North Atlantic.[1] However, the plastic found in these gyres and suspended throughout the seas is not exclusively composed of identifiable objects in the form of water bottles, toy ducks or sandwich bags, but also consists of microplastics. These small-scale pellets, or nurdles, and other plastic fragments are residues from the breakdown of plastic products or fallout from manufacturing sites where tiny plastic feedstock drifts in considerable quantities from factory lots to the seas. Plastics are materials in process; they fragment and break down, while also generating new material arrangements. In what ways do the plastics that are accumulating in oceans give rise to new environmental processes? Who or what are the agents involved in working through the new materialities and effects of plastics as they accumulate and break down in the earth's oceans?

Material processes of accumulation and biodegradability have become evident in many different modes of working through plastics. For example, the amassing of plastics in seas and oceans has given rise to new ways of working through plastics, such as the recent European Union (EU) Maritime Affairs and Fisheries initiative to pay fishermen in the Mediterranean to catch plastic rather than fish (Damanaki 2011). On the one hand, this initiative addresses the problem of over-fishing and disposal of less desirable fish for market, but, on the other hand, it demonstrates that the seas and oceans are now a shift- ing, if distinctly plastic, material matrix of chemical-biotic-economic pro- cesses. Fishing for plastics, it may turn out, could be an economic alternative to fishing for fish, since plastics may be retrieved year round, and the demand for (recycled) plastics feedstock continues to rise.

Fishing for plastics also seems to address the pollution of the seas, which not only affects water quality but also impairs the lives of many marine organisms. Images of dead seabirds that have starved from a stomach full of plastic, together with tales of fish and turtles who 'mistake' plastic for food, and through ingesting this debris eventually die, are regular features of scientific and public concern (Moore *et al.* 2001; Barnes *et al.* 2009). At the same time, newly identified forms of microbial life appear to be emerging

that ingest plastic in the seas – although to what effect is yet to be determined, since it is likely that these bacterial forms of ingesting and decomposing plastics also release chemicals for distribution in the seas and concentration in food chains (Zaikab 2011). Yet these labouring bacteria seem to offer an ideal image of how the seas might be cleaned of our offending debris, in the ever-elusive search to eliminate the negative effects of plastics.

In each of these examples, new encounters, practices and natures emerge through material entanglements with plastics. Accumulation in this sense points less towards an exclusive emphasis on environmental contamination and more towards processes of environmental modification in which we are situated with multiple more-than-human entities. It may seem that one way to deal with plastics accumulating in oceans is to fish them out and remove them from the seas. Yet plastics are accumulating in many different ways, as they break down, enter food chains as plasticizers and generate altera- tions in the eating patterns of diverse organisms. How might a material politics of plastics that is less inclined toward, a purifying discourse of envir- onments and that is more invested in attending to the emergence of new material arrangements make possible a greater engagement with the new natures and practices to which we are committing ourselves – and more- than-humans? How do the new entities and processes that emerge in plasti- cized oceans shift our understandings and approaches to the material-political ecologies of these spaces?

Accumulation here refers not just to the literal accretion of residual matter in the seas, but also to the build-up of plastics within environmental processes and corporealities. Such 'natures-in-the-making' as well as 'bodies-in-the- making', as Harvey and Haraway (1995: 514) suggest, are junctures where political possibilities may emerge in relation to new material processes and arrangements. Material politics, in this sense, describes the ways in which the materialities we are involved in making are sites not just of responsibi- lity and concern, but also of ongoing – if often problematic – invention. As Thompson's and Takada's chapters in this collection demonstrate, there are numerous new effects and entities emerging with the ongoing presence of plastics in environments. From marine organisms that ingest plastics with concentrated levels of persistent organic pollutants (POPs), to bacteria and algae that colonize plastic, and marine organisms that incorporate plastic debris as habitat or flotation medium, plastics are having considerable effects on organisms and environments. This chapter then discusses how the accumulation of plastics in oceans gives rise to new natures and bodies in the making, as well as new modes of working through these material arrangements.

In order to take up these multiple and different ways in which plastics are accumulating across environments and bodies, I mobilize a notion of material politics that attends to how plastics are entangled with and generative of specific forms of more-than-human *work*. The notion of work is important for this investigation because it allows for an approach to plastics that accounts

for the complex creaturely and environmental processes that coalesce in relation to these materials, as well as the political possibilities that might emerge through these natures and bodies in the making. The making of bodies and natures involves the relational 'work' of bodies as they 'hold sites together' (Woodward *et al.* 2010: 274). But the processes whereby sites hold together also change, and so a shifting range of heterogeneous entities undertake material practices that specifically concresce in the actual occasions of plastics as they degrade in the oceans. Drawing on Whitehead (1929) in this under- standing of material processes, I suggest here that the ways in which plastics are encountered and worked through as historical forms sedimented in the present also inform the future potential processes that may be undertaken in relation to plastics.

The concept and practice of work and working materialities points to ways in which it may further be possible to reconceptualize the notion of 'carbon workers', a term that refers to the diverse – if at times problematic – ways in which any number of humans and more-than-humans are enrolled in the work of mitigating climate change.[2] Here, I extend and translate this notion of carbon workers towards plastics. Plastics are composites of carbon, both in their physical form as petrochemical hydrocarbons and in the carbon energy used to manufacture them. Eight per cent of world oil production contributes to the substance and energy required to manufacture plastics (Thompson *et al.* 2009b). As composites of carbon, plastics are participants in and mobilize distinct types of carbon work, particularly at end-of-life. Plastics accumulate, break down and degrade, but these processes also enrol humans and more- than-humans in different forms of carbon work. Upon disposal, plastics travel to those carbon sinks of oceans and landfills. In these zones, they further degrade and, depending upon chemical composition, may release carbon dioxide or lodge in the bodies of ocean organisms, thereby diversely influencing the material composition of the ocean as a carbon sink (or source).

I focus on *biodegradability* as a specific form of carbon work that involves processes of transformation, deformation and generation of materials and bodies. Biodegradability has at times been a sought-after quality for plastics, as it signals the seamless elimination of this highly disposable material. Most plastics do not actually biodegrade, but instead *degrade* into smaller particles through chemical processes and physical weathering. Numerous environ- mental, chemical and biological impacts occur along with these degradation processes across organisms. The actual and typically problematic ways in which plastics do break down – by adsorbing chemicals, entering food chains, and altering biological and reproductive processes through increased levels of toxicity – indicate how degradation and biodegradation are as much political as ecological processes that inform the possibilities of natures and bodies in the making. Biodegradation may be the sought-after quality for plastics, but degradation is the concrete way in which plastics dematerialize and remater- ialize to generate new environmental conditions. Even when plastics do bio- degrade, they often do not completely disappear but instead fragment into

smaller invisible pieces. The *bio*-of degradation then has as much to do with the forms of life – the organisms, processes and environments – that are drawn into the ongoing breakdown of plastics, whether by inadvertently ingesting microplastics or undergoing increased exposure to pollutants that are concentrated on plastic debris surfaces.

The material-political dimensions of biodegradation become more evident through the notion of carbon workers, which is a way to capture the active, material, productive and participative ways in which humans and more-than-humans work through and remake plastics and plastic environments. How might the multiple ways in which plastics are worked through begin to give rise to a material politics of plastics that accounts for these more-than-human modes of carbon work? What types of carbon work become identifiable in relation to plastics as they biodegrade, and what potential types of work might emerge to generate new material political practices?

Accumulation

The plastics accumulating in seas have been storing up and breaking down since the post-World War II rise in plastic consumer goods (Ryan *et al.* 2009). Plastics in the seas are now present in considerable densities, a record of accumulation that is due in many ways to the increasing quantities of plastics, since as Richard Thompson and colleagues (Thompson *et al.* 2009b: 2154) write 'the production of plastic has increased substantially over the last 60 years, from around [half a] million tons in 1950 to over 260 million tons today'. Plastics also collect and sediment over time in cumulative quantities. All plastics ever manufactured since the rise of the Plastic Age are still likely to be present in the environment and oceans in some form, as they will not have completely broken down yet (Lebwohl 2010; Andrady 2003).

While the oceans were relatively free of plastics prior to the post-war Plas- tic Age, now they are a pervasive substance circulating through oceans, and could even be considered a common entity within ocean ecologies. Oceans are becoming new material compositions, as literary scholar Patricia Yaeger suggests, since with plastic accumulation 'we've reconstituted the physical ocean in a mere fifty years' (Yaeger 2010: 538). In this era of the Anthropocene, not just atmospheres but also oceans are part of ongoing environmental alter- ations. The reconstitution of the oceans refers less to an essential originary nature, rather indicating how the new natures now emerging are spatial and temporal accumulations of lived materialities. In this plasticization of the ocean, our present and future material politics are then necessarily committed to responding to these natures-in-the-making.

Just as plastic accumulation is taking place in oceanic sinks, these sinks then become spaces where complex biochemical and environmental 'intra-actions' occur across microbial, vegetable and animal corporealities (Barad 2003: 810). Intra-action, as Karen Barad explains, describes processes where entities can be seen to emerge through – rather than prior to – relations.

Bodies and natures form *in* and *through* shared contexts. In the space of plastic accumulation, both humans and more-than-humans take part in material and relational exchanges filtered through plastics and their residues. Such intra-actions take many forms. Plastic debris is now a frequent trans- port medium for organisms that travel ocean currents. By 'hitchhiking' on fishing gear and disposable takeaway containers, typically invasive species are able to make far-flung journeys on this readily available debris. While in transit, these species are able to reshape places, as they circulate on plastic media to settle into – or 'colonize' – new environments (Gregory 2009). At the same time, plastics have been shown to be an adsorption medium for potentially harmful chemicals, carrying and dispersing additives and plasti- cizers such as flame retardants, Bisphenol-A (BPA) and phthalates, as well as drawing in and concentrating chemicals from seawater (Song *et al.* 2009; Takada 2013; Thomas *et al.* 2010). When ingested, these plastics then poten- tially pass on chemical loads to other types of marine life, which regularly make a meal of plastic particles, thereby amplifying chemical effects in the food chain. The intra-actions that occur through plastics are typically perni- cious exchanges, where bodies exposed to plastics and plasticizers accumulate plastic effects, and undergo endocrine disruption or physical blockage, as discussed by Thompson and Takada in Chapters 9 and 11, respectively, of this collection.

While accumulation is often read primarily as a Marxian term that describes strategies of property and capital acquisition – and indeed the ocean can be seen as a space of capital accumulation, as the artist Alan Sekula (1995) makes clear in his work – the accumulation of plastics in the oceans demonstrates the more residual effects of these political economic practices. Here, accumulation extends to bodies and environments as sites of 'produc- tion' that require working through the residual materialities of plastics. Harvey and Haraway, together and individually, suggest the ways in which bodies and economies that are jointly formed might be called 'corporealiza- tion' (Harvey and Haraway 1995: 510; see also Haraway 2007; Harvey 1998), where the body also constitutes an 'accumulation strategy' along with eco- nomic modes of accumulation (Harvey 1998). However, with residual plastics, the ways in which political economies materialize may occur long after cycles of production and consumption are complete. Within these residual mater- ialities, multiple participants are involved in distinct and often intra-active practices of working through the accumulation and degradation of plastics. Plastics do not simply break down in ocean environments; rather, they enrol humans and more-than-humans in new processes and practices of working through and with these natures in the making.

Carbon workers

To say that the oceans are polluted with plastics is an approach to environ- ments through contamination that may not fully account for the more-than-

human ways of working through plastics that are already taking place. Instead, from the perspective of natures and bodies in the making, accumu- lating plastics generate specific material conditions within and through which humans and more-than-humans participate, whether through changing the composition of food chains or increasing levels of toxicity in environments. The accumulations and biodegradations of plastics are events that signal the need to open up approaches to plastics through a more-than-human material politics, since the multiple entities affected – and emerging – through these plastic processes involve numerous other actants.

The material politics under consideration here draws on questions recently raised in relation to 'political matter' – namely, how do politics change when more-than-humans enter into these deliberations (Braun and Whatmore 2010)? How do more-than-humans, as integral to material processes, alter practices and understandings of politics (Haraway 2007; Stengers 2010)? Even more than attending to the ways in which more-than-human entities partici- pate in politics, I am interested in specifying how particular material entities and practices emerge as newly relevant contributors to the politics of chan- ging environments. In this respect, I adopt the term 'carbon workers', which has emerged within specific policies to address the human (and more-than- human) contributions to mitigating climate change, to describe the ways in which plastics are worked through, and the material politics that emerge within these specific processes of degradation and biodegradation.

Within climate change discourse, the concept of carbon workers has gained traction to describe the long list of 'tree planters and tenders, measurement technicians, landscape deforestation modellers, carbon accountants, carbon certifiers and verifiers and others' who have emerged to take care of trees and forests that have been identified as key sites of biotic carbon sequestration through the Kyoto Protocol (Fogel 2002: 182; Lövbrand and Stripple 2006: 235). Carbon workers within climate change discourses primarily describe the various roles that humans play in relation to carbon sink policy instruments, and the often problematic matrix of relations that occurs when developed countries seek to offset carbon emissions – where, for instance, indigenous forest dwellers in developing countries are enrolled in performing carbon work in designated biotic sinks (since many of these sinks are tropical forests). Trees – and the many other more-than-humans that inhabit forests – are also implicitly included as carbon workers in this context, since their participation is gauged in relation to the project of reducing carbon. More- than-humans might then be more explicitly included as workers in the carbon project – entities the participation of which becomes identified as relevant in relation to reducing (or contributing to) carbon emissions.

Oceans are another, less recognized carbon sink, since most carbon work has been configured in relation to terrestrial and atmospheric spaces. Yet oceans are also sites of considerable carbon work, and are now beginning to be addressed not just for their absorption of carbon dioxide, but also for the ways in which the biotic–chemical exchanges that take place there are now of

interest for 'managing' this other carbon sink (Stone 2010). The accumulation of plastics and plastic additives is one aspect of this project of attending to the oceans, and gives rise to new forms of possible carbon work.

Carbon work is a way to specify particular types of exchanges and practices that take place in relation to plastics accumulating in oceans. By specifying practices – or 'arrangements of practices', as Haraway suggests – 'heterogeneously complex' modes of agency may become more readily apparent as being interwoven with and generative of concrete political occasions and effects (Harvey and Haraway 1995: 520). Carbon work, as discussed here, could be one way to begin to develop a precise attention to the connections and processes within oceanic sinks. Carbon work is also a way to specify the intra-actions that take place in relation to biodegrading plastics in oceans. The examples of the different modes of working through plastics with which I began this chapter signal types of carbon work that variously 'clean up' or break down plastic hydrocarbons. From EU fishers paid to fish for plastic, to marine researchers focused on documenting the effects of degradable plastics, to nongovernmental organizations (NGOs) focused on raising public aware- ness around plastic pollution, to animals and birds that ingest plastic debris, to bacteria that may biodegrade these materials, a whole range of carbon workers, relations and practices begin to materialize in distinct ways in relation to plastic oceans.

In these processes of accumulating plastic hydrocarbons, the carbon work of humans and more-than-humans articulates distinct material-political rela- tions to the seas. These material intra-actions within plastic oceans are part of what enables processes of materialization to even turn up as carbon work: plastic fragments turn up by accumulating over time in oceans, bodies and seas, and then become the object of clean-up campaigns or toxicity studies. Dead animals turn up: their inability to process plastic through ingestion makes them a visible remainder and reminder of the intractable accumulation of plastic debris and its ongoing effect on biodiversity. Plastic-loving bacteria turn up, inhabiting and apparently decomposing plastic: are they new, or have they been here all along, and could they clean the oceans of excess debris?

New types of carbon work then emerge as possible strategies for dealing with these fragments. Describing these material processes as *carbon work* draws attention to the complex transformations and exchanges within plastic production, consumption and disposal, which involve more-than-humans in our material lives. The material politics of oceans as sinks, and their role within environmental change, make these processes more evident as forms of work, and demonstrate how our material lives are forceful conjugations and sites of material-political engagement, responsibility and invention.

More-than-humans working

It would be possible here to make a long list of all the working animals to be found in more-than-human research, from the research labour of laboratory

animals to military dolphins searching for mines and the industrial labour of aquaculture. However, my interest in attending to the work of more-than-humans is less about the direct servicing of animals or other more-than-humans to economic processes, and more about the ways in which new material collectives emerge to do key carbon work in relation to breaking down plastics in oceans. In this sense, the carbon work of plastic-related activity could be seen to be more comparable to what anthropologist Stefan Helmreich (2009) describes in his study, *Alien Ocean*, where 'methane-metabolizing' bacteria at vents in extreme ocean environments consume and exchange methane through a process of chemosynthesis, thereby pre- venting additional greenhouse gases from entering the atmosphere (Helmreich 2009: 36–37).

Here is an exchange that could be described as a form of work that contributes to attempts to reduce greenhouse gases, which are articulated and monitored across spaces of policy and everyday practice. These bacteria are not immediately a resource, but they do turn up as a more-than-human contribution in the material politics of climate change. The natures that are in the making in this context involve not just changing climates and distributions of greenhouse gases, but also pertain to the ways in which more-than-human processes emerge as relevant or as contributing to specific environmental concerns and actions.

In his metabolic theory of labour and value, Marx excluded the non-human from his definition of human labour. For Marx, labour was an expression of 'man's' metabolic relation with and conversion of 'nature'. Yet this labour is notable not just for its assumed conversion of nature into resource, but also for what it is not. Non-human work does not constitute labour, Marx argues, since 'nature's work' – whether the web of the spider or the hive of the bee – has not undergone a prior mental conception that would, for instance, char- acterize the labour of an architect conceptualizing a building (Marx 1990: 283–84).[3] The exclusion of non-human work from theories of labour informs the types of material politics that are possible, since non-humans may not then be recognized as participants in our material lives.

If we trouble Marx's assertion of where work might be situated or identified, we can instead consider how a post-Marxian concept of work might not consist of 'man' labouring to transform 'nature' through metabolic relation, but rather occur through intra-actions and processes of materialization that direct new possibilities for material politics. Instead of human-driven meta- bolic transformations, here we might consider something closer to Michel Serres's *metabolas* as ongoing processes of transformation, where material and environmental exchanges are characterized by all manner of conversions that take place not just in human bodies, but also in 'animals and plants', as well as 'air crystals … cells and atoms' (Serres 1982: 72–73).

Numerous humans and more-than-humans are involved in the process of converting plastics in one way or another, whether it is bacteria breaking down microplastics, seabirds ingesting bottle-tops, or fisherman fishing for

plastics. One of the ways in which these carbon works and exchanges might be characterized further is through processes of degradation and biodegrad- ation. Carbon workers are involved in and producers of material exchanges and arrangements that are not so much metabolic and resource driven, but instead necessarily oriented towards realizing new material dynamics and relations in the ongoing attempts to process and break down plastic hydro- carbons. Through these modes of work, new entities emerge, which contribute to a processual reshaping of what counts as material politics.

The work of the biodegradable

The degradation of plastics in oceans and terrestrial environments is part of the contradictory way in which plastics accumulate: not primarily as identifi- able objects but mostly in the form of microplastics, chemical migration and bodily accumulation (Guthman 2011; Thompson *et al.* 2009a). As mentioned in the introduction to this chapter, most plastics are not considered *bio*de- gradable, but rather degrade only in relation to forms of physical weathering (American Chemistry Society 2010), in some cases through exposure to light or oxygen (Thomas *et al.* 2010), or in other cases through the addition of specific 'transition metals' such as iron or cobalt (Cressey 2011; Roy *et al.* 2011). At the same time, these degradable forms of plastics often break down into fragments that last indefinitely in the environment. Even though these plastic fragments are no longer present in an identifiable form, they still persist as debris with toxic effect.

The persistence of plastics for potentially several hundred years (since degradation depends in part upon context) has often served as one of their least redeeming features. Biodegradable plastics, or bioplastics, have been developed in an attempt to find a remedy for the material persistence and recalcitrance of plastics.[4] Rather than having crude oil as their primary sub- strate, biodegradable plastics are usually made from starch and cellulose – what otherwise are referred to as 'renewable' materials. Since these materials are derived from plants, and may be composted or degraded through anaerobic digestion rather than put into landfill, they are seen as a possible way to address the accumulation of plastics in environments (Song *et al.* 2009: 2127). When biodegradable plastics break down, they decompose into 'carbon dioxide, methane, water, inorganic compounds, or biomass in which the pre- dominant mechanism is the enzymatic action of microorganisms' (Song *et al.* 2009: 2127–28). In order to meet the terms of biodegradability, micro- organisms must also completely use up plastic fragments within a set period of time.

Biodegradation presents an ideal vision of matter, lapsing back into 'nature' without leaving a visible residue. To be biodegradable is to be eco- friendly, to embody the promise to disappear into the earth without a trace. Biodegradability – even if this process involves fragmenting into toxic par- ticles – may be seen to be preferable to being confronted with the visual

evidence of enduring plastic remains. Biodegradation could be described as a form of biomimesis, where materials 'mimic' the assumed 'natural' tendency of materials towards reintegration into trophic cycles. Yet biomimesis, as Bensaude Vincent articulates, often involves mapping a teleological agenda on to so-called natural processes in order to realize 'economical rationality' in relation to 'natural systems' (Bensaude Vincent 2007, 2011). Biodegradation could then be seen as a way to attempt to naturalize plastic materials so that they seem to spring easily from and return to nature. Yet this also could be seen as a way to elide, if not idealize, the material politics and processes of which plastics are constitutive.

Within the work of biodegradability, moreover, microorganisms provoke alternative conceptions of what material transformations involve – not as a process of becoming invisible, but rather as an articulation of new collectives brought into the space of material politics. What counts as carbon work here does not then reduce down to a singular entity labouring away at a piece of plastic, but instead requires collective environmental conditions and entities – from light and oxygen to microbial life – to come together in the process of plastic degradation.

Bacteria redux

The microplastics that are present in increasing numbers in oceans are often described as having transformed oceans into a 'plastic soup' (de Vrees 2010). Plastic soup indicates not identifiable items for retrieval but more of a turbid medium of plastic deformation. Perhaps in contrast to an image of garbage patches or marine litter as a thick surface layer of bottles and trash bags choking the upper ocean, here instead is an extensive suspended medium of plastic debris and pellets, which variously pass through the bodies of marine life and undergo bacterial transformation. This plastic soup is a site of con- tinual metamorphosis and intra-actions, so that new or previously unrecog- nized corporeal relations emerge in the newly constituted spaces of the oceans.

In these spaces, biodegradable as well as petroleum-based plastics have been found to undergo the work of 'plastic munchers', or bacteria that are colonizing and may potentially be digesting plastic. The 'discovery' of bacteria that may be consuming plastic has led to the further proposal to find ways to deploy specific microbes on plastic patches in an attempt to clear these spaces of their accumulated residue. Yet the effects of these carbon-working bacteria are yet to be fully understood: to what extent do the bacteria recirculate the chemical effects of plasticizers into the water and through the food chain? How does this process of 'bioremediation' unfold, which other organisms might be affected, and what time spans and resources might it require? One researcher likened the scale of the bacteria's task in consuming garbage patches to one person having to eat the whole of Canary Wharf (BBC News 2010).

While the scale comparison between bacterial decomposition and dense urban districts might appear daunting, a 1970s science-fiction novel, *Mutant 59: The Plastic Eater* (Pedler and Davis 1971), imagines a scene where bacteria capable of biodegrading plastic run amok in London. Due to their reproductive success, the plastic-loving bacteria are able to multiply, chew through and dissolve entire plastic urban infrastructures. From the failure of electrical wires and cables that are insulated with plastic, to the explosion of water pipes that are similarly made of plastic, the indiscriminate appetites of these bacteria are a force that reshapes and shuts down entire cities. As the Introduction and numerous contributions to this edited collection demonstrate, our material lives increasingly are composed of plastics. Because of the extent of plastic materialities, plastic-digesting bacteria could become architectural agents, remaking the pervasive plastic fabric of our environments. In *Mutant 59*, the urban environment becomes an apocalyptic experiment in degradation, where these new bacterial forms develop evolving appetites and capacities for material transformation as they eat and alter plastic scenes.

Biodegradability and 'eating well'

The work of plastics biodegradation is thus less about making the effects of ongoing disposal-oriented consumerism disappear, since even degradation and biodegradation generate new intra-actions and material politics. Instead, biodegradability points to how the residual materialities of plastics activate a more collective understanding of material processes. As sociologist Myra Hird (2010) suggests, material processes may be indicative of 'eating well', since bacteria are the fixers or producers that make available the elements on which so many heterotrophs, or organisms that require external nourishment, depend. Eating well, she suggests, drawing on Jacques Derrida (1991), is a way to encounter bacteria (and processes such as decomposition) as part of the material collectives in which we all participate. These exchanges and relations might also give rise to indigestion, as Haraway (2007) suggests, or to modes of exchange and incorporation that instead unsettle or disrupt relations.

As I have previously argued in my work on electronic waste and carbon sinks (Gabrys 2009, 2011), in a waste-based materiality, 'things' are rarely present as discrete entities, since materiality involves processes of breaking down, transforming, dispersing and reworking. Hird addresses this lack of discreteness through bacteria in order to articulate how the edges of more-than-humans are not distinct, and how our material processes and politics are always undertaken in collectives. These collectives are sites of ethical relation and obligation. Eating well is about recognizing connections and interdependencies, as well as acknowledging that many more-than-human processes fall outside the scope of our usual sites of recognition. Material collectives are not just sites of eating together, but also of transforming,

making possible and available different versions of shared as well as differently inhabited materialities.

Derrida has given us his thoughts on 'eating well', as well as 'biodegradability', which together perhaps offer a revised metabolic imaginary beyond that linear sequence articulated through a more Marxian political (and material) economy. Through the 'figure of the word "biodegradable"', which Derrida transposes to 'cultural uses', he asks: 'What is a thing? What remains? What, after all, of the remains …?' (Derrida 1989: 812).[5] Biode- gradability draws attention to the ways in which things become 'non-things'. Derrida's analysis deals primarily with cultural investigations, but the ways in which things become non-things in the plastic oceans involve multiple mate- rial collectives that are undertaking these transformations. In the shifting composition of oceans, bacteria, marine life and fishermen working through EU directives, the carbon work of processing residual plastics in oceans gives rise to newly emerging collective material politics.

Conclusion: material collectives

What types of material politics and material collectives emerge through speculative, expanded and more-than-human modes of carbon work? What might this work consist of, specifically as reconfigured through degradability? Such an approach could be seen to open into all kinds of directions, but I would like to end by discussing how this view of carbon workers and biodegradability as a material-political engagement might open up new types of material thinking. The notion of the 'life-cycle' is a typical device used in the eco-design of products and buildings. It articulates ways for materials to loop back through cycles of production and consumption without material loss or waste. However, from the view of biodegrading and degrading plas- tics, a life-cycle becomes a very different type of process, far from a closed loop, since the site of recovery might even become a new site of manufacture and material process encompassing the carbon work of multiple material collectives.

Following on from the examples of accumulating, degrading and working through plastics with which I began this chapter in the form of fishers fishing for plastics and bacteria emerging to decompose it, I would like to end with a discussion of one speculative creative practice project, *The Sea Chair Project*, which has been developed to address the increasing amounts of plastics in oceans, and which offers an alternative to life-cycle thinking (Groves *et al.* 2011). The creators of *The Sea Chair Project*, Alexander Groves, Azusa Murakami and Kieren Jones, develop their project as a response to the increasing amounts of plastic found in the seas and at the littoral margins. The project participants have developed a 'nurdler' device, a 'sluice-like con- traption' for collecting and sorting plastic debris and microplastic pellets from the ocean. Working in the first instance at the strandline of Porthtowan beach in Cornwall, Grove, Murakami and Jones salvaged plastics for reuse at

this site where a particularly large amount of plastic debris and pellets collects. Salvaged plastics were separated by density (and colour) through a floatation-tank technique. The material was then heated in a 'sea press', a furnace and hydraulic press that may be transported on small fishing vessels. The mouldable plastic material was then shaped into a chair – or, more precisely, a three-legged stool (see Figures 12.1–12.5).

In this speculative materials-reclamation proposal, the project creators are specifically interested in addressing the EU initiative to have fishers catch plastic (mentioned throughout this chapter). Here, they have taken this proposal further by developing plans for a sort of 'floating factory ship' that salvages plastic for the production of sea chairs. Rather than work towards an ideal closed-loop life-cycle product, *The Sea Chair Project* works with those historical remains of our lived plastic materialities to begin to generate new approaches to how plastics orient material practices and politics in the present. The reclamation of plastics from oceans is not a straightforward solution to increasing amounts of plastics in oceans, since any project that collects plastics, particularly microplastics, must also attend to the numerous marine (micro)organisms that may be caught up with any collection effort. However, the shifting material arrangements of plastics in oceans here give rise to speculative practices for salvaging degrading plastics as a resource for renewed production. New rounds of production turn from sourcing raw or even recycled materials made raw again, towards the ongoing – if problem- atic – accumulations of plastics in oceans. Far from a closed loop, the site of

Figure 12.1 'The Nurdler' (2011), *The Sea Chair Project*
Source: (Groves, Murakami and Jones 2011)

Figure 12.2 'Nurdle Collection' (2011), *The Sea Chair Project*
Source: (Groves, Murakami and Jones 2011)

recovery becomes a new site of manufacture and material process. The *carbon work* that emerges does not consist of closed loops of original material recycled again; instead, it generates transformed practices, intra-actions, economies, ecologies and material politics in relation to plastic oceans.

On the one hand, it is sensible – as many researchers have suggested – to deal with the problem of plastics contaminating oceans at the source, to strive either for a policy of minimal waste through redesign or to ensure that plastics do not travel, whether through wayward manufacturing or disposal, to seas. On the other hand, though, the current permeation of oceans and environments with plastics and their chemical residues suggests additional approaches to plastic waste as it already exists are also relevant. Large quantities of plastics continue to be generated and disposed of across estab- lished and emerging economies. Many of these economies currently lack waste-handling infrastructures and manufacturing practices that would cap- ture plastic waste before it enters the environment. Hawkins (2010) suggests that it is useful to attend to the ways in which particular materialities may become manifest through environmental practices.[6] Specific materialities may be activated in the actions of banning bags, for instance, or through the uncanny reuse of these same items. These specific materialities are also the sites where 'political capabilities' emerge (Hawkins 2010: 46). By attend- ing to the ways in which materialities are constituted, sustained and pro- duced, it is also possible to consider what practices might prompt alternative forms of material politics. By rethinking the material collectives and material

Figure 12.3 'Plastic Sample: Black' (2011), *The Sea Chair Project*

politics that are emerging in relation to plastics in oceans, and the new carbon work to be undertaken there, it may be possible to attend more effectively and more creatively to the material entanglements within which we are now situated.

Figure 12.4 'The Sea Chair Tools' (2011), *The Sea Chair Project*
Source: (Groves, Murakami and Jones 2011)

Figure 12.5 'The Sea Chair' (2011), *The Sea Chair Project*
Source: (Groves, Murakami and Jones 2011)

Such forms of material engagement and material politics perhaps direct us towards what Barad (2010: 266) calls 'an ethics of entanglement', which 'entails possibilities and obligations for reworking the material effects of the past and the future'. Reworking is also a way of working, and carbon reworking engages with and transforms the sedimented effects of environ- mental and bodily pasts as they turn up in the present and future. Toward what forms of entanglement are we working, and to which natures and bodies in the making are we committed? Which material collectives are brought together, and how do these material relations articulate and make possible different modes of material politics that work through and with these multiple connections?

Materialities and material collectives inform politics, but they are also part of the *becoming possible* of politics. These possibilities of politics are located within forms of work that transform and concretize everyday prac- tices. Bacteria are now establishing their factories in the seas; marine organ- isms are building highways on polystyrene; and plastic trash is mobilizing human and non-human bodies to work through these oceanic discards in any number of ways. However, these material residues also provide fodder for rethinking the trajectory of our material politics, outside the closed loop of renewed capital, to a more extensive understanding of and speculative approach to the complex and collective carbon work that emerges from our lived plastic materialities.

Notes

1. Numerous reports and organizations document the increasing amounts of plastics in oceans, including the United Nations Environment Programme (2005); and Allsopp *et al.* (2006). The UN report suggests the estimates of plastics per square kilometre should be read with caution, as it is very difficult to gauge exactly how much plastic is in oceans, given how 'vast and varied' they are. For more infor- mation on the ocean gyres where plastics collect, see 5 Gyres (n.d.); and US Environmental Protection Agency (2011).
2. The term 'carbon workers' is used across climate-change literature to refer to specific forms of work that emerge in relation to carbon sinks (via their designation in the Kyoto Protocol). Cathleen Fogel (2002, 2004) has addressed this topic briefly in her work on the Kyoto Protocol. Eva Lövbrand and Johannes Stripple (2006) draw on Fogel's work, and briefly deploy the term in relation to understanding the territories of carbon sinks and possibilities for mitigating climate change.
3. In Marx's analysis, transformations of nature are the basis for human labour – but 'nature' also transforms through these processes, and so generates new conditions in which to work.
4. An early report on this varied phenomenon tends towards the science fictional, as in BBC News (1999). For a current industry perspective and overview on bioplastics, see en.european-bioplastics.org (accessed 20 August 2012).
5. While Derrida's text is largely oriented towards a debate on Paul de Man and several academics' interpretations of his work, he deploys the material and metaphoric language of waste to undertake an analysis of the persistence or dissolution of scholarly work. The use of biodegradables via Derrida is a lateral interpretation,

yet his suggestion of how things become non-things is instructive for this study on plastics. As Derrida writes, 'On the one hand, this thing is not a thing, not – as one ordinarily believes things to be – a *natural* thing: in fact, "biodegradable," on the contrary, is generally said of an artificial product, most often an industrial product, whenever it lets itself be decomposed by microorganisms. On the other hand, the "biodegradable" is hardly a thing since it remains a thing that does not remain, an essentially decomposable thing, destined to pass away, to lose its identity as a thing and to become again a non-thing' (Derrida 1989: 813).

1. Hawkins asks: 'How would the politics of plastic bags be understood if the focus shifted from questions of effects to questions of practice?' (Hawkins 2010: 43).

References

5 Gyres (n.d.) 5gyres.org (accessed 19 July 2012).

Algalita Marine Research Foundation (n.d.) www.algalita.org/index.php (accessed 19 July 2012).

Allsopp, M., Walters, A., Santillo, D. and Johnston, P. (2006) *Plastic Debris in the World's Oceans*, Amsterdam: Greenpeace International, www.greenpeace.org/international/en/publications/reports/plastic_ocean_report (accessed 19 July 2012).

American Chemistry Society (2010) 'Hard Plastics Decompose in Oceans, Releasing Endocrine Disruptor BPA', *ACS News Release*, 23 March, portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_ARTICLEMAIN&node_id=222&content_id=CNBP_024352&use_sec=true&sec_url_var=region1&-uuid=be0e851a-5400-474f-a7cb-31193010961a (accessed 19 July 2012).

Andrady, A.L. (ed.) (2003) *Plastics and the Environment*, Hoboken, NJ: John Wiley & Sons.

Barad, K. (2003) 'Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter', *Signs: Journal of Women in Culture and Society* 28(3): 801–31.

——(2010) 'Quantum Entanglements and Hauntological Relations of Inheritance: Dis/continuities, Spacetime Enfoldings, and Justice-to-come', *Derrida Today* 3(2): 240–68.

Barnes, D.K.A., Galgani, F., Thompson, R.C. and Barlaz, M. (2009) 'Accumulation and Fragmentation of Plastic Debris in Global Environments', *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1526): 1985–98.

BBC News (1999) 'Can the Oceans be Cleared of Floating Plastic Rubbish?' 6 October.

——(2010) 'Scientists Unveil Plastic Plants', 28 September.

Bensaude Vincent, B. (2007) 'Reconfiguring Nature Through Syntheses: From Plastics to Biomimetics', in B. Bensaude-Vincent and W.R. Newman (eds) *The Natural and the Artificial: An Ever-evolving Polarity*, Cambridge, MA: MIT Press.

——(2011) 'A Cultural Perspective in Biomimetics', *Advances in Biomimetics*, 3 February, nano2e.org/?p = 303 (accessed 19 July 2012).

Braun, B. and Whatmore, S. (eds) (2010) *Political Matter: Technoscience, Democracy, and Public Life*, Minneapolis: University of Minnesota Press.

Butler, J. (1993) *Bodies that Matter: On the Discursive Limits of* '*Sex*', New York: Routledge.

Cressey, D. (2011) 'Puzzle Persists for "Degradable" Plastics', *Nature News*, 21 April.

Damanaki, M. (2011) *How Plastic Bags Pollute the Future of Our Seas*, Athens: European Commission for Maritime Affairs and Fisheries.

Derrida, J. (1989) 'Biodegradables: Seven Diary Fragments', *Critical Inquiry* 15(4): 812–73.

——(1991) '"Eating Well" or the Calculation of the Subject: An Interview with Jacques Derrida', in E. Cadava, P. Connor and J.-L. Nancy (eds) *Who Comes After the Subject?* New York: Routledge.

de Vrees, L. (2010) 'Marine Litter: Plastic Soup and More', Brussels: European Commission, Environment Directorate-General, 8 November, ec.europa.eu/environment/water/marine/pdf/report_workshop_litter.pdf (accessed 19 July 2012).

European Bioplastics (n.d.) en.european-bioplastics.org (accessed 19 July 2012).

Fogel, C. (2002) 'Greening the Earth with Trees: Science, Storylines and the Construction of an International Climate Change Institution', unpublished PhD thesis, University of California, Santa Cruz.

——(2004) 'The Local, the Global, and the Kyoto Protocol', in S. Jasanoff and M.L. Martello (eds) *Earthly Politics: Local and Global in Environmental Governance*, Cambridge, MA: MIT Press, 103–25.

Gabrys, J. (2009) 'Sink: The Dirt of Systems', *Environment and Planning D: Society and Space* 27(4): 666–81.

——(2011) *Digital Rubbish: A Natural History of Electronics*, Ann Arbor, MI: University of Michigan Press.

Gregory, M.R. (2009) 'Environmental Implications of Plastic Debris in Marine Settings: Entanglement, Ingestion, Smothering, Hangers-on, Hitch-hiking and Alien Invasions', *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1526): 2013–25.

Groves, A., Murakami, A. and Jones, K. (2011) *The Sea Chair Project*, www.seachair.com (accessed 20 August 2012).

Guthman, J. (2011) 'Does Eating (Too Much) Make you Fat?' in J. Guthman, *Weighing In: Obesity, Food Justice, and the Limits of Capitalism*, Berkeley, CA: University of California Press, 91–115.

Haraway, D. (2007) *When Species Meet*, Minneapolis, MN: University of Minnesota Press.

Harvey, D. (1998) 'The Body as an Accumulation Strategy', *Environment and Planning D: Society and Space* 16(4): 401–21.

Harvey, D. and Haraway, D. (1995) 'Nature, Politics, and Possibilities: A Debate and Discussion with David Harvey and Donna Haraway', *Environment and Planning D: Society and Space* 13(5): 507–27.

Hawkins, G. (2010) 'Plastic Materialities', in B. Braun and S. Whatmore (eds) *Political Matter: Technoscience, Democracy and Public Life*, Minneapolis, MN: University of Minnesota Press, 119–38.

Helmreich, S. (2009) *Alien Ocean: Anthropological Voyages in Microbial Seas*, Berkeley, CA: University of California Press.

Hird, M.J. (2010) 'Meeting with the Microcosmos', *Environment and Planning D: Society and Space* 28(1): 36–39.

Lebwohl, B. (2010) 'Anthony Andrady says Plastics in Ocean Biodegrade Slowly', *EarthSky*, 11 January, earthsky.org/earth/anthony-andrady-plastics-in-ocean-biodegrade-slowly (accessed 19 July 2012).

Lövbrand, E. and Stripple, J. (2006) 'The Climate as Political Space: On the Territorialisation of the Global Carbon Cycle', *Review of International Studies* 32(2): 217–35.

Marx, K. (1990 [1867]) *Capital: A Critique of Political Economy, Volume 1*, trans. B. Fowkes, Harmondsworth: Penguin.

Moore, C.J., Moore, S.L., Leecaster, M.K. and Weisberg, S.B. (2001) 'A Comparison of Plastic and Plankton in the North Pacific Central Gyre', *Marine Pollution Bulletin* 42(12): 1297–300.

Pedler, K. and Davis, G. (1971) *Mutant 59: The Plastic Eater*, London: Souvenir Press.

Roy, P.K., Hakkarainen, M., Varma, I.K. and Albertsson, A.C. (2011) 'Degradable Polyethylene: Fantasy or Reality?' *Environmental Science and Technology* 45(10): 4217–27.

Ryan, P.G., Moore, C.J., van Franeker, J.A. and Moloney, C.L. (2009) 'Monitoring the Abundance of Plastic Debris in the Marine Environment', *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1526): 1999–2012.

Sekula, Allan (1995) *Fish Story*, Düsseldorf: Richter Verlag.

Serres, M. (1982) *Hermes: Literature, Science, Philosophy*, eds J.V. Harari and D.F. Bell, Baltimore, MD: Johns Hopkins University Press.

Song, J.H., Murphy, R.J., Narayan, R. and Davies, G.B.H. (2009) 'Biodegradable and Compostable Alternatives to Conventional Plastics', *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1526): 2127–39.

Stengers, I. (2010) 'Including Nonhumans in Political Theory: Opening Pandora's Box?' in B. Braun and S. Whatmore (eds) *Political Matter: Technoscience, Democracy, and Public Life*, Minneapolis, MN: University of Minnesota Press, 3–34.

Stone, R. (2010) 'The Invisible Hand Behind a Vast Carbon Reservoir', *Science* 328 (5985): 1476–77.

Takada, H. (2013) 'International Pellet Watch: Studies of the Magnitude and Spatial Variation of Chemical Risks Associated with Environmental Plastics', in J. Gabrys, G. Hawkins and M. Michael (eds) *Accumulation: The Material Politics of Plastic*, London: Routledge.

Thomas, N., Clarke, J., McLauchlin, A. and Patrick, S. (2010) *Assessing the Environmental Impacts of Oxo-degradable Plastics Across Their Life Cycle*, London: Department for Environment, Food and Rural Affairs.

Thompson, R.C., Moore, C.J., vom Saal, F.S. and Swan, S.H. (2009a) 'Plastics, the Environment and Human Health: Current Consensus and Future Trends', *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1526): 2153–66.

Thompson, R.C., Swan, S.H., Moore, C.J. and vom Saal, F.S. (2009b) 'Our Plastic Age', *Philosophical Transactions of the Royal Society B: Biological Sciences* 364 (1526): 1973–76.

United Nations Environment Programme (2005) 'Marine Litter: An Analytical Overview', www.unep.org/regionalseas/marinelitter/publications/docs/anl_oview.pdf (accessed 19 July 2012).

US Environmental Protection Agency (EPA) (2011) *Marine Debris in the North Pacific: A Summary of Existing Information and Identification of Data Gaps*, San Francisco: EPA.

Whitehead, A.N. (1929) *Process and Reality: An Essay in Cosmology*, New York: The Free Press.

Woodward, K., Jones, J.P. III and Marston, S.A. (2010) 'Of Eagles and Flies: Orientations Toward the Site', *Area* 42(3): 271–80.

Yaeger, P. (2010) 'Sea Trash, Dark Pools, and the Tragedy of the Commons', *Publications of the Modern Language Association* 125(3): 523–45.

Zaikab, G.D. (2011) 'Marine Microbes Digest Plastic', *Nature News*, 28 March.