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Volatile Worlds, Vulnerable Bodies: Confronting Abrupt Climate Change

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Abstract

The abrupt climate change thesis suggests that climate passes through threshold transitions after which change is sudden, runaway and unstoppable. This concurs with recent themes in complexity studies. Data from ice cores indicates that major shifts in global climate regimes have occurred in as little as a decade, and that for most of the span of human existence climate has oscillated much more violently than it has over the last 10,000 years. This evidence presents enormous challenges for international climate change negotiation and regulation, which has thus far focussed on gradual change. It is argued that existing social theoretic engagements with physical agency are insufficiently geared towards dissonant or disastrous physical events. Wagering on the past and future importance of abrupt climate change, the paper explores a way of engaging with catastrophic climatic change that stresses the inherent volatility and unpredictability of earth process, and the no-less inherent vulnerability of the human body. Drawing on Bataille and Derrida, it proposes a way of nestling the issue of environmental justice within a broader sense of immeasurable indebtedness to those humans who endured previous episodes of abrupt climate, and considers the idea of experimentation and generosity without reserve.

Keywords

abrupt climate change, fire, catastrophe, vulnerability, ethics, Bataille, tipping point, embodiment

...for more than 90 per cent of the time that our species has existed on this planet it has had to grapple with an immeasurably more capricious climate (Burroughs, 2005: 16).

The current stable interval is among the longest in the record. Nature is thus likely to end our friendly climate, perhaps quite soon (Alley, 2000: 4).

I don't understand why doubters claim and believers deride the idea that it isn't man made. If global warming isn't caused by man, doesn't that mean we're even more fucked? (Ivan, post on Boing-boing.net, March 4, 2008).

Suppose there was a still more inconvenient truth than the facts of anthropogenic global heating. What if the event of our time turns out to be not so much the knowledge that human action is altering global climate, as the realisation that climate is responsive to our nudges only because it far more precarious than we ever dared imagine? And what if the current suspicion that humankind has turned the planet's weather systems into a vast experiment has

a supplement, the idea that drastic climatic shifts have been experimenting with human life, putting us through the cruellest trials, time and time again? Would social theory, as it stands, be prepared to wager on such events? Are we ready to be 'true' to conditions and processes that threaten a radical undoing of the human capacity for collective action – to seek fidelity to a story that puts the cataclysm upstream of our humanity, and not simply downstream where we can still dream of diversion and escape?

'Interpretation of ice cores, and of many other climate records, has recently revolutionized our view of Earth' claims climatologist Richard Alley (2000: 13). Scientists have been piecing together evidence about the periodic advance and retreat of ice sheets since the 19th century, but only in the last two decades has it become apparent that the transition between warmer and cooler phases may be abrupt rather than gradual (see Broecker, 1987; Alley et al, 2005). While the great ice sheets take tens of thousands of years to build-up and thousands of years to recede, many climate scientists now believe that dramatic changes in global temperature occur in as little as a decade or even a few years. Analysis of Greenland ice cores, backed up by other proxies of past climate, suggests that the movement in and out of glacial phases takes place through a succession of sudden, seesawing shifts. As Alley puts it: 'for most of the last 100,000 years a crazily jumping climate has been the rule, not the exception' (2000:120).

This doesn't imply, as Ivan's posting suggests, that current anomalies in global temperature can be put down to other-than-human causes. But we should commend Ivan's courage to confront the broader issues raised by non-anthropogenic forcing of climate. The abrupt climate change thesis speaks of thresholds which, once passed, leave climate systems tipping rapidly and irretrievably into alternative states. In this way it resonates with the growing understanding of the dynamics of complex systems: a more generalized turn in the natural sciences which underlines the inherent volatility and unpredictability of many of the physical processes that human beings and other living things rely upon. As Alain Badiou observes: 'the world we live in is a vulnerable, precarious world.... This world does not announce the serenity of a linear development, but rather a series of dramatic crises and paradoxical events' (2005: 41). Badiou, however, like most other contemporary thinkers who speak of human implication in a worldly eventfulness, focuses largely on the social dimensions of our existence. But he could, perhaps should, be speaking also of the forces and processes that compose the wider physical universe, which in a very literal way pursue non-linear and crisis-ridden paths. These trajectories, I suggest, have profound implications for the ways in which we might think of our selves, our embodiment, our vulnerability in the face of events that far exceed our own measure.

There are more obviously political issues that hinge on claims about the inherent instability of climate. While few critical thinkers or activists are content with the outcomes of international climate change negotiations to date, most agree that the institutions and frameworks set up to deal with the problem deserve support. Indeed, the pursuit of what Gayatri Spivak refers to as 'the perhaps impossible vision of an ecologically just world' (1999: 382) would seem to require some formal means of apportioning human responsibility for predicted climate change and converting this culpability into remedial action. The trouble is that the notion of inherently unstable climate, together with the catastrophic scenarios associated with crossing climate thresholds, threatens to undermine the very ground on which such accounting might take place. Messing with conventional understandings of cause and effect, and foregrounding dynamics that far exceed the reach of social negotiation and contestability, the abrupt climate change thesis is not simply resistant to the traction of critical politics, it is potentially wide open to deployment in ways which could upset the nascent and fragile architectures of trans-national climate governance. To even partially shift the focus of debate and deliberation away from human influence on climate is to risk consorting with 'climate sceptics', to invite the charge of siding with those who would 'depoliticise' the whole issue of global environmental change. As Jacques Derrida reminds us, if we are not vigilant, even the best-intentioned

recourse to the idea of 'excess' dices with injustice and irresponsibility: 'Left to itself, the incalculable and giving idea of justice is always very close to the bad, even to the worst for it can always be reappropriated by the most perverse calculation' (1992: 28).

So what are we to make of abrupt climate change? Now that academic science, popular science writing and Hollywood cinema have all warmed to the idea of sudden threshold transitions in climate systems, the issue is unlikely to recede. We have also passed the point at which progressive social thought can content itself by keeping a critical distance from the substantive claims of the natural sciences, and entered a situation which cries out for a degree of fidelity to events unfolding around us. Which would seem to me to imply at least provisional commitment to an idea of how our physical world actually works. My gamble, with the usual provisos about decision-making under conditions of unknowability, is that we must front up to the past reality and future likelihood of crossing climate thresholds. And that we need to try and dream up some storylines which will help us to nudge the abrupt climate change thesis in the direction of supporting the quest for 'an ecologically just world', rather than relinquishing it to more callous interests. As a step in this direction, I put the stress on the inherent variability and volatility of our planet, and link this with a sensitivity toward the no-less inherent vulnerability and openness of human bodies - to each other and to the wider universe. More than just accentuating the risks that capricious climate poses to human life, I attend to the improbable and awesome achievements of our distant ancestors who made it through multiple episodes of sudden climate change, emphasizing their ability to experiment or improvise their way through extreme events. In this way I work towards an expanded sense of environmental justice that is informed and inspired by the idea of a profound indebtedness of present lives to those past.

Oscillating Climate, Swaying Bodies

I want to set out not from the great abstractions of global climate that are so often at the crux of climate change negotiation, but from somewhere closer to ground level, where ordinary people tussle with the stuff of their environments. For most human communities, fire is a vital element in the mediation between local conditions and the wider world. Around fire bodies sway or strain to the rhythms of matter and energy. Through fire they remake themselves, make over their worlds, and make contact with others.

Wildfire is the irregularity of climate incarnate. Sunlight and moisture plump up vegetation, heat and dry weather convert it into fuel loads - for which lightening sooner or later provides the spark, if another source of ignition doesn't get in first. Fire, as Stephen Pyne (2007) points out, is the predominant way that biological life interacts with climatic inconsistency, a dynamic that makes combustion one of the most definitive physical features of our planet. All human communities intervene in this process in some way. For hundreds of thousands of years, the manipulation of fire has been the major way in which humans have dealt with the localised variability engendered by fluctuating sunlight, wind and moisture (Pyne, 2007: 46). Over recent centuries we have sought to smooth out these irregularities by tapping into geologically sequestered energy, a process which has involved the substitution of open fire with the contained and disciplined burning of 'internal combustion'.

But wildfire has not been and could not ever be fully displaced by confined fire. It continues to rage, and will rage afresh as changing weather patterns redistribute wind, heat, moisture and biomass. In colonial Australia, wildfire - both natural and anthropogenic - was a constant threat, as it remains today. Reporting in 1840, Lieutenant Stokes of the *Beagle* was surprised to see Australian Aboriginals 'engaged in kindling, moderating, and directing the destructive element, which under their care seems almost to change its nature, acquiring, as it were, complete docility, instead of the ungovernable fury we are accustomed to ascribe to it' (cited in Hallam, 1979: 33). Essayist and poet Mary Gilmore, who spent her childhood in rural New South Wales in the 1860s and 70s, develops this theme in the context of the

relations between her own settler community and the local Wiradjuri people. ‘‘Send for the blacks!’’ was the first cry on every settlement when a fire started’, she recalls (1934: 152; see also Main, 2004)¹. Before adding:

it was the natives who taught our first settlers to get bushes and beat out a conflagration. My grandparents used to tell of how new immigrants when they first came to the country, unaccustomed to the danger in the wild country, would start fires and let them run heedless of the result; and they would stand panic-stricken at having loosed something they could not control. And they would go on to relate how the natives would run for bushes, put them into the immigrants’ hands, and show them how to beat back the flame as it licked up the grass. Indeed it was a constant wonder, when I was little, how easily the blacks would check a fire before it grew too big for close handling (1934: 152).

Gilmore’s account shows her to be a particularly astute observer of different bodily dispositions and their place within a broader economy of managing natural forces:

The white man used large bushes and tired himself out with their weight and by heavy blows; the blacks took small bushes and used little and light action. The white expended the energy of panic; the blacks acted in familiarity, as knowing how and what to do. They used arm action only, where the white man used his whole body. Where, as a last resort, the white man lit a roaring and continuous fire-break, the aboriginal set the lubras² to make tiny flares, each separate, each put out in turn, and all lit roughly in line . . . The aboriginals said that not only must fire be met by fire, but that it could only be fought while still not too hot . . . when it became so hot that it burnt and exhausted men, it had to be met from a distance. They also said that a big fire as a fire-break was as dangerous as a big fire itself, as the wind might change and bring it back on the watchers³ (1934: 152-3).

As well as an insight into indigenous practices, Gilmore gives us a glimpse of a particular mode of European bodily comportment in the process of its unravelling. It is no coincidence that the notion of curfew, as a means of keeping tabs on the populace is derived from *couvre feu*, covering or dousing a fire (Pyne, 2001: 109). At the same time that urban populations were being subjected to new regulatory practices, enlightenment agronomists were busily stamping out rural folk traditions of burning fallow. Just as unruly urbanites were being induced to channel and augment their bodily energies (Foucault, 1991), Europe’s peasant farmers were compelled to quell their fires and desist from fallow – so as to tighten and amplify the energetic circuits of agricultural production. The ancient custom of revitalising farmland by torching accumulating vegetation had come to be seen as an unconscionable waste, while free-ranging fire was dismissed as uncivilized and disorderly. Gradually, across Europe, customary practices of working with fire as means of modulating variable flows of warmth, moisture and biomass were attenuated and extinguished (Pyne, 1997: 162-8, 2001: 145-6). The object of ‘a *general prohibition*’ in everyday life, fire ceased even to be of interest to science (Bachelard 1987: 11,2). When émigré Europeans eventually found themselves face to face with elemental forces beyond their measure, there was little alternative but to turn to other collective bodies - if disaster was to be averted.

There is more at stake here than simply setting traditional capacities to ‘go with the flow’ of nature’s forces against modern intransigence and rigidity. The fire-tending skills of Australian Wiradjuri, like those of Andaman Islanders, Malagasy, or rural Scandinavians were hard won, and there is a sense in which all experience of working with open cast fire is provisional. As Pyne stresses, no two fires or consecutive fire seasons are ever quite the same (1991: 29). And sometimes the difference is profound, abrupt and unforeseeable. In a recent study of charcoal and pollen sediments from parkland around Sydney, paleoecologists Manu Black and Scott Mooney provide evidence of one such episode in which the climatic conditions, and

the associated fire regime, underwent a sudden shift. What appears as a dramatic spike in the graph of charcoal deposits is indicative of a rapid increase in the prevalence and intensity of fire in south eastern Australia around 5,700 years ago (2007: 47). This signature of irrupting wild fire shows up at the same time not only in comparable records from other sites in Australia, but right around the Pacific Basin.

These convergent traces have been interpreted as the footprint of the El Niño Southern Oscillation, the planet-girdling ocean-atmosphere system that serves to dissipate the solar warmth received by the equatorial Pacific Ocean to cooler latitudes. Paleoclimatologists believe that ENSO passed through a critical threshold fifty-seven centuries ago, its irregular rhythms of drought and dampness suddenly intensifying at this moment (Black and Mooney 2007; Caviades, 2001: 256). What Black and Mooney's charcoal sediments offer is a frightening intimation of the impact of this transition at ground level: wildfire of a scale and ferocity that could only have come as shock to those who had experienced thousands of years of much less intense El Niño events – even if, like the Aboriginal people of the Sydney basin, they had already been working with fire for many millennia.

But the charcoal and pollen record hints at a further changes, no less noteworthy. For some two and half thousand years after the turning point, fire more-or-less maintains its new intensity, flaring, waning, flaring again. And then, around 3,000 years ago, there is a marked tailing off. There is no evidence of an accompanying shift in the ENSO regime, however, nor does it appear that fire ceases to be a significant force in the landscape. It is just that big fierce fires seem to have given way to smaller and more numerous low-intensity burns. Black and Mooney's explanation is tentative, but intriguing. They suggest that by this stage Aboriginal land management using a strategy of intentional and controlled burning had developed to the point where it could mitigate the intensities of the El Niño's deadly wet-dry fluctuations – and pre-empt the risk of vast and deadly conflagrations (2007: 50).

What we may be seeing in the charcoal record, then, are the vital signs of two to three thousand years of improvisation and experimentation by human collectivities in response to the effects of an abrupt transition in climate. The evidence is sketchy, and entangled with other variables - such as increasing Aboriginal population density. Still, there may be an imprint here of the background story to the indigenous pyrotechnical skills that so impressed Stokes and Gilmore. And perhaps also the intimation that the price of an ease and familiarity with 'the destructive element' was an almost unthinkable extended effort, a putting of bodies on the line over countless generations. All of which, with the privilege of hindsight, we might see encapsulated in Gilmore's account of the passing of bushes and torches - the paraphernalia of working with fire - from one people to another.

Thinking across Thresholds

Meanwhile, Australia is again grappling with the effects of climatic variability – and with the outbreaks of wildfire that are one of its most prevalent manifestations. At the national level, the current drought has spotlighted the issue of human-induced environmental change to such an extent that the recent political contest between John Howard's 'climate-change sceptical' Liberal administration and the Kevin Rudd's 'pro-Kyoto' Labor Party was billed as 'the world's first climate-change election' (Glover, 2007). While anthropogenic global heating may indeed be contributing to the continent's six-year spell of 'rainfall deficit', some climatologists suggest that what Australia is now experiencing are weather patterns which reflect a multi-decadal shift in the El Niño Southern Oscillation (Lester, 2006). For all the talk of a 'one in 1000 year drought', the magnitude of this shift is scarcely comparable with the threshold through which earlier Australians passed 5,700 years ago. And that critical transition in turn pales by comparison with the sort of climatic changes endured by our ancestors in the Pleistocene era.

Climate science tells us that the last 10,000 odd years, covering the interglacial known as the Holocene, has been a period of exceptional climatic stability – a warm and calm anomaly in an otherwise largely glaciated epoch (Burroughs, 2005: 54). Move out of this balmy interlude and it's like dropping off a precipice. Between 12,800 and 11,500 years ago, in the midst of a trend towards interglacial warmth, there was a sudden return to ice age conditions, known to paleoclimatologists as the Younger Dryas event (Alley, 200: 4). Evidence from the Greenland ice cores, fleshed out by fossil records and other paleoenvironmental data-sets, indicates temperature changes of up to 15 degrees Fahrenheit in less than a decade, a shift far beyond anything experienced in the whole span of the Holocene. Go back a few thousand years more and this sort of wildly oscillating climate appears as the norm rather than the exception – for hundreds of thousands, perhaps millions of years. And this means that almost all the achievements of humankind about which we are familiar and knowledgeable are stamped with anomalousness and provisionality. 'Civilization rose during a remarkable long summer', anthropologist Brian Fagan observes. 'We still have no idea when, or how, that summer will end' (2004: 25). Although the latest data from polar ice cores points to an interglacial longer than our own some 400,000 years ago, the weight of evidence still suggests that we should not count on the current stable interval to persist.

In basic terms, the message from recent geochemical and paleoenvironmental research is that the earth's climate, of its own accord, goes through critical transitions from time to time, at many different spatial and temporal scales (Burroughs, 2001: 1-3). This implicates the field of climatology in the more general turn in the sciences toward the study of complex systems, and in particular with the growing understanding of the non-linear dynamics of systems with more than one 'state' or 'regime' (Urry, 2005, Clark 2005). Through field studies and computer modelling, the sciences of complexity have teased out some of the ways in which complex physical systems, by virtue of their dense internal feedback loops, are capable of absorbing pressures for change whilst maintaining their current state. That is, until a certain threshold is passed. After this 'tipping point' is reached, feedback works the other way round, amplifying the impact of stimuli, which effects a rapid and usually unstoppable transition into a new regime (Scheffer et al, 2001). As Alley puts in, in relation to global climate: 'Sometimes a small push has caused the climate to change a little, but other times, a small push has knocked Earth's climate system into a different mode of operation (2000: 13; see also Broecker, 1987).

Though it remains notoriously difficult to identify their early warning signals, such 'sudden, drastic switches to a contrasting state' have been thoroughly documented in numerous real world systems, from eutrophying lakes to algal colonisation of coral reefs (Scheffer et al. 2001: 591). In recent years, the search for potential triggers of rapid climate change and their likely 'tipping points' or 'tipping elements' has become a prominent theme in climate science and its popular reporting, with such candidates as the switching off of the ocean conveyor or 'thermohaline', Amazon rainforest dieback and the collapse of Greenland or Antarctic ice sheets garnering increasing attention (Lenton et al, 2008). While the Intergovernmental Panel on Climate Change remains focussed on gradual climatic change in its official reports, high profile expert witness such as NASA's James Hansen and Gaia theorist James Lovelock have been making provocative claims about the imminence of passing over a threshold into runaway climate change (Pearce, 2006: 15, Lovelock, 2006: 51).

In some ways, Ulrich Beck's observation that 'ours is the age of the smallest possible cause for the greatest possible destruction' looks more valid than ever (1995:4). But climatology and other sciences of complexity suggest a much more general point. Because of the very nature of feedback effects in complex systems, the idea that a small stimulus can give rise to a large transformation appears more as an ontological condition than as a characteristic of a particular historical era or mode of technological development. And this in turn points to a paradox of our current predicament, one which social thought cannot avoid confronting. The fact that human 'forcing', in the form of rising greenhouse gas emissions, now appears to

have the potential to push global climate into a radically different state seems to put human agency at centre stage - to the extent that some physical scientists make the case for a recent transition to a new geological epoch dubbed the 'Anthropocene' (Crutzen, 2002).

On the other hand, new understandings of the inherent instability of global climate and other physical systems, together with mounting evidence of previous climatic transitions, points to a propensity for sudden, momentous change that inheres in physical reality itself, irrespective of human contributions. As climatologist Matthew Huber sums up: 'Even people who describe themselves as global warming skeptics can accept the fact that massive changes happened in the past because research shows that climate change is natural. But the real point is that not only is climate change natural, but it's also easy to set in motion' (cited in Purdue University, 2006 unpag). By this logic, anthropogenic emissions are merely one trigger amongst a wealth of possible forcings - and that makes us far from unique or special, however important our contribution might be at the current juncture. In what is a rare intervention into this field from philosophy, Isabelle Stengers grasps this point clearly. Speaking of major global environmental change she counterposes the human experience of 'catastrophe' with the bigger terrestrial picture: 'From the viewpoint of the long history of the Earth itself, this will be one more "contingent event" in a long series' (2000: 145).

The 'human', in this way, appears to be at once advancing and withdrawing, centring and decentering itself. Perhaps the most obvious way to negotiate this paradox is by recourse to the theories of human and other-than-human 'co-enactment' of reality that currently prevail in critical social science discourse around the topic of nature. Much of this work accompanies Bruno Latour in his call for a 'principle of generalized symmetry' which invites us to address 'the production of humans and nonhumans simultaneously' (1993: 103). In this way, actor-network theory and cognate approaches seek to overcome any *a priori* privileging of the agency or effectivity of particular categories of being, in favour of accounts which attribute capacities for world-making even-handedly amongst all apposite entities. Many of the studies which hew to this agenda demonstrate how nature, rather than pre-existing 'out there', is actually accomplished or 'materialized' through specific practices involving various actors, apparatuses and repertoires (Barad, 2007; Hinchliffe, 2007). The climate that is now giving such cause for concern is no exception. As David Demeritt explains:

neither the idea of a "global climate" nor the phenomena that it designates are conceivable apart from the world-shaping network of social practices, standardized instruments, orbiting weather and communications satellites, and computer models through which they are made manifest (2001: 312).

It is important to stress that physical forces also actively contribute to this 'making manifest' - whether by joining humans in their expanding alliances, resisting our enrolment, or by otherwise pursuing their own agendas (Latour, 1988). Thus the phenomenon we refer to as 'global warming' comes about 'through the action of each of us, with all the oceans, high atmosphere and even the Gulf Stream ... participating' (Latour, 2003: 32). In this way, theorems positing an ontology of co-enactment offer us the possibility of thinking about the ways that human beings modify and 'perform' global climate without losing sight of the capacity of geo-climatic factors to leave their mark upon human actors.

However, care must be taken so that the inclusivity implied by the call for symmetry between the human and nonhuman does not come with its own pre-emptive effects. Much of this work has emerged in response to perceived threats arising out of the incautious extension of human techno-scientific capabilities, resulting in a clear predilection for the study of constellations of objects in which human agency is always already prevalent. Whereas in this context, the acknowledgement of the other-than-human interests and agencies may seem like a welcome recuperation and an evening up of the score, there are other situations in which the inference

of relations of equivalence or co-production amongst all actors present seems to woefully underestimate the extremity of an extra-human materiality.

Latour himself is explicit that 'symmetry' in no way implies a balance of forces: 'the principle of symmetry aims not only at establishing equality – which is the only way to set the scale at zero – but at registering differences – that is, in the final analysis asymmetries' (1993: 107). He has also made it clear, from very early on, that nonhuman objects are quite capable of organising their own interactions without need for human intermediation (Latour, 1988: 192-211), a claim picked up and amplified more recently by other theorists (Barad, 2007: 140, Hinchliffe, 2007: 1). Yet it is remarkable just how rarely Latour's work, or any of the 'co-enactment' literature, ventures into domains where the dominant force is genuinely other-than-human, let alone where humans are not present in any significant sense (see Harman, 2009; Massey, 2005: 355).

Moreover, the ethnographically-inspired predilection for 'thick description' of everyday practices that characterises these approaches - a partiality for research which positions itself 'in the thick of things' – tends to result in attention to the routine and the ordinary at the expense of more extraordinary or dissonant events (Hinchliffe, 2007: 55, Van Loon, 2005,). When other-than-human forces are shown to make a difference, it is most often in ways that are easily amenable to assignment or conceptual containment. And in this regard, what Nigel Thrift has to say resonates beyond his chosen target:

actor-network theory is much more able to describe steely accumulation than lightning strikes....(It) is good at describing certain intermediated kinds of effectivity but ...dies a little when confronted with the flash of the unexpected and the unrequited (2008: 110).

What this adds up to is a sense that even the most promising engagements with an active materiality that social theory currently has on offer still lag behind the natural sciences in their willingness to confront the autonomous dynamism of physical forces head on. When it comes to events of the magnitude of shifts in global climatic regimes, any social scientific approach that expects to be able to identify and track all the constitutive elements of the situation risks being overwhelmed by the objects of its analysis. Or as Jean-François Lyotard once put it: 'Suppose an earthquake destroys not only lives, but the instruments used to measure earthquakes directly and indirectly' (1988: 56). Though Lyotard's seismic trope may have been metaphorical, there is every reason to believe that there are terrestrial and cosmic processes with the potential not only to join in the enactment of the human, but to radically unmake much or all of what passes for our humanity (Brassier, 2007). And this is a profound challenge not only for social thought, but for the social agencies charged with responding to global climate change.

Confronting Cataclysm

As Latour aptly observes, modern political philosophy did not shape itself with the governance of sea, sky and climate as its remit (2004: 204). By the same token, the international institutions assembled over recent decades to administer global 'warming' were not convened with the challenge of runaway climate change in mind. Scientists concerned about climate threshold transitions have their own reasons why the major regulatory bodies, such as the Framework Convention on Climate Change have generally 'underestimated' the possibility of abrupt change. In particular, they have noted that most of the climate models to date have been inclined to represent certain key complex processes in uniform or linear ways, which reduces the sensitivity of simulations to threshold crossings. Researchers have also made the point that the imperative to identify human forcing of climate has steered attention away from the bigger picture of natural causation of abrupt change (Alley et al, 2003).

It is in contexts like this that constructionist social science proves especially helpful. Demeritt (2001) has deftly traced the 'feedback loops' that link the formulation of research questions with the technocratic interests that hold sway in the nascent international regulatory regimes. He suggests that through their ongoing interactions with policy makers, many scientists have been subtly but appreciably encouraged to marshal their inquiries around those aspects of climate change that are most conducive to being managed, with the result that the potential for 'surprises' or extreme events has been systematically played down (2001: 325-6). It needs to be stressed here that for those scientists who have taken upon themselves a fidelity to the event of sudden or non-linear climate change the experience of feeling subjected to political imperatives can be a frustrating and painful one.

A more reflexive understanding of the production and dissemination of expert knowledge, Demeritt proposes, would surely help. But there are situations where 'reflexive discourse' itself moves too quickly to join up what might best be left open and disjunct, and thus, in Foucault's terms, 'runs the risk of leading the experience of the outside back to the dimension of interiority' (1987: 21). The point made by scientists favouring the abrupt change paradigm about the bias towards human forcing of climate needs to be taken seriously, for it has implications well beyond the critique of technocracy or managerialism in the regulatory arena. No less than would-be planet-managers, those of us who dream of a more exacting environmental justice find ourselves dependent on the establishment of causal connections that only make sense in terms of human agency. Wherever the intention is to expose and address the disparities between those who have been most advantaged by fossil fuel consumption and those who will likely bear the brunt of global heating – whether this applies to social-structural, international or intergenerational differentials - it is necessary to attribute responsibility for climate change. That means not only isolating the human contribution from the 'background noise' of natural climatic variability, but doing so with enough confidence to be able to apportion human forcing amongst geographically and historically determinate social groupings. Not surprisingly, given this imperative, any causal or categorical muddying that ensues from re-asserting the importance of other-than-human forcing of climate can quickly invite the charge of 'depoliticizing' the whole issue.

It needs to be made clear that those climatologists who 'unearthed' the signatures of abrupt climate change (often to their own surprise and dismay) have little in common with the expert witnesses who supply evidence intended to undermine strategies aimed at mitigating anthropocentric climate change. By contrast to those buttressing the 'sceptical' stance, scientists who take the possibility of non-gradual climate change seriously tend to present this as an incentive to greatly intensify efforts to avoid crossing climatic thresholds (see Alley, 2000; Lovelock, 2006) - and quite a few of these researchers hold important positions in political advisory bodies. There are still signs of serious disjuncture, however, when it comes to actually translating concern over abrupt change into prediction or policy.

As its title attests, the report sponsored by the US Global Change Research Program [Abrupt Climate Change: Inevitable Surprises](#) takes the threat of climate tipping points seriously enough to be investigating their possible repercussions. According to its authors:

there is virtually no research on the economic or ecological impacts of abrupt climate change ... Geoscientists are just beginning to accept and adapt to the new paradigm of highly variable climate systems, but this new paradigm has not yet penetrated the impacts community, particularly in economics and the other social sciences (Committee on Abrupt Climate Change, 2002: 121)

But it's clear from the report's sketch of potential economic and socio-cultural impacts that even large-scale climatic regime shifts are not necessarily equated with cataclysmic social effects, and do not appear to unduly perturb the kind of managerialism described above by

Demeritt. Identifying sectors of the US economy where loss of revenue might be expected as well as laying out areas of opportunity, the document's cost-benefit approach is very much one in which the persistence of familiar economies of production and knowledge goes without question. The incongruity between event and response has not gone unnoticed in the scientific community. Geologist Kenneth Deffeyes offers the retort: 'Try writing an environmental impact statement for a continental glacier thousands of feet thick all the way from Hudson's Bay to South of New York City (2005: 170-1). Likewise, in relation to a switching off of the North Atlantic thermohaline, climatologist William Burroughs announces that 'the economic consequences would be unimaginable' (2001: 273). Even economist William Nordhaus – pioneer of the application of cost-benefit analysis to climate change - has gone on record saying: 'once we open the door to consider catastrophic changes a whole new debate is engaged' (cited in Meyer, 2000: 54).

Or not engaged, as the case may be. Although it tends to be treated implicitly rather than explicitly, the dilemma for all those attempting to respond in a just way to global heating – wherever their ideals of environmental justice fall on the political spectrum - is that the mechanics of abrupt climate change present fundamental challenges to the modern axioms of economic value and ethico-political responsibility. As long as effects can be related to causes with some degree of proportionality, as is the case with gradual climate change, it remains conceivable (whatever the technical or political hurdles) that parties contributing to documented changes in regional or global climate could be held to account for their actions. Such accounting, organised at a national scale, currently forms the basis of institutionalised attempts to mitigate global heating, and in some proposals would underpin regimes of reparation for the harmful consequences of climate change.

The event of passing over a tipping point into a climatic regime shift threatens to implode the figure-ground distinction between human-induced change and the background noise of natural variability, and by the same logic, promises to confound the system of accountability that hinges on the linear or proportional relationship between cause and effect. We have encountered the evidence that, under certain circumstances, a tiny nudge may be all it takes to unleash a set of cascading, self-reinforcing changes in the climate system. Conversely, a major impetus to change might lie dormant in the system for centuries or millennia before its impact is manifest. In this way, non-linear change with regard to climate and other environmental change gives rise to 'a high degree of mismatch between time-frames', as sociologist Barbara Adam presciently noted over a decade and a half ago (1993: 406). Furthermore, as some scientists, have suggested, global climate might already be 'naturally' close to a tipping point, thus dramatically amplifying the significance of human forcing, while there is also the possibility that human impacts have taken climate systems closer to a threshold, for which the final push could turn out to be an unforeseeable nonhuman forcing - such as a large-scale volcanic eruption (Zillman 2005: 20).

But even this last point comes with complications, for there is a growing scientific consensus that climate change – anthropogenic and otherwise – impacts upon other, 'extreme', geological events. By reorganizing the global distribution of water and ice, changes in climate can significantly alter the loading on the earth's crust, adding to the stresses and strains that are always already present - and thereby increasing the likelihood of volcanoes, earthquakes, and submarine landslides. On the other hand, a big increase in volcanic effluvia in the atmosphere could also counteract global heating, at least temporarily, though in ways which would likely be devastating for human life (McGuire, 2006).

In other words, because a vast ensemble of human and nonhuman elements effectively form a single complex global system – with its own internal dynamics and emergent properties, certain conventions of isolating specific causal agents and accounting for their contribution to overall change need to be fundamentally rethought. As Silvio Funtowicz and Jerome Ravetz explain: 'Precisely because of the interpenetration of the different dimensions of the emergent

complex system that is (in retrospect) the disaster waiting to happen, it can be difficult to assign responsibility or blame for the event' (1994: 577).

The idea that technological accidents of a particular strain and magnitude defy 'insurability' has been well-explored (Beck, 1995), but this notion may need a radical extension. The growing acknowledgement that major fluctuations, instabilities and threshold transitions are inherent characteristics of climate systems - at every spatial and temporal scale - suggests that the challenge to insuring against loss or damage inheres as much in the normal chaos of earthly existence as it does in any specific socio-technological predicament. But it's not just a matter of insurance. It is an issue for economies or systems of 'value' more generally. There are events which go by the name of 'disasters' or 'cataclysms' that by definition involve irrecoverable loss, and in this way break with the logic of equivalent or exchangeable values that, as many philosophers and social theorists have noted, has been axiomatic to modern social life. Or as John Caputo puts it: 'disasters throw all reckoning and cost-accounting into chaos' (1993: 29).

Confronted by the human-induced conflagrations and atrocities of the last century, many thinkers have explored the idea of the 'disaster' or the 'cataclysm' as the self-undoing of our modernity (see Blanchot, 1995; Wyschogrod, 1998). But few have dwelt with such intensity on the ongoing capacity of the earth itself to visit on its inhabitants events of unthinkable destruction and loss, as if somehow the rise of discernibly 'human' holocausts had shunted lightning strikes, earthquakes, and wild fire into a domain of relative insignificance. Much 'disastronomical' thinking of recent decades draws on Georges Bataille's notion of a restricted economy which remains forever open to a radical outside from which come momentous forces that can tear open the present (1991, 1993). Precious little of this thought heeds his insistence that this 'measureless catastrophe under the threat of which we are living' is first and foremost an expression of the boundless energies of the earth and cosmos (1993: 429; see also Stoekl, 2007). Long before it was fashionable, Bataille wagered that the problem modern humankind faced was not a shortage of energy or materials or goods, but an over-accumulation 'which has turned the whole world into a colossal powder keg' (1993: 427-8). For him this was not a human rupturing from nature, but rather, the outcome of an overly effective tapping and channelling of energies that were already excessive long before our escalating interventions.

It is Bataille too, who recognised that not only production and knowledge, but justice also - was constantly under threat from the upheavals of a universe that is never going to settle for equilibrium (1991: 38). Justice, as Rosalyn Diprose has more recently argued, dreams of 'equal and harmonious forces', and in this way 'exists by marking itself off from an outside to which it is hostile (2002: 33). In the present global environmental predicament, the outside against which justice bolsters itself, as Bataille intimates, not only includes the many formidable human impediments to equity and fair-play, but the wider universe of elemental forces. This is the domain beyond our control, our knowing or our adjudication, and therefore beyond political purchase in any conventional sense. But this does not mean that all reference to the most forceful cosmic or terrestrial processes must side with the apolitical or the depoliticised. In the final section, I want to sketch out an ethic of abrupt climate change that might allow justice to touch its outside generatively and hopefully. And thereby, perhaps, helping salvage 'the incalculable' from its appropriation 'by the most perverse of calculations'.

Earthly Volatility, Human Vulnerability

As many critical thinkers and activists know only too well, the pursuit of sustainable and equitable futures in the arena of climate change negotiation gets quickly mired in the quantification of cause and effect, a calculus constantly threatening to reduce the ethical and political to the merely economic. Though it may be true that justice is a 'chilly virtue'

requiring impartiality and even-handedness (Dobson, 1998: 229), a vision of the just inspired by an appreciation of our disastrously fissured past might ultimately prove more enthralling than one which is contained within the closed circuits of proven causality. Fuelled by 'a sense of wonderment for the immensity and complexity of the Earth's climate' (Burroughs, 2001: 274), and an awe for the achievements of distant ancestors who made it over the spikes of transition thresholds with nothing like the resources we have at our disposal, we might even stoke some fire under the negotiating tables of climate summits yet to come.

Earlier I drew on Gilmore's account of her Wiradjuri neighbours to invoke the ordinariness of an embodied engagement with the materials and energies through which climatic variability manifests itself in a local environment. But I also stressed that composure and dexterity in the face of volatile elements may not have come easily. The temptation to simply romanticize the indigene or demonize the colonial interloper needs to be tempered by awareness that *all* habitation over the *longue durée* is sooner or later likely to entail exposure to conditions beyond the scope of memory and practice, resulting in stress, suffering, loss. This exceeding of the known and the familiar, as theorists of the cataclysm would have it, haunts our every effort to secure the world. And such events defy our attempts to render them present, to fully grasp their meaning or consequences (Wyschogrod, 1998). We cannot know exactly what it was like to live through the abrupt change in intensity of drought-induced fire in Australia 5,700 years ago. Nor can we truly identify with those more distant ancestors who found themselves struggling against the precipitous slide into a Pleistocene glacial episode.

But we can speculate. Paleoclimatological evidence suggests that, while temperature changes were more pronounced closer to the poles, the sudden flip into a cooler regime would have had severe impacts right across the planet's surface, resulting in declining rainfall, fierce winds and dust storms, vast forest fires and collapsing animal populations (Calvin, 2002; Burroughs, 2005). Time and time again, early humans or hominids would have had to face the rapid onset of such conditions, far enough apart to rule out any continuity of experience or cultural memory. As evolutionary psychologist William Calvin puts it: 'one unlucky generation ... suddenly had to improvise amidst crashing populations and burning ecosystems' (2002: 4). Genetic mapping points to severe 'bottlenecks' in human populations as a result of these rhythmical climatic changes, but also shows the signatures of other (though not necessarily unrelated) kinds of catastrophes, such as disease outbreaks or major volcanoes. There are signs that the volcanic eruption of Indonesia's Lake Toba, which occurred some 70,000 years ago, altered global climate for at least a thousand years and levelled human numbers worldwide to as few as 15,000 individuals – odds which prompt molecular anthropologists to speak of 'survival of the luckiest' (Burroughs, 2005: 138-9).

For all their brute finality, such quantifications scarcely convey the significance of so many lives and lineages extinguished, or the hauntingly absent presence of possible futures that never came to be (Wyschogrod, 1998: 173; Clark, 2007). But the fact that there are such huge losses that cannot be recuperated, so much individual or communal being that is destined to remain obscure and immemorial, does not simply imply a faltering of thought or the end of projects that hinge on critical thinking. For as Derrida would have it: 'this incomprehensibility is not the beginning of irrationalism but the wound or inspiration which opens speech and then makes possible every logos or every rationalism' (1978: 98). In this way, thinking through the human in terms of a constitutive vulnerability to forces beyond its control need not stop at melancholic musings on fragility or finitude, but can be taken as an incitement to informed action. The cataclysm that has always already occurred, then, might be taken not just as the gap or non-relation that rends the present, but as the opening that propels us into previously unthinkable possibilities of knowing and doing.

That being said, the recent revival of interest in the radical susceptibility of embodied selves (see Butler, 2004; Harrison, 2008; Turner, 2006) is suggestive that current thinking around the mutual enactment or co-production of the human and the non-human is still overly

committed to a paradigm of action, albeit one where activity is generously distributed. What the idea of a fundamental exposure or radical passivity of the self obliges us to consider is all that a body owes - not only to those with whom its linkages and alliances can be established, but to those who are no longer with us, those with whom we can never be together. As Catherine Chaliel puts it: 'The history of every creature stands in relation to that anteriority or that absence, it bears witness to them, in spite of itself and often unbeknownst to itself' (2002: 119) But the inclusiveness of Chaliel's choice of 'creature' hints that we should also heed the insistence of theorists of human-nonhuman co-enactment that there is far more at stake in the becoming of bodies than encounters with a merely human alterity.

Like those philosophers who write of the disaster (with whom they have close affinities), few theorists of bodily vulnerability have taken full account of the porosity of human bodies to other living things, and fewer still have attended to our openings to elemental or earth processes (but see Lingis, 2000). 'To posit oneself corporeally is to touch an earth', announces Emmanuel Levinas - with a promise he never quite fulfils (1969: 128). Here too, it is Bataille who pushes forward with his evocation of an inter-corporeal generosity that taps into and extends the life-giving flow of solar energy. '(T)o live', he intones 'signifies for you not only the flux and the fleeting play of light which are united in you, but the passage of warmth or light from one being to another' (1988: 94).

We have seen how indigenous Australians quite literally passed the fire to new arrivals in their land, a gesture which signals a much more general bequeathal - and appropriation - of the skills and repertoires of inhabiting a changeable environment. In a similar way that all of us alive on the earth today are the 'improbable descendants' of a succession of forebears who survived upheavals of their physical world (Calvin, 2002: 3), most of us have also dwelled in or travelled through landscapes whose vagaries and irregularities have been softened by the efforts of prior inhabitants. As Alphonso Lingis muses:

The world I find under my feet does not extend about me as a miasma in which I grope alone; I am born in a place that another has vacated and sent along paths which others have trod. For me, the world is, from the start, a field of possibilities others have apprehended and comprehended ... (1994: 171).

In this sense we are all recipients of 'the gift of possibility of a common world' (Diprose, 2002: 141). A gift which we might see as putting us, from the very start, in debt to a procession of others who came before us: a debt too immense to be measured, too abyssal and asymmetrical to be paid back. These transfers of abundance and potentiality come down to us deeply incised with inequity, unevenly distributed and biased in their acknowledgement: the hard graft behind them too often overlooked or accepted ungraciously (Vaughan, 2002: 111-2, Diprose, 2002: 9). [Gilmore goes so far as to suggest that some of the worst blazes in her area were lit intentionally by European settlers to annihilate Aboriginal people (1934: 153)]. There is no obligation to convert an immense indebtedness into recognition or gratitude. There is no easy or obvious passage from gratitude to justice. And there is most certainly no direct link between proximity to the violence of physical forces and the cultivation of a generous disposition towards others.

As Bataille himself was well aware (though he was still too close for comfort for some commentators), a heightened sense of human immersion in the monstrous energies of the cosmos, if it is accompanied by an elevation of ecstasy and anguish over moderation and self-control, can just as easily foster the worst excesses of inter-human violence as it can the more laudable excesses of radical generosity (Bataille, 1991: 23-4). Which is precisely the tension that Derrida alludes to in his juxtaposition of the extreme risk and the precarious promise of an 'incalculable' justice that I cited earlier. This is the reason why, with all the ensuing paradoxes, any move in the direction of an 'unrestricted economy' of environmental justice

demands more rather than less rigorous and sustained commitment to political, ethical and affective 'work'.

There are more substantive reasons why the experience of historically or geographically distanced 'others' cannot simply be excavated or extracted and applied, as some environmental managers have sought to do through the codification of diverse indigenous practices under the label of 'traditional ecological knowledge' (see Cruikshank, 2005: 255-6). While every effort needs to be made to protect and further develop both old and new repertoires for living with variable climatic conditions, important provisos apply. Clearly, the world's human population has reached a size beyond any meaningful comparison with that pertaining to previous episodes of abrupt climate change, a profusion of bodies that is increasingly enabled by and locked into complex, durable infrastructures. While predominating patterns of urbanized and globally-interconnected settlement have proved capable of responding flexibly to minor environmental fluctuations, gathering evidence points to a disturbing vulnerability to major and long-term transformations (see Davis, 1998: 20-5). We need also to keep firmly in mind that current anthropogenic forcing is likely to precipitate a level of heating which exceeds even the jagged extremes of the Pleistocene. Paleoclimatologists are now turning to the mid-Pliocene (currently calibrated at 3.29–2.97 million years ago), to find atmospheric carbon levels, temperatures and tipping points that offer the nearest analogue for the forecast conditions of the latter 21st century (Hayward et al, 2009). With regard to hominid evolution this draws us deeper into the realms of irrecoverable and the non-identifiable, even further from any mnemonic grasp which might bear in practical ways upon our own lives.

And yet, I still want to wager that the quest for just and workable responses to conditions of climatic instability will be better served by an opening up of the political to the exorbitant energies beyond its normal bounds, than it would be by a repression and silencing that cedes the cataclysm to self-serving or 'perverse' interests. The task of cracking open what Lauren Berlant (2008: 5) has referred to as the state 'of sociopathic disavowal and ordinary compartmentalization' of the current climate change crisis calls not only for political and economic trajectories apposite to long-term survival, but also for the vitalising charge of new affective intensities. While I have been suggesting that passions and attachments that interrupt or stretch the compacted timescales of modernity might serve an incitement, Berlant reminds us how important it is not to downplay the everyday, the quotidian, the mundane. Which brings us back to the irony that animates Bataille's thought: that the best way to become attuned with the vast convulsions of the cosmos is by commending ourselves to 'good expenditure' in our most intimate and ordinary relations. As Allan Stoekl (207: 142) riffs off this theme, we might have a better chance of prising the planet out its current ecological predicament accidentally, not as the goal of a grand, visionary project but as the unintended consequence of more joyous and generous living right here and now.

Notwithstanding the risk of romanticisation, it still feels like most of the bodies sitting down to deliberate over global climate have more in common with the anxious rigidity of Gilmore's white settlers than with the grace and ease of the Wiradjuri. Looking at prevalent responses to the environmental crisis, we seem to be holding tight to a 'physico-political anatomy' that seeks to conserve and augment power by channelling it through closed circuits (Foucault, 1991), rather than expending our energies in brazen acts of generosity and creativity. If the abrupt climate change thesis has a lesson, its surely as much about the way that extreme conditions condemn us and other creatures to experimentation and improvisation - as it is about the need for precaution and self-restraint. We need more than new curfews. As Diprose puts it, 'If we do not lighten up, remain open to change, and become flexible we will perish' (2002: 62). So too should we remember that loosening up and going with the flow is itself likely to be a long and costly adventure, at least as dependent on innumerable daily acts of endurance, compassion and making-do as it is on moments of high drama or breakthrough.

And we might also heed the Wiradjuri's warning that under conditions of inherent uncertainty, an over-zealous response to a conflagration can be as deadly as the fire itself (cf Bauman, 1992).

References

- Adam, B. (1993) 'Time and Environmental Crisis: An Exploration with Special Reference to Pollution', *Innovation in Social Science Research* 6 (3) 399-413.
- Alley, R. B. (2000) *The Two-Mile Time Machine: Ice Cores, Abrupt Climate Change, and Our Future*. Princeton: Princeton University Press.
- Alley, R. B., Marotzke, J., Nordhaus, W. D., Overpeck, J. T., Peteet, D. M. Pielke, R. A., Pierrehumbert, R. T., Rhines, P. B., Stocker, T.F., Talley, L. D., and Wallace, J. M. (2003) 'Abrupt Climate Change'. *Science* 299 (28 March) 2005-10.
- Bachelard, G. (1987, 1st 1938) *The Psychoanalysis of Fire*. London: Quartet.
- Badiou, A. (2005) *Infinite Thought: Truth and the Return to Philosophy*. London: Continuum.
- Barad, K. (2007) *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Durham and London: Duke University Press.
- Bataille, G. (1988) *Inner Experience*. New York. State University of New York Press.
- Bataille, G. (1991) *The Accursed Share: Volume I*. New York. Zone.
- Bataille, G. (1993) *The Accursed Share: Volumes II & III*. New York. Zone.
- Bauman, Z. (1992) 'The Solution as Problem', *The Times Higher Education Supplement*, 1045 (13 November) 25.
- Beck, U. (1995) *Ecological Politics in an Age of Risk*. Polity Press, Cambridge.
- Berlant, L. (2008) 'Thinking about Feeling Historical'. *Emotion, Space and Society* 1(1) 4-9.
- Black, M. P. and Mooney, S. D. (2007) 'The Response of Aboriginal Burning Practices to Population Levels and El Niño-Southern Oscillation Events during the Mid- to Late-Holocene: a Case Study from the Sydney Basin using Charcoal and Pollen Analysis'. *Australian Geographer* 38 (1) 37-52.
- Blanchot, M. (1995) *The Writing of the Disaster*. Lincoln and London: University of Nebraska Press.
- Brassier, R. (2007) *Nihil Unbound: Enlightenment and Extinction*. Houndmills, Basingstoke: Palgrave Macmillan.
- Broecker, W. S. (1987) 'Unpleasant Surprises in the Greenhouse', *Nature* 328 (9 July) 123-6.
- Burroughs, W. J (2001) *Climate Change: A Multidisciplinary Approach*. Cambridge: Cambridge University Press.

- Burroughs, W. J (2005) *Climate Change in Prehistory: the end of the reign of chaos*. Cambridge: Cambridge University Press.
- Butler, J. (2004) *Precarious Life: The Powers of Mourning and Violence*. London: Verso.
- Calvin, W. H. (2002) *A Brain for all Seasons: Human Evolution and Abrupt Climate Change*. Chicago: University of Chicago Press.
- Caputo, J. (1993) *Against Ethics*. Bloomington and Indianapolis: Indiana University Press.
- Caviedes, C. N. (2001) *El Niño in History: Storming through the Ages*. Gainesville, FL: University Press of Florida.
- Chalier, C. (2002) *What Ought I to Do? Morality in Kant and Levinas*. Cornell University Press, London.
- Clark, N. (2005) 'Ex-orbitant Globality', *Theory, Culture & Society* 22 (5) 165-185.
- Clark, N. (2007) 'Living through the Tsunami: Vulnerability and Generosity on a Volatile Earth' *Geoforum* 38: 1127–1139.
- Committee on Abrupt Climate Change, National Research Council (2002) *Abrupt Climate Change: Inevitable Surprises*. URL (consulted March 2008) http://www.nap.edu/catalog.php?record_id=10136
- Cruikshank, J. (2005) *Do Glaciers Listen? Local Knowledge, Colonial Encounters and Social Imagination*. Vancouver: University of British Columbia Press
- Crutzen, P. J. (2002) 'Geology of Mankind' *Nature* 415 (6867) January 3: 23.
- Davis, M. (1998) *Ecology of Fear: Los Angeles and the Imagination of Disaster*. New York: Metropolitan Books.
- Deffeyes, K. S. (2005) *Beyond Oil: The View from Hubbert's Peak*. New York: Hill and Wang.
- Demeritt, D. (2001) 'The Construction of Global Warming and the Politics of Science', *Annals of the Association of American Geographers*, 91 (2) 307-337.
- Derrida, J. (1978) *Writing and Difference*. Routledge, London.
- Derrida, J. (1992) 'Force of Law: The "Mystical Foundation of Authority"', pp 3-67 in D. Cornell., M. Rosenfeld., and D. G. Carlson (eds) *Deconstruction and the Possibility of Justice*. New York and London: Routledge.
- Diprose, R., (2002) *Corporeal Generosity: On giving with Nietzsche, Merleau-Ponty, and Levinas*. Albany, NY.: State University of New York Press.
- Dobson, A. (1998) *Justice and the Environment: Conceptions of Environmental Sustainability and Dimensions of Social Justice*. Oxford: Oxford University Press.
- Fagan, B. (2004) *The Long Summer: How Climate Changed Civilization*. London: Granta.
- Foucault, M. (1987) 'Maurice Blanchot: The Thought from Outside' in Blanchot, M. and Foucault, M., *Foucault/Blanchot*. New York: Zone.

- Foucault, M. (1991) *Discipline and Punish: The Birth of the Prison*. London: Penguin.
- Funtowicz, S. and Ravetz, J. R. (1994) 'Emergent Complex Systems', *Futures* 26 (6) 568-582.
- Gilmore, M. (1934) *Old Days: Old Ways, A Book of Recollections*. Sydney: Angus and Robertson.
- Glover, J. (2007) 'The Lucky Country?' *The Guardian* November 23, 2007. URL (consulted May 2008) <http://www.guardian.co.uk/environment/2007/nov/23/climatechange.australia?gusrc=rss&feed=12>
- Hallam, S. J. (1979) *Fire and hearth: a Study of Aboriginal Usage and European Usurpation in South-Western Australia*. Australian Institute of Aboriginal Studies: Canberra.
- Harman, G. (2009 forthcoming) *Prince of Networks: Bruno Latour and Metaphysics*.
- Harrison P. (2008) 'Corporeal remains: Vulnerability, Proximity, and Living on after the End of the World', *Environment and Planning A* 40(2) 423 – 445.
- Hayward, A.M., Dowsett, H. J., Valdes, P. J., Lunt, D. J., Francis, J. E., and Sellwood, B. W. (2009) 'Introduction: Pliocene Climate, Processes and Problems'. *Philosophical Transactions of the Royal Society A* 367: 3-17.
- Hinchliffe, S. (2007) *Geographies of Nature: Societies, Environments, Ecologies*. London: Sage.
- Latour, B (1988) *The Pasteurization of France*. Cambridge, MA: Harvard University Press.
- Latour, B. (1993) *We Have Never Been Modern*. Cambridge, MA: Harvard University Press.
- Latour, B. (2004) *Politics of Nature: How to Bring the Sciences into Democracy*. Cambridge, MA: Harvard University Press.
- Latour, B. (2003) 'Atmosphère, Atmosphère', pp 29-41 in May, S. (ed) *Olafur Eliasson: The Weather Project*. London: Tate Publishing.
- Lenton, T. M., Held, H., Kriegler, E., Hall, J. W., Lucht, W., Rahmstorf, S., and Schellnhuber, H. J. (2008) 'Tipping Elements in the Earth's Climate System', *Proceedings of the National Academy of Sciences USA* 105(6), 1786–1793.
- Lester, B. (2006) 'Australia's Drought May Stay for Keeps', *Cosmos Online*. URL (consulted May 2008) <http://www.cosmosmagazine.com/node/927>.
- Levinas, E.(1969) *Totality and Infinity*. Pittsburgh, PA.: Duquesne University Press.
- Lingis, A. (2000) *Dangerous Emotions*. Berkeley, CA.: University of California Press.
- Lovelock, J. (2006). *The Revenge of Gaia*. London, Penguin.
- Liotard, J-F. (1988) *The Differend: Phrases in Dispute*. Manchester: Manchester University Press.

- McGuire, B. (2006) 'Earth, Fire and Fury'. *New Scientist*. 27 May, 190 (2553): 32-36.
- Main, G. (2004) 'Red Steers and White Death: Fearing Nature in Rural Australia'. *Australian Humanities Review*. 33, August -October. URL (consulted June 2008) <http://www.lib.latrobe.edu.au/AHR/archive/Issue-August-2004/main.html>
- Massey, D. (2005) 'Negotiating Nonhuman/Human Place', *Antipode* 37 (2) pp.353-357.
- Meyer, A. (2000) *Contraction and Convergence. The Global Solution to Climate Change*. Devon: Green Books.
- Pearce, F. (2006) *The Last Generation: How Nature will take her Revenge for Climate Change*. London: Eden Project books.
- Purdue University (2006) 'North Pole's Ancient Past Holds Clues about Future Global Warming' *Physorg.com* May 31st. URL (consulted February 2009) <http://www.physorg.com/news68305951.html>
- Pyne, S. J. (1991) *Burning Bush: A Fire History of Australia*. New York: Henry Holt.
- Pyne, S. J. (1997) *Vestal Fire*. Seattle and London: University of Washington Press.
- Pyne, S. J. (2001) *Fire: A Brief History*. Seattle and London: University of Washington Press.
- Pyne, S. J. (2007) *World Fire: The Culture of Fire on Earth*. Seattle and London: University of Washington Press.
- Scheffer, M., Carpenter, S., Foley J A., Folkes, C., and Walker, B. (2001) 'Catastrophic Shifts in Ecosystems', *Nature* 413 (11 October) 591-6.
- Thrift, N. (2008) *Non-Representational Theory: Space/Politics/Affect*. London and New York: Routledge.
- Turner, B. S. (2006) *Vulnerability and Human Rights*. University Park, PA., University of Pennsylvania Press.
- Urry, J. (2005) 'The Complexity Turn'. *Theory, Culture & Society* 22 (5) 1-14.
- Spivak, G.C.(1999) *A Critique of Postcolonial Reason: Toward a History of the Vanishing Present*. Cambridge, MA.: Harvard University Press.
- Stengers, I. (2000) *The Invention of Modern Science*. Minneapolis: University of Minnesota Press.
- Stoekl, A. (2007) *Bataille's Peak: Energy, Religion, and Postsustainability*. Minneapolis: University of Minnesota Press.
- Van Loon, J. (2005) 'Epidemic Space', *Critical Public Health*, 15 (1) 39-52.
- Vaughan, G. (2002) 'Mothering, Co-muni-cation, and the Gifts of Language' pp 91-113 in E. Wyschogrod, J-J Goux and E Boynton (eds) *The Enigma of Gift and Sacrifice*. New York: Fordham University Press.
- Wyschogrod, E. (1998) *An Ethics of Remembering: History, Heterology, and the Nameless Others*. Chicago: University of Chicago Press.

Zillman, J. W. (2005) 'Uncertainty in the Science of Climate Change' pp 3-26 in Zillman, J.W., McKibben, W. J. and Kellow, A (eds) *Climate Change: The Challenge for Policy*. Canberra: Academy of the Social Sciences in Australia.

¹ I am indebted to George Main's superb 'Red Steers and White Death' (2004) for pointing me to Gilmore's writings.

² Settler term for Aboriginal women, now considered offensive.

³ This resonates with Zygmunt Bauman's observation, in reference to Ulrich Beck's risk society thesis, that 'Catastrophes most horrid are born – or likely to be born – out of the war against catastrophes' (1992: 25).

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