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Extinction

edited by Claire Colebrook

Introduction: Extinction. Framing the End of the Species

Introduction

Scientific events have their own consistency and it is often a mistake for humanities scholars to reduce such complexities to 'worldviews' or the history of ideas. To pass from quantum uncertainty to postmodern literary styles reduces the disciplinary specificity of scientific discovery and functions, and risks presenting literature and culture as reflections or contexts for scientific facts. Yet it is also the case that certain scientific events do not occur as facts within history but rather open up a new experience and possibility of history, and a new way in which the very relation between history and science might be considered. When Darwin posited that the human species had a beginning within the history of life, this was not only a fact about 'our' history; it also opened up formal problems for the imagination: how could our understanding of the human and the humanities proceed with a sense of the processes of life beyond human time? History is no longer a human narrative, and human narratives themselves

seem to incorporate forces that are no longer human – from Thomas Hardy's cosmic irony to modernism's sense of atavism and the genesis of human life from hearts of darkness. Genuine scientific events provide a richness for aesthetic practice (especially if we consider how the possibility of a world without humans has opened up new genres of post-apocalyptic film and literature, and if we note Victorian poetry's capacity to approach something like sound itself that would intone beyond human meaning). But events are two-sided and allow as much for humanizing re-inscription as they do for disturbances of our already-ordered modes of comprehension.

The concept of evolution and the temporality it brings in train opens new horizons for knowledge – not just new facts but also ways of approaching the world of facts. If evolution is a concept, it is so in Deleuze and Guattari's sense: it is both a function (or a way of thinking about processes of the world from an inhuman point of view) and a concept that reorients the entire terrain of thinking, requiring us to have new figures of the human, new figures of life, new relations among life and perception, and even new understandings of what would count as thinking (Deleuze and Guattari, 1994). The conceptual possibilities of evolution are dampened if they are folded around the human point of view. If we see life as functional, oriented towards our types of complexity and order, and inevitably leading towards the types of complexity exemplified by humans, then we miss the decentering randomness and rogue

temporalities of evolutionary processes. It is perhaps too easy to look back on social Darwinism and think that we are now so much more sophisticated in our assimilation of Darwinian time into human time. But I would suggest that this is not so, and that the uses of Darwin today – especially in what has come to be known as 'literary Darwinism' – actually have the effect of reducing the force not only of Darwinism but of another temporal event, extinction: not only have we humanized the emergence of humans from deep time (by regarding evolution as being oriented towards adaptation), but we have also domesticated the sense of the human end. I would refer to this as a reaction formation: precisely as the multiple threats to our species intensify, we affirm various modes of 'post-humanism' that deny the specific scars human beings have inscribed on the planet (as though we could simply abandon the destructiveness of our species and become one with a connected, ecological and creative world). Maturana and Varela's theories of embodied cognition are gaining increasing currency, positing that there is no such thing as mind that is not already embodied and emergent from the world (even though all the evidence of anthropogenic destructions suggests that we have successfully closed ourselves off from all sense of connectedness. Perhaps the most astounding modes of this reaction take the form of seeming incorporations of Darwinism: cognitive archaeology, to name but one example, will assert that human formations as abstract as modernist art have their origin in the organism's functional capacity to organize perceptions for the sake of survival. The

essays on extinction in this volume – essays that evidence an increasingly destructive, world-disturbing and distinctly human force, along with a complexity that precludes any simple narrative or single causality – suggest that however the human species has evolved, there can be no question that function, survival and fitness tell only part of the story of life processes. Claims such as the following are typical of what has come to be known as 'literary Darwinism':

> To qualify as Darwinist, a reading would have to bring all its particular observations into line with basic evolutionary principles: survival, re-production, kinship (inclusive fitness), basic social dynamics, and the reproductive cycle that gives shape to human life and organizes the most intimate relations of family. While retaining a sense of the constraining force of underlying biological realities, literary Darwinism would also have to emulate the chief merit of Foucauldian cultural critique—its understanding that the forms of cultural representation are highly variable, that these variations subserve social and political interests, and that every variation has its own specific imaginative quality. (Carroll, 2010: 59)

Never mind that Darwinism would require a commitment to forces of random mutation that would not necessarily lead to 'survival, re- production, kinship (inclusive fitness), basic social dynamics, and the reproductive cycle that gives shape to human life and organizes the most intimate relations of family'; never mind that science after Darwin has

emphasized processes that go beyond human survival, the family and the organism (including molecular evolution and sexual selection); and never mind that Foucault's entire oeuvre was critical of interests as the focus of politics (precisely because of discursive and material forces that could not be reduced to intent or surviving life). What requires response in this summation of what 'qualifies' as Darwinism is this seeming concession of science to the unique nature of 'imaginative quality.' It is as though science provides function and interests, while literary form then breaths life into these purposed by bestowing some special aesthetic sheen. Science yields facts while the humanities trade in the effects and packaging of those facts: what this approach does not allow is any sense of positive feedback. Perhaps more complex narrative modes and understandings of temporality allow for different modes of inquiry, and perhaps scientific inquiry of those broader temporalities opens new structures of literary form that cannot be reduced to 'imaginative quality.' The humanities have increasingly responded to Darwinian evolution in a humanizing manner that has reached crisis point today: either it was deemed that the creativity of human life yielded a specific and irreducible wonder of cultural evolution – so that some exception might be made for humans within life – or, as is more common today, evolution is used as a figure to explain morality, politics, language, art and technology, all as conducive to the furtherance of the human organism. And yet other signs exist, beyond all the domesticating uses of Darwin, of deep formal

ruptures, of which Darwinism was but one expression.

Not only did imaginative horizons and forms transform to include deeper times and histories beyond those of human agency, so that it became possible to see language, culture and history as possessing a force beyond purpose and intent; new styles of question were posed. Darwin's vision of human emergence was not a fact absorbed by human time but opened a new figure of time. On the one hand Darwinism enabled science to expand a theological humanism – with life now becoming a wondrous panorama generating complexity and grandeur beyond the limits of 'man'; on the other hand, a new mode of viewing life and time was required that would no longer privilege the contingent point of view of the human (Indeed, as Nick Bostrom's work (following Carter and Leslie) on the 'doomsday' version of the anthropic principle indicates, a calculation of the probability of any single human point of view would suggest that if there is a species with a distinct temporal phase then I must conclude that it is more likely that I would exist at the point of that phase when humans are the most numerous (Bostrom 2001).) It follows then that for any calculating human observer the chances are that I exist at the end of time and that it is illogical to assume that life will necessarily extend beyond me, infinitely in grand panorama of creation, if any individual point of view is, statistically, more probably located at the end of time (when there would be the greatest number of humans). The same

anthropic principle that would lead me to conclude, statistically, that I am placed at the final point of history when humans are most numerous has another, positive, articulation. Given that I exist in a complex universe of living forms with human evolution, cultural and technological development continuing and proliferating, does it make sense to assume that complex life is highly improbable or do I imagine so many possible and different worlds that ultimately my complex existence would be close to inevitable? Statistically, from my own point of view and focusing on probability, the same anthropic reasoning that would make it rational to expect that I'm in the last phases of human evolution would also prompt me to infer that human life cannot be that improbable, given that it actually exists, and so it's more likely that there are very many worlds that would, eventually, have produced something like complex life. What such anthropic reasoning suggests is that the human point of view, at least statistically, is at once always oriented towards doomsday and always more likely to be located in a vast panorama of possibilities, of which its own actuality would be but one form. In terms of evolution, we can move from the calculation of probabilities from the human point of view to the inhuman point of view of deep time: here, too, the existence of the human species in time appears as fleeting, exceptional and as a fragment of an inhuman spectrum of possibilities.

The concept or figure of evolution has two sides: evolution has been thoroughly humanized, allowing

'man' to see all his technical extensions (from writing to morality) as adaptive extensions of his organic and self-serving life; but a broader view of evolution allows a temporality of extinction in which no life-form can be considered normative, necessary or particularly worthy. This 'double vision' (in which life at once seems to open its temporal horizon for human viewing and yet also extends beyond human comprehension) cannot be isolated as they way in which a certain individual (Darwin) or a certain science pictured the future: with the thought of a time from which the human species emerged, for something altered more generally in the modes and possibilities of knowledge. Just as extinction events occur both as single catastrophes and as pulses (Benton), so thought events occur as shifts in the very relation between thinking and what is thought, and in additional ruptures. Darwinism was a thought event that placed humanity within time, but the pulse of extinction awareness that is coming to the fore in the twenty-first century adds the sense of an ending to the broader awareness of the historical emergence of the human species.

From the nineteenth century onwards novels began to consider human actions as having some space within a deeper time of life of which humans were epiphenomena. Well before Darwin put forward the scientific concept of evolution, Mary Shelley's novels, *Frankenstein* and *The Last Man*, imagined life as a process from which humanity emerged, a life which also might extend beyond humans. Marx also articulated a broader notion of human 'species being'

which could not be reduced to interests or decisions. It is possible to see Darwin as an articulation of a broader shift in which humanity grasps a sense of 'man' as a being who is at once determined by life processes but whose social and cultural being will constitute the modes in which those processes are lived: something like a concept of 'life' as a general force of which 'man' is a specific determination come to the fore. For Michel Foucault the concept of 'life' is not one concept among others, but is intertwined uniquely with a strangely double sense of 'man' and time. 'Man' recognizes himself as an effect of a deep time, which he can only know after the event of cultural, linguistic and social formations. 'Man' generated new modes of knowledge, such as the social sciences in which the human species was deemed to be explicable according to a life that explained 'man's' distinction (language and culture) but grounded that distinguishing history in a more general logic of life. For Foucault, the human sciences such as anthropology, ethnography or linguistics marked a new 'fold' between time and knowledge. Man was not one species among others, but recognized himself as the being who could come to know life's temporality only as it was disclosed through culture and language. Further, there was a shift from morality, or the assertion of what counts as the good, to ethics, encapsulated in the following question: how does one legitimate the law one gives to oneself? There is a split between the scientific knowledge of facts or what is, and what ought to be, or the law humans create for themselves. This distinction relies on the separation of something like

life from the way in which life is formed and rendered meaningful. (Today, with evolutionary science being deployed to explain moral systems, aesthetic values and economic decision-making we can note two distinct moves: first, there is a distinct field of life processes that orient the human organism towards adaptation, and then there are various cultural systems through which this life is expressed. For Foucault, this leads to bio-politics and normalization: for now there is something like life which can act as the ground for other systems. We speak, socialize, paint, sing, educate, and form ourselves in terms of one logic of life.) In the absence of normativity, or the straightforward assertion of a moral system, one is left with normalization; it is now life (and increasingly bio-political life) that orients enquiry. Life provides the ground or locus for moral-political questions. How might we educate, house, socialize, represent, rehabilitate, reproduce or manage humans to maximize life? It is no surprise that sub-disciplines, such as bio-ethics or applied philosophy, have started to create bridges between philosophical questions and policy: for such linkages or 'applications' are required only when something like life appears as a separate object with its specific normality. We can then ask whether it is legitimate to intervene in, enhance, extend or manufacture life.

For Foucault, the discovery of 'life' as a process that could provide the ground for negotiating certain questions regarding man marked the period and temporality that he referred to as modernity. Looking beyond man and modernity, Foucault

suggested that if we could think of the ways in which language operated against organic and historically developing life then we might exit the normalization of man and approach new types of questions. Commenting on this aspect of Foucault's work, Gilles Deleuze argued that 'life' too – as well as language – could be considered beyond the normalizing notions of the organism, especially the organic figure of man. This is especially worth considering today, at a time when there has been a plethora of studies explaining morality, visual art, language, music, literature and even seeming pathologies such as over-spending and over-eating by referring back to some notion of species-serving adaptive evolution. But this possibility of thinking life beyond purposive striving might also give us pause when considering what new knowledge formations the concept of life might require in the twenty-first century.

If, as many humanities scholars have noted, the Darwinian thought of a time beyond humanity – with man as a species existing within an evolving life – required new forms of narrative and different 'folds' between 'man' and the life of which he was an expression, the new sciences of extinction and catastrophe should not simply add information or data to our ways of thinking about human life, but rather should require entirely new forms of discipline and relations among disciplines. Most importantly, the very concept of discipline – as a regular knowledge practice – needs to be brought in line with the increasingly apparent indiscipline of humanity and its tendency towards extinction. Broadly, one

might consider this new relation between disciplines and indiscipline under the broad rubric of climate change. If one starts to research extinction, it is difficult to avoid the problem of climate change. While the human species – and all other species – face other threats of extinction (including nuclear disaster, viral pandemic, global terrorism and systemic collapse), climate change has become the icon of the thorough event of extinction. This is almost certainly because climate change both discloses the non-survival temporalities of human evolution (or all the ways in which we have evolved to shorten the time span of different species, including our own), at the same time as climate change can refer to a whole swathe of intensifying disaster horizons. It is not only the meteorological climate that is changing: global catastrophic risks are being disclosed at a number of levels. Some of these risks have always been present and are becoming discernible; others have intensified, both because of meteorological climate change, but also because political, economic, cultural and epistemological climates have altered. Many of these threats intertwine and are over-determined: an elevation in global temperature may enable diseases to flourish in previously incompatible environments, but infectious diseases also have a greater chance of traveling to new zones given the increased global network of travel (which of course itself adds to increased carbon emissions and further temperature elevations) (Shuman, 2010; Greer, Ng and Fisman, 2008). More significantly still, globalism is not just an economic phenomenon that renders the world

financial system more volatile and conducive to catastrophe, and not just a political problem that intensifies terrorist energies; it is also a new event in the scientific imaginary that is perhaps best thought of by broadening the sense of climate. Climate (derived from the sense of a surface or region of inhabitation, from the Greek *klima*) allows us to grant attention to our milieu. If the nineteenth-century and Darwinism opened up a sense of man as a species within a broader line of inhuman time, then a strange counter-fold has occurred with space: 'man' becomes an animal of a delimited time – now capable of imagining his end – and this because he inhabits a climate that he at once marks geologically and that is a limited and waning resource. To say, as geologists are now doing, that we are having such an effect on the planet that human existence – after extinction -- will be readable in terms of geological scars, is also to say that we must add to man's expansion of temporal point of view that occurred with evolution a spatial contraction that has occurred with climate change and the various extinction scenarios it brings in train.

The 'discovery' of climate change needs to be considered as an epochal event: it does not simply occur within time but, like the Darwinian positing of a time before humans, it also opens up a time after humans and an end-time that humans themselves will be able to witness precisely as they contribute to its acceleration. (We can think of the phenomenological sense of 'epoche' here: if we 'bracket' the world, and view it no longer as ours, no

longer familiar or meaningful, then the world appears as a delimited world from which there would be other possible worlds.) But if Darwinian evolution expanded the horizons of life and the human – allowing us to think of our species as one creative fragment of an ever-creative whole, climate change and the possibilities of extinction it brings in train alter the very notion of a scientific event.

First, today, we are not only reading the past genealogically – asking how, from the present, current conditions of life must have emerged. The possibilities of thinking about extinction, rates of extinction, accelerations of extinction and human contributions to extinction demand that our ways of thinking about past extinction events must be applied to the present, at the same time as an unprecedented intensification of anthropogenic destruction must alter our modes and disciplines of calculation of the future. One of the great problems of climate change in its broadest sense is modeling, with our approach to the future being intensive. It is not as though the past gives us a trajectory from which we might read the future as an ongoing extension; just as our use of fossil fuels consumes a past and pollutes a future, so our greater knowledge of the past and the volatility of the planet requires ever more nuanced models for the future. If we want to calculate the rate of human extinction (extinctions caused by humans, as well as the possibility of humans themselves becoming extinct) then factors about human prediction themselves come into play. On the one hand our increasing awareness of

environmental destruction might prompt us to act. On the other hand the very extent of catastrophic possibility and the sorts of knowledge that extend beyond any individual grasp tend to lead to inaction. It is as though what is facing extinction is not only the human species but also a certain mastery or image of the species (the species sense of its mastery and its capacity to master itself): climate change is not only change of the climate but a change in the very way in which we think about climates and rates and modes of change. Extinction is not only extinction of the species but also an extinguishing of the human animal's sense of humanity. Part of predicting rates of extinction requires predicting how humans respond to threats of extinction; part of managing and predicting climate change requires dealing with denial, inertia and an increasingly complex field of knowledge that precludes the very certain and decisive action that the 'situation' demands. There is no discipline of climate change (given the multiple factors) nor, similarly, could there be any such discipline of extinction studies. The new modes of asking questions about life occur in a volatile present where what we are reading and its potentiality for change, and the speeds and modes with which it might change are constantly shifting.

The Darwinian thought of the genesis of life was already a multiple problem, for evolutionary thought has to consider variations of multiple strata of life; an organism does not adapt to its environment, for there is variability from which something like bodies and milieus emerge (Fodor and Piattelli-Palmarini,

2010). This problem of multiple times, scales, strata and causalities is exacerbated by the dawn of extinction awareness. Thinking the end of life takes 'us' beyond any single domain of the life sciences and any straightforward notion of interdisciplinarity. There is a volatility of knowledge, predictions, disciplines and the imagination in which – for example – something like the denial of climate change might be a survival mechanism (allowing us to live here and now, not overly concerned with complexities of a too-distant future); alternatively, the very mechanism of survival – of striving to live on – might push 'us' to a threshold in which the absence of life becomes an imminent and immanent possibility.

Second, the scientific event of extinction and the relation it bears to a broader sense of climate change and species destruction need to be both narrowed and expanded. The broader concept and possibility of extinction – that life's creative mutability also generates the destruction of living forms – can be discerned in both smaller and larger scales. Two concepts seem to mark 'our' current position within history as epochal: first, humans are beginning to imagine the next great extinction event – which is to say that this will be the first time that extinction has been imagined. It is as though the layers of our geological past yield a possibility (of extinction) from which we might regard a future that is not a future for us, and a future in which all the ways in which we have mapped time and history will be absent. For even our current conceptions of deep time – a time

beyond human histories – have emerged from a present reading of our own past. What we now imagine, from this reading of the past, gives us a sign not only of our end within time, but also of the fact that we will ourselves have altered our place in time.

With geologists suggesting that we might be on the brink of a major extinction event, this time caused not by external factors but by one of the earth's own species, it might be time for the humanities and other disciplines to ask the question of extinction, and to take seriously the very notion of the humanities and discipline. In this living book I have collected some of the more readable or assimilable materials about extinction, but a glance at the field shows both that there is no field (because catastrophic scenarios can be envisioned variously according to whether one focuses on carbon, methane, nuclear weapons and even probability theory), and that from various points of view the work of these fields becomes increasingly unreadable. Certainly, if one accepts one of the notions of knowledge and the humanities – that the striving for truth is a mode of adaptiveness – then we would avoid the stark evidence that technoscientific practice has led to extension and destructiveness of life. Rather than celebrating or affirming a post-human world, where man no longer deludes himself with regard to his primacy or distinction, and rather than asserting the joyous truth of ecology where life is finally understood as one vast, self-furthering interconnected organic whole, we should perhaps

take note of the violent distinction of the human. For some time now, humans have been proclaiming their capacity to render themselves figurally extinct. All those claims for man's specialness, for the distinction of reason, for human exceptionalism have given way to claims for unity, mindfulness, the global brain and a general ecology. Alongside the actual threat that humans pose in terms of contributing to an envisaged sixth wave of extinction, we are witnessing a virtual or imagined extinction. Humans have started to imagine that they are no longer really separate from an earth, which they now regard less as an object and more as their adjacent milieu. This is the first positive sense of extinction: it as is though the only way in which 'we' will see life survive is if we remove the traditional concept of (mastering, consuming, dominating) man from the horizon. But this sense of human absence is not only delusional; it is symptomatic and psychotic. Just as all the evidence presents itself that humans are contributing markedly and irrevocably to the planet's destruction they claim that there is nothing unavoidably distinct about human existence. It is imagined that we might overcome our history of distinction and circumvent the inevitability of widespread extinction.

Nowhere is this symptom of reaction formation more evident than in the discourse of post-humanism: precisely when man ought to be a formidable presence, precisely when we should be confronting the fact that the human species is exceptional in its distinguishing power, we affirm that there is one

single, interconnected, life-affirming ecological totality. After centuries of a supposed 'humanism,' in which 'man' was deemed to have no essence other than the form that life he gave to himself, and in which man (like God) was nothing other than his pure existence, liberated from any determining essence, there seems to have been a strange double shift. On the one hand man extinguishes himself: it is declared that there really is no such thing as man, that the notion of human exceptionalism was a lie and that in truth there is one life in which all the features that had once marked the human – knowledge, emotion, linguistic capacity, altruism, mind and community – are in fact present in all life. Man is declared to be dead, to be nothing more than life itself. And life is deemed to be mindful, creative and self-organizing (Varela, Thompson and Rosch, 1991;Thompson, 2007). Cartesian man (the subject detached from the world who pictures and masters a world of dead matter) is diagnosed as the error of modernity from which life now saves us (Damasio, 1994; Flanagan, 2007). On the other hand, and at the same time, there is widespread evidence of the truth of Cartesianism, a truth that is intoned everywhere and yet never heard, witnessed but not recognized. In addition to anthropogenic climate change, and the proposal by geologists to mark a new era of the Anthropocene that would be readable in the earth's layers from a post-human future, the intensity of the human extinction drive goes well beyond climactic (or distributed conditions). Localized volatilities such as viral pandemic (exacerbated by technological speeds), rogue nuclear powers, short-term resource

catastrophes (oil spills and radioactive leaks), and the systemic paralysis that would preclude dealing effectively with any of these potential disasters also present extinction threats. It is now a commonplace to note that as evidence for anthropogenic climate change becomes more convincing, fewer and fewer humans allow themselves to be convinced; and we might add to this that the more numerous and intense the extinction threats appear to be, the more shrill becomes the cry that we have now become benevolently post-human. As the imminence of extinction looms large we shift into a myopic immanence, declaring the there is no life or world other than the one we know and give to ourselves. The presence of local threats – such as the 2008 economic collapse – far from awaking us from our suicidal slumbers pushes us away from geological and extra-human truths and draws us into dealing with economic timelines: we start to refer to short-cycle narrative terms such as recession or even 'double-dip' recession, both of which were likened to earlier events of the century (the present supposedly being possibly as serious as the great depression, which we have survived and which provides a somewhat calming precedent). The positive sense of extinction – the hailing of Cartesian man as dead and buried – is accompanied by a near psychotic foreclosure of the genuinely destructive sense of extinction. That destructive sense can be repressed or negated by being viewed extensively – that at 'some' point in the future 'we' and what we know will be extinct, as with all things that come into being and pass away. That extensive temporality, whereby

the future will be a vague continuation or waning of present life feeds directly into the ways in which humans think about their own extinction (both the extinctions they inflict and the extinction that will befall them). In terms of endangered or threatened species we imagine acting somewhat less destructively, using a little less, damaging without quite so much force in order to save, for now, what 'we' have left. We speak about mitigation, adaptation, survival, cap and trade, and set targets that would require gradually moving towards less damage, as though the arrow of time were indeed an arrow (moving in one line), and as if this arrow's trajectory might be slowed, if not reversed.

However, another destructive sense of extinction can be opened up from the point of view of intensive time: the future does not present itself in degrees, in terms of a certain end that is sooner or later, that can be sped up or delayed by using more or less. Nor is there a quantity – using less or emitting less – that might allow 'us' to calculate the rate of extinction (whether that be extinction of ourselves, our current mode of life or other lives). Rather, intensive time alters the very mode and speeds of temporality with each of its vectors: consider, again, the 2008 economic crises. These were not events that occurred within time, that we could view and calculate. Instead, our witnessing of temporal volatility – enhanced by multiple forms of media coverage and devices (such as smartphone displays of rising and crashing stocks) – intensified temporal volatility. The more the markets crashed, the more the markets

crash; the more we are aware of the markets crashing, the more the markets crash, and the less capable we are of witnessing the very 'events' that our viewing and monitoring intensify. With those economic complexities rendering all other forms of action volatile – for we now know that one mode of terrorism would be to sabotage management and financial systems, and we know that economic crises put other 'broader' issues on hold. Panic becomes not so much a localized and avoidable occurrence, but a new mode of experience and time that feeds directly into the highly multiple nature of extinction. We are witnessing ever greater threats to our species and other forms of life, but the proximity of what we are witnessing not only precludes us from acting on the threat of extinction; it also renders certain supposedly human powers extinct.

The Anthropocene

Will Steffen
: The Anthropocene, Global Change and Sleeping Giants: Where on Earth Are We Going?

Jan Zalasiewicz *et al*.
: Are We Now Living in the Anthropocene?

Jan Zalasiewicz *et al*.
: Stratigraphy of the Anthropocene

Jan Zalasiewicz, Mark Williams and Will Steffen
: The New World of the Anthropocene

Even though environmental efforts to check carbon emissions have been central to pressures exerted on policy makers, and even though carbon is only one

among many complex factors – with the focus on carbon perhaps allowing for other life-threatening factors to intensify unabated – carbon itself cannot be reckoned as an extensive quantity. It is not simply the case that increased carbon emissions will add, incrementally, to some overall warming of the planet. Rather, even carbon as an isolated factor operates intensively: each increase of emission alters the very way in which emissions change the environment. That is to say, what counts as the environment, or the specific system of exchanges that constitutes 'our' milieu, is itself altering. We cannot, then, simply come up with a number that would be the ideal point at which carbon emissions would be capped, nor calculate the temperature elevation that would be the limit beyond which environmental management would be achievable. As Will Steffen demonstrates, the emission of carbon will have complex and non-linear intensive effects: if there is an elevation in temperature then this will have an effect on soil respiration and lead to the release of more carbon; further, carbon emissions are perhaps better understood not so much as steady incremental rises than as 'pulses', with increased temperatures increasing the incidence of wildfires and pest outbreaks, damaging ecosystems and destroying their capacity to act as sinks for atmospheric CO2. Nor is carbon a simple evil or harm to the environment; black carbon that is stored in soils acts as a sink for emissions, but temperature rises will lead to melting permafrosts and the loss of peatlands, resulting in the release of CO2 and CH4. Carbon is not an isolated element but a cyclic quality

that acts in relation to other quantities, producing specific relations.

Disturbance in temperature is but one outcome of increased carbon emissions, but once temperature is disturbed, or once ocean acidity rises because of the formation of carbonic acid, then oceans also lose their capacity to act as sinks. Considering just one element – carbon – in this cyclic and intensive manner increases the justification for thinking of our era as a geological epoch. For it is not simply the case that 'man' will exist as one species among others, having his day in his environment, perhaps destroying a few species along the way. Man will not only become extinct and cause species extinctions, his mode of species existence will also have environmental and geological effects. Carbon emissions, to name just one factor, do not simply damage or deplete ecosystems; they alter the temporality, volatility and relations of ecosystems – so much so that it makes sense to think of something like the Anthropocene era as a geological phenomenon.

Time and Discipline

K. J. Willis
: How Can a Knowledge of the Past Help to Conserve the Future? Biodiversity Conservation and the Relevance of Long-term Ecological Studies

Valentí Rull
: Ecology and Palaeoecology: Two Approaches, One Objective

There is no shortage of climate change research networks and centres, and very little doubt that the problems faced by the human species and its relation to the future require complex interdisciplinary thinking. But is it the case that the future (and our species' already grave impact on its own sustainability) can really be approached by connecting or joining disciplines? Do we not have to question the very mode and limit of discipline? A discipline is at once enabling – we can only have manageable knowledge practices by focusing on a field with certain methods and conventions – but those very enabling procedures will also limit what and how we know. Nowhere is this more evident than in the relation the human animal bears to imagining its own future. Most of the disciplines that make up climate change science take place within human time frames of reference, with one of the key temporal markers for modeling and decision making being the threshold of the industrial revolution. Because this is the point in our brief history when impact became significant and measurable, it makes sense that we would chart alterations from that historical point and model the future according to rates of change from the industrial revolution onwards. But this raises several problems that can be brought to light, both by considering inhuman time frames (in order to assess how we might think of acting in the wake of humans) and inhuman modes of life, especially bacterial life which, as Stephen Jay Gould and others have demonstrated, should lead us to downgrade the centrality we grant

to humans and mammals in our 'iconography of life'.

Climate change disciplines are predominantly oriented both to human dimensions of time, precisely because anthropology, economics, politics and sociology are social or human sciences, and to human notions of scale, because both social and hard sciences have to work with policy makers, who in turn deal with very short-term future times spans (often of election cycles) and alarmingly short historical vistas (usually fifty years). According to the case made for considering the paleo-ecological record, an understanding of deep time reconfigures the way in which we approach the temporality and risks of the present, especially species extinction. We can begin by comparing current rates of species extinctions with previous (non-anthropogenic) mass extinctions, and add weight not only to the notion that we are experiencing a sixth mass extinction event, but also to the notion of this current extinction wave as being an aspect of the Anthropocene epoch, where after man's non-existence he will have left a signature that will be discernible in the fossil record. But a consideration of broader time frames illuminates not just that there are extinction events, but just what extinctions are imminent. A short time frame might lead us to focus on species with small populations, or species that are experiencing natural fluctuations as part of a very long cycle. Fossil records give some sense of natural variability and even information on the natural limits of species' evolutionary life. Real decline that lies outwith a species' natural temporal range would then be cause

for concern and would alter the ways in which the 'red list' of endangered species would be calculated.

Knowledge or conjecture regarding 'natural' extinction timelines raises the problem of the human counterfactual: should conservation efforts be geared towards saving species that would have a much longer historical span were humans not in existence, or would awareness of the deep impact humans have already had on ecosystems not oblige us to think of conservation as oriented to a planet that is irreversibly humanized, already tipped into an Anthropocene epoch? Fossil records not only allow us to read timelines of species beyond human existence, they can also indicate that what we tend to think of as natural is already reliant on 'human disturbance.' Some ecosystems have developed as a result of anthropogenic changes, so that conservation cannot simply be a matter of restoring nature to some imaginary pre-industrial origin. Temporal records beyond human history also bring biodiversity decisions into sharper focus; it is not simply a question of saving threatened species, but of placing the numbers of what remains in relation to cycles of disturbance and proliferation. The 'synanthropic history thesis' uses records of previous anthropogenic impact to indicate which species will survive in the Anthropocene future, with it no longer being a question of simply opposing native and exotic species – for what counts as native or natural has already evolved in human-altered systems. What counts as a species; what counts as a species' natural range, and is 'natural' to be defined according to Holocene, pre-

human or Anthropocene times and strata? Paleo-ecological records not only enable a more nuanced approach to the present; they can render future modeling exercises more precise by examining how the planet and its species have responded to previous epochs of (non-anthropogenic) climate change. Further, if it is the case that policy decisions will need to think about what species are threatened with extinction, and how such extinctions will impact upon future biodiversity, then running prediction models in reverse, and seeing how accurately they pan out with previous extinction events enables a far more focused sense of future threats. Records from the past can be used to test models, both through backward prediction and running models in reverse. But the broader question posed by paleo-ecological inquiry opens up a new mode of future ethics: what is a species, or a 'natural range'? As we look further into the past we can recognize not only waves of extinction, and the normality of extinction, but also the various ways in which extinction opens a niche for another ecology. Even if we accept that biodiversity is a prima facie good (which might only be possible with some neo-theological commitment to the ongoing proliferation of life), it becomes evident that a species is a temporally finite phenomenon, with a 'natural range' that may be shortened by human disturbance. If ecosystems have evolved with human disturbance then natural range considerations may have to adopt quite different norms of 'nature' (including extinction, disturbance and encroachment.)

Ecosystems and Biodiversity

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Extinction, viewed from a non-anthropocentric perspective, and looking towards a more geological perspective aware of the exceptional and fleeting nature of mammalian life, is neither good nor evil. This is so not only because prior mass extinctions have contributed to 'explosive evolution and diversification of surviving clades' (Jackson), but also because those organisms that will benefit from current extinction phases may, or may not, contribute to new modes of biodiversity. (Biodiversity is also only a good considered from the point of human life, which requires current ecosystem services in order to ensure its own survival, but that – too – is a relative and fleeting value once considered from the point of view of deep time.) If we do accept, however parochially, that ocean biodiversity is a good that we seek to maintain for the sake of our own species, then we are faced with a series of problems that create yet one more instance of what Steven Gardner (2011) has referred to as the 'perfect moral storm'. We have problems of modeling and predictability – just how soon and in what mode

destruction will occur – combined with problems of responsibility (because polluting my coastline now or overfishing now will yield more benefit than ceasing such activities, especially if everyone else continues to allow run-off and depletion to occur), and these problems of knowledge and responsibility are rendered even more difficult through temporal range: as we create more and more damage the sacrifices required by each succeeding generation become more and more significant, and with less and less promise of maintaining a lifestyle that enjoys 'ecosystem services'. The problems with even approaching a management of extinction rates in oceans bring this 'perfect storm' to the fore. First, there is the unclear relation between local perturbations (overfishing and pollution from run-offs) and broader climate changes affecting ocean chemistry; this results in 'different and incongruent temporal and spatial scales.' Added to this are the positive feedback loops, where fishing, the destruction of habitats, introduction of species and eutrophication reinforce each other. Further, in addition to the problems of disseminating the scientific arguments in a world where 'merchants of doubt' manufacture misleading claims about the proof of anthropogenic climate change (Oreskes and Conway, 2010), there is also the problem that data regarding various factors altering the world's oceans is often gathered for commercial purposes rather than for experimental science. It is also unclear, when dealing with extinctions in the oceans and elsewhere, just how many species there are, and how many are threatened with extinction. Extinction is not just a question of loss but also of proliferation.

Eutrophication (or excessive nutrients) has led to an explosion of microbes, altering the trophic scales and destroying relations and systems rather than individual species. Some species will benefit from overfishing, especially as predatory species die away. We cannot know what will emerge in these new ecosystems. Trophic cascades (or the layers of predation) will alter, both from the loss of 'top' predatory species and from the increasing nutrients from run-off altering delicate ecosystems. It is not only coastal areas, suffering from over-fishing and run-off, that will create new systems; the open ocean experiences its own forms of depletion. Oceans are also affected by fishing and dredging. More generally, global warming that increases the surface temperatures of oceans inhibits nutrient-rich waters from rising, creating – in turn – a chronic oceanic El Nino effect. The general process of ocean acidification not only leads to decreased calcification, again altering ecosystems and biodiversity, but may be central to the mechanisms of the anticipated sixth great extinction event.

Mass Extinction

S. A. Wooldridge

Mass Extinctions Past and Present: A Unifying Hypothesis

Extinctions may have many triggers – the striking of the earth by an asteroid, volcanic activity, human disturbance – but one possibility is that various triggers lead to extinction because of one crucial

factor: the enzyme urease. Whatever the trigger for extinctions there may be a unifying 'kill-mechanism', and the anticipated Anthropocene extinction would be no exception. We can define extinction as any reduction of biodiversity. The disappearance of species can be considered part of the 'natural' rhythm of life and evolution, unless there is a reduction of diversity in a geologically insignificant time period. That is, all things are finite and pass away, but what causes a relatively sudden drop in the range and system of species? If we accept the once controversial notion that the end-Cretaceous extinction event was cause by bolide impact (Alvarez, 1980), or entertain other possibilities such as massive volcanic eruptions, these remain 'triggers', but how is it that our planet has gone through five major extinctions, and will anything allow us to think about a sixth? What is the 'kill mechanism'? If the last great extinction was caused by a bolide impact, how did this lead to mass extinction, and would this illuminate anything with regard to the future Anthropocene or sixth extinction? Despite diversity of life processes, urease protein sequences are similar across species. Urease allows organisms to access nitrogen for cell growth; it facilitates the biomineralisation of calcium carbonate by invertebrates and plays crucial roles in the ongoing syntheses of life. If urease is disrupted – by pH disturbance from ocean acidity – then 'dead zones' will result. Various external triggers (such as postulated bolide impacts or volcanic action) can create phocean disturbance, in turn leading to such enzymatic dead zones. Marine extinctions would

result if species were not able to form shells or skeletons because of impeded mineralization. Species that did not rely on biomineralisation would survive; and species that were not so close to the ocean surface would also be likely to survive. It is not only in marine species that urease would explain why some species survive rather than others; if urease is essential for modes of plant production using seeds, then ferns (reproducing via spores) would survive. The fact that amniota – including mammals – do not require urease explains their survival after the last extinction event. Dinosaurs would have suffered because eggs would have had thinner breaking shells as a consequence of disturbed urease, or thicker shells causing suffocation. But the real significance lies in the possibility of the next extinction event: increased CO2 emissions – possibly as early as 2050 – tied to warmer temperatures and ocean ph disturbance would create a collapse of ocean productivity, leading in turn to further warming. A single enzyme, at the smallest of thresholds, tied to the past extinction events and our own mammalian emergence, may well be the 'kill mechanism' of the Anthropocene era.

Comprehending Extinction

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Possible Anthropic Support for a Decaying Universe: A Cosmic Doomsday Argument

In a recent television interview the climate scientist Michael Mann and the climate science journalist David Roberts (from grist.org) were discussing the problem of facing the future of climate change: not only does the science of climate change, at first glance, lack the appeal of straightforward human agonistics, there is also no real temporality (or 'newness') of news: the planet is still warming, sea levels are still rising, deforestation continues and policy remains hopelessly inadequate. Roberts responded to this problem by noting that the revolution required in everyday life in order to face the future ought to be a fascinating and engaging concern. Mann also contributed by suggesting that the window for ongoing survival of the human species did still exist, but that urgent attention was required. How can a topic as significant for the human species have fallen down the list of attractive

media topics? One policy response has been to call for approaches to climate change that render the issues more human, more narrative in style, and even more personal: CRED (Centre for Research on Environmental Decisions) research shows that, in order for climate science information to be fully absorbed by audiences, it must be actively communicated with appropriate language, metaphor, and analogy; combined with narrative storytelling; made vivid through visual imagery and experiential scenarios; balanced with scientific information; and delivered by trusted messengers in group settings.

There is an ethical problem with any such guideline: how do 'we' divide the labor between those who count as scientists with expert information and power of decision, and those who need metaphor and narrative to feel the urgency of issues? Is the threat of the end of the human species sufficiently imminent to warrant an intervention of such a rhetorical nature, where scientific facts are conveyed to those who require 'personal' and affective modes of language? If the human species has shown itself to be both destructive and blind to its own destructiveness, is the addition of 'communication' to scientific warning going to be sufficient? An examination of the scientific literature suggests that what is required is less a unifying, humanizing and narrative approach, and more what Stephen Jay Gould has referred to as a new iconography of life. If one considers life non-anthropocentrically then the emergence of man, and mammalian life in general, would be a minor, contingent and unrepresentative

exception to the majority of life forms, which are more typically bacterial. Rull notes that 'our planet has been devoid of humans for almost its entire existence' and that even if we consider humans to be a success, given their invasive and dominating power, it behooves us to begin to think of life beyond humans.

Given that we do have a parochial interest in the ongoing existence of our species, a broader sense of extinction and life beyond our own extinction would nevertheless serve us well. First, we might transform Michael Mann's (2009) question about what counts as Dangerous Anthropogenic Interference – 'Dangerous For Whom? – to 'Dangerous for What?' We know that different countries and different cultures – and different groups within cultures – experience threats to the species more or less acutely. Asking about varying degrees of urgency opens up the politics of our species and time: the longer we avoid intervention, the harsher the measures will be. But the threat to our own life opens up the question of life more generally, and of how we wish to live whatever time is left for the human species. There is so much more to our species' destructiveness than carbon emissions, and even within carbon emissions there is so much more to assessing damage than simply calculating outputs – given the complex feedback loops. Beyond carbon and methane (Currier, 2011), a consideration of habitat destruction, alien introductions and overexploitation requires that we consider human life within a broader framework of other species' extinction and in

terms of an ecological footprint. Not only has the number of humans on the planet increased sevenfold over the past century and a half, there has been a fifty-fold increase in ecological footprint. Alongside this destructive force is the problem of knowing just what (and how many) species we actually threaten with our existence. To add to Gould's observation that we have parochially focused attention on birds, mammals and amphibians – who attract one third of the efforts of species categorization, while comprising 1% of all known species – we can also note a vast array of threatened, unnoticed, uncategorized life beyond our purview. Our calculation of what species are threatened with extinction is altered by our slanted valuation of what species we ought to approach with taxonomic scrutiny. Our grasp of extinction rates is already anthropocentric. Even if we accept our anthropocentric bias, the extinction of other species is of serious concern – not just because of an aesthetic loss of biodiversity, but also because of quite a calculable and ongoing degradation and depletion of 'ecosystem services.' Indeed, the imminent extinction of species requires, according to May's program for a science of the future, not a rendering human of climate change, but a different mode of economic calculation that would move beyond human production to include ecosystem services. This does not lead to some simple calculation that would then require effective communication and execution, but rather opens genuine questions – akin to those raised by Mann: 'Who is the more virtuous: the average Swede living within the country's sustainable limits or the

average Egyptian with roughly one-fifth the personal EF yet exceeding the country's sustainable capacity by a factor of three?' (May, 2010). This, in turn, raises questions about the way in which we think about climate – for if there is such a thing as the climate then the simple notion of calculating an individual's ecological footprint might be intensive rather than extensive (calculated justly only if the portion of space which one occupies is not measured in the same way as any other portion), and this in turn would create deeper questions about future generations and the space they occupy. If we expand productivity to include non-human agents – so that there might be some GDP equivalent that included all the necessary contributions of ecosystems we are continuing to harm – we might then be able to approach extinction of other species with a sense of life that is at once beyond human myopia, and yet more beneficial in approaching our self-interests for the future.

As we consider different modes of calculation, production and depletion, it is also worth noting a shift in human metabolic economies. According to May, pre-modern hunter-gatherer lifestyles survived by spending 0.1 of a calorie to ingest 1 calorie. Post-1900 humans, by contrast, started spending 1 calorie (though not their own) to get 1 calorie of input, with this increasing to a ratio of 10:1 today (with fossil fuels contributing the surplus). If we accept that human technology and intellectual development is an economy, whereby we invest in extended and delayed procedures for greater yield, we have to acknowledge

an unsustainable parasitism; increasing human autonomy and mastery aligns with increasing human consumption of fuels, just to gain calorific load. (This does not take account of the overconsumption of those increasingly expensive calories.) We are consuming more and spending more energy that is not our own than ever before. May refers to this as 'external energy subsidies' that are required just to maintain the human species; with most of this subsidy load coming from fossil fuels. Noting further problems with energy distribution, such as 13 per cent of the world's population consuming half of the world's energy, May raises a question about adaptation that goes beyond the usual notion of simply how 'we' adapt. His work raises the question of whether there is any 'we' in general, and the additional complexity of the different temporalities of human adaptation: stable societies that can deal efficiently with commands and controls are less likely to be dynamic enough to take on the changes required. The authority required for drastic measures is at odds with the social adaptability that would allow for a new future.

Once we move beyond the parochialism of the human, noting both our destructive economy as a species and our organism-centred approach to other species that precludes us from assessing the future of human existence, we can start to approach the question of life and extinction in more speculative modes. For Gould, attention to natural selection (and a specifically functional notion of 'fit' traits being 'selected for') needs to be tempered with the forces of

extinction: ‘mass extinctions wipe out substantial parts of biotas for reasons unrelated to adaptive struggles of constituent species in "normal" times between such events.’ For Gould, this extinction-attentive point of view opens inquiry onto more chaotic and random processes than those of fitness (including but not reducible to ‘spandrels’ or accidental side-effects that may later appear to be functional), and destroys a residual theologism in figures of evolution: ‘preferential evolution toward complexity,’ he argues, not only is ‘an unlikely phenomenon’ but also evidences ‘a bias inspired by parochial focus on ourselves.’ Indeed, Gould’s ‘new iconography of life’s tree’ would show that maximal diversity was reached early in life’s history, and that today’s world is dominated by fewer basic anatomies. If diversity and longevity are the criteria for life, then bacteria, not humans, are the great successes of this planet’s history. But talk of success is relative and glib, for there is no internal direction for life’s trajectory; humans are both contingent, fleeting, exceptional and at war – if we wish to survive – with life’s broader tendency towards extinction and microbial proliferation. Mass extinctions, however, are not just accelerated versions of ordinary processes of mutation; though frequent, rapid, extensive and different in effect from the coming and going of species through steady evolutionary processes, mass extinctions are genuine events. They indicate the pointless nature of life – utter contingency – from which it is occasionally the ‘weakest’ that survive. Benton refers to ‘disaster taxa’ or those beings that may not have been adapted

at all to the world, but that exploited the new niches available after bolide impacts or volcanic disruptions. Strictly speaking, humans are not disaster taxa; we do require complex ecosystems for our ongoing survival. But the figure of disaster taxa might allow us to imagine a future beyond ourselves and beyond the notion that disaster for us might not be the opening of new ecologies – ecologies that might be imagined from the present in order to transform the time that remains.

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