

Microbes

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On a cell-by-cell basis... you are only 10 percent human. For the rest, you are microbial.¹

In short, all previous biology has been grossly zoomorphic.²

On any possible, reasonable or fair criterion, bacteria are – and always have been – the dominant forms of life on Earth. Our failure to grasp this most evident of biological facts arises in part from the blindness of our arrogance but also, in large measure, as an effect of scale. We are so accustomed to viewing phenomena of our scale – sizes measured in feet and ages in decades – as typical of nature.³

1. The microbial turn

In his wonderful collection of scurrilous short stories, *Sum – Tales of the Afterlife*, the neuroscientist David Eagleman presents a number of scenarios and perspectives that could be called ‘posthumanist’ or ‘post-anthropocentric’ in their intent to play with the established scalar cosmology which places humans between (divine or transcendent) infinity and the infinitesimal or the ‘microbial’. One story in particular, entitled ‘Scales’, spells out the irony of everything being ‘consumed by smaller scales’:

For a while we worried about a separation from God, but our fears were eased when the prophets revealed a new understanding: we are God's organs, His eyes and fingers, the means by which He explores His world. We all felt better about this deep sense of connection – we are a part of God's biology... But it slowly grew clearer that we have less to do with His sensory organs and more to do with His internal organs. The atheists and the theists agreed that it is only through us that He lives. When we abandon him, He dies. We felt honored at first to be the cells that form God's body, but then it became clearer that we are God's cancer... He has finally reached His peace with this and lies quietly in His bed at the convergence of green antiseptic corridors... Then He begins to notice something. While He cannot stop us or hurt us,

there's something that can. He watches us turning to the smaller scales to battle our own leukemias, lymphomas, sarcomas, melanomas. He witnesses His subjects anointing themselves in chemotherapy, basking in the glow of radiation therapy. He watches His humans recklessly chewed up by the trillions of cells that constitute them... And God suddenly bolts up in His bed with a revelation: everything that creates itself upon the backs of smaller scales will by those same scales be consumed.⁴

Eagleman follows up on this 'new biology'⁵, which is also an eschatology, with another story, simply entitled 'Microbe', in which the scales have been reversed in the sense that 'God is the size of a bacterium':

There is no afterlife for us. Our bodies decompose upon death, and then the teeming floods of microbes living inside of us move on to better places. This may lead you to assume that God doesn't exist – but you'd be wrong. It's simply the He doesn't know we exist. He is unaware of us because we're at the wrong spatial scale. God is the size of a bacterium. He is not something outside and above us, but on the surface and in the cells of us. God created life in His own image; His congregations are the microbes. (*Sum 54*)

This thought experiment is topical in the sense that, in recent years, microbes, microorganisms and the 'microbial' in general have received quite a dramatic re-evaluation, as far as their role in the evolution and ecology of life are concerned, and they have all but erased the distinction between human and nonhuman biology. One of the established science textbooks, *Microbiology - An Evolving Science*, stakes out its terrain in cosmological terms:

Life on Earth began early in our planet's history with microscopic organisms, or microbes. Microbial life has since shaped our atmosphere, our geology, and the energy cycles of all ecosystems. A human body contains ten times as many microbes as it does human cells, including numerous tiny bacteria on the skin and in the digestive tract. Throughout history, humans have had a hidden partnership with microbes ranging from food production and preservation to mining for precious metals.⁶

Eagleman's little 'fable' also acknowledges this by stating that: 'The chronic warfare over host territory, the politics of symbiosis and infection, the ascendancy of strains: this is the chessboard of God, where good clashes with evil on the battleground of surface proteins and immunity and resistance. Our presence in this picture is something of an anomaly. Since we – the backgrounds upon which they live – don't harm the life patterns of the microbes, we are unnoticed. We are neither selected out by evolution nor captured in the microdeific radar' (*Sum 54*).

What Eagleman describes here is very much the essence of this 'new (micro)biology' with its focus on symbiosis and (auto)immunity. In doing so, it is both part of the context of the rise of '(micro)biopolitics' and the postanthropocentric critique of evolutionary teleology:

God and His microbial constituents are unaware of the rich social life that we have developed, of our cities, circuses, and wars – they are as unaware of our level of interaction as we are of theirs. Even while we genuflect and pray, it is only the microbes who are in the running for eternal punishment or reward. Our death is unnoteworthy and unobserved by the microbes, who merely redistribute onto different food sources. So although we supposed ourselves to be the apex of evolution, we are merely the nutritional substrate. (*Sum* 54-55)

Human entanglement with the microbial is thus another attack on human or humanist narcissism, hubris and human exceptionalism. Instead it underscores views by many 'feminist materialists' (e.g. Rosi Braidotti, Moira Gatens, Luce Irigaray, Hélène Cixous and Claire Colebrook) who argue for a new understanding of the relationship between humans and their bodies and their nonhuman environment by stressing the 'messiness' of complex materialities (or 'matter-realities') and corporalities (or 'corpo-realities'). The ethico-political aim that many other posthumanisms share with these new materialisms that often emerge from a feminist base with a strong affinity to the materiality of difference is to find more ecologically and socially just forms of inter- and 'intra-action'⁷ by breaking down the idea of a strong autonomy between (human) self and (nonhuman) other and highlighting the co-constitution of the world by 'biological, climatic, economic, and political forces'.⁸ In doing so they also critically inhabit the contemporary extension of global biopolitics into the infinitesimal realm of the microbial.

2. (Micro)biopolitics, critical animal studies and posthumanism

The microbial level of life that inhabits every human and nonhuman as well as their environments forms at once a connection with an 'ancestral' past and a 'posthuman future' of life on this planet. It is therefore no wonder that microbes call up all kinds of biological and symbolic, as well as affective, psychological and 'immunological' reactions. Martin Rees, the eminent astronomer, for example listed the microbial as one of the 'Post-2000 Threats', as well as one of the solutions to our current problems. In his *Our Final Century* he explains that: 'We may not have to wait long before new kinds of synthetic microbes are being genetically engineered... [which could] help solve the world's energy and global warming crisis'.⁹ Taking the (bio)economic implications of this statement further, both Nikolas Rose and Melinda Cooper in their analyses of contemporary 'biopolitical' society refer to the

'microbial' as an essential part of 'biocapital' to be harnessed by the developing 'bioeconomy'.¹⁰ Arguably, the recent focus on biopolitics and bioeconomy is part of a more general reevaluation of our microbial other, from being the arch-enemy of modern medicine to becoming one of the main allies in a posthuman ethics and ecology.

Microbes are, one could say, a true 'pharmakon'¹¹ in that they represent both poison and remedy and thus contain an essential power that will need to be harnessed in a shift towards a postbiological, postevolutionary, technosynthetic bioeconomy that is no longer based on a distinction between organic and inorganic, between artificial and biological forms of life, and in which microbes are understood as maybe the main form of 'biomedia' that constitute the interface between genetics and computing.¹² Harnessing the power of the microbial is thus vital both for current neoliberal biocapitalism and for the resistance to it. This reevaluation of microbial agency thus may become a major force in the promotion of fields like animal studies and posthumanism with their common ambition to construct a postanthropocentric 'multispecies' ethics, politics and ecology. It is in this context that some of the studies by new feminist materialism, posthumanism, and 'biophilosophy', as well as parallel developments within biomedicine and the medical humanities have to be seen.

Re-evaluating the relationship between microbial and human agency, in terms of new feminist materialism (e.g. in the work of Stacy Alaimo, Karen Barad, Donna Haraway, Myra Hird, Vicki Kirby, Jane Bennett and Elisabeth Wilson), might lead to a 'relational ontology' that takes into account the 'continuous process of materializing differences', and which shows that 'humans are not only the result of ongoing material encounters but also that, in our human being, we are not separable from the "environment" or other "animals", including "microbes"'.¹³ An acknowledgement of the interconnectedness between humans, animals, microbes and 'matter' in general is a form of 'worlding', as Denise Kimber Buell puts it: 'thinking in terms of microbes keeps us thinking in terms of being in this world and accountable to it, rather than envisioning an escape from it'.¹⁴ Even though thinking about ourselves as 'chimera at the cellular level'¹⁵ might be somewhat unsettling, it might also lead to a more complex and ecological view of human-nonhuman-environment 'material' entanglement and an end to human exceptionalism.

This means accepting, as illustrated in Eagleman's story, that microbes might be seen as the real 'heroes' of evolution, as the ancestors of nonhuman and human animals and 'the origin of sociable life' in general.¹⁶ Myra Hird begins her project of developing a 'microontology' by quoting from Haraway's *When Species Meet*:

I love the fact that human genomes can be found in only about 10 percent of all the cells that occupy the mundane space I call my body; the other 90 percent of the cells are filled with the

genomes of bacteria, fungi, protists, and such, some of which play in a symphony necessary to my being alive at all, and some of which are hitching a ride and doing the rest of me, of us, no harm. I am vastly outnumbered by my tiny companions; better put, I become an adult human being in company with these tiny messmates. To be one is always to become with many.¹⁷

The companionate multi-species ethical, political and ecological conclusions that Hird draws from this entanglement of genes that gives rise to embodiment (the 'enmeshing of bodies' that is the starting point for new feminist materialisms) is the demand for a 'microontological' shift – or a shift in scale, one could say – in our understanding of the role of bacteria, following the incisive work of Lynn Margulis:

Most organisms are bacteria: they evince the greatest organismal diversity, and have dominated evolutionary history. Bacteria invented all major forms of metabolism, multicellularity, nanotechnology, metallurgy, sensory and locomotive apparatuses (such as the wheel), reproductive strategies and community organization, light detection, alcohol, gas and mineral conversion, hypersex, and death.¹⁸

In this context of 'symbiogenesis' (Margulis) it becomes highly problematic to speak of human (biological) 'identity', or of that of any other species for that matter. This also poses conceptual challenges to a field like animal studies, and, as seen in the list of microbial 'inventions' above, it also thoroughly problematizes any ontological distinctions between technology, biology and nature. The specific challenge that Hird's conclusion poses to critical animal studies is to widen its scale by going beyond its largely zoocentric approach and zooming in on the smallest living species: 'Our all-too-human insistent focus on biota "big like us" obscures the rich diversity of living structures and processes through which the biota, including animals like us, thrive'.¹⁹ This leads her to ask:

How does our current concern with human – animal relations obscure bacterial intra-actions? Eating well²⁰ with bacteria, for instance, complicates animal rights discourse, vegetarianism and veganism. This task is indeed far ahead of us: we must somehow survive humanism, if we are to survive at all.²¹ (Hird, 2010: 38)

Of course, this doesn't invalidate in any way the necessity of continuing to address (and problematize) the very porous boundary between human and nonhuman animals. But it does provide a larger (posthumanist) framework that could help address the humanist residue (i.e. the problematic inversion of anthropocentrism) that underpins some animal studies approaches, which necessarily based on 'advocacy', 'agency' and 'subjectivity'. It is therefore less than 'helpful' to call Hird's microontology 'ethically obscene' or a form of 'intellectual "pornography"',²² or to refer to it as an attempt to 'derail CAS and animal liberation's current focus on the creatures ensnared in the

animal industrial complex (and those ravaged by human hubris in the form of habitat destruction, environmental devastation, and so on) in order to account for the existence and ethical claims of bacteria'.²³ Animal liberation will be a hollow victory (if it really is an achievable goal at all) if it left the humanist notion of subjectivity intact. Hird's move towards a microontological scale (which is not to the exclusion of other, bigger, scales, of course) should therefore not be misunderstood as an extension of 'advocacy', nor does she argue for microbes to be seen as in any way 'ethical subjects' (she is very aware of the harmful aspects of human/nonhuman-microbial entanglement). One should never forget that something like advocacy for something like microbial rights would be a very risky business indeed, as the editors of *Interspecies* explain for example, since bacteria are of course not only 'companionate critters but also, significantly, "incompanionate" pests... in other words, forms of life with which interspecies relating may not be so obvious or comfortable'.²⁴ But it is precisely the 'pharmacological' and 'promethean' ability of bacteria to produce, end and change life that makes them so important both 'to think with' (for posthumanism and animal studies) and 'to instrumentalise and to industrialise' (for biocapitalism). Animal studies and posthumanism ideally should thus be allies in problematizing the notion of 'bodies and their purported organic [or inorganic] boundedness'.²⁵

3. The new biology and symbiosis

Both critical posthumanism and critical animal studies take as their premise that human and nonhuman living entities are companion species to each other in a symbiotic, mutually beneficial relationship that co-produces their world. Lynn Margulis's thesis that symbiogenesis is the key to understanding the evolution of life took a long time to be acknowledged²⁶, but under the conditions of contemporary biopolitics and computerised microbiology her focus on the role of bacteria for the evolution of more complex life forms provides the 'biophilosophical' components that are required for a new imaginary both for a posthumanist ethics as well as biocapitalism. 'Most evolution', Margulis summarises in her late work, 'occurred in those beings we dismiss as "microbial scum"':

All life, we now know, evolved from the smallest life-forms of all, bacteria. We need not welcome this fact. Microbes, especially bacteria, are touted as enemies and denigrated as germs. Microbes, in fact, are any live beings – algae, bacteria, yeast, and so forth – seen more accurately with a microscope than as smudges or scum with the naked eye. My claim is that, like all other apes, humans are not the work of God but of thousands of millions of years of interaction among highly responsive microbes. This view is unsettling to some. To some it is

frightening news from science, a rejectable source of information. I find it fascinating: it spurs me to learn more.²⁷

This evolutionary view that focuses on the microbial and its role in creating and sustaining all life also leads to the notion of the ‘inextricable connectedness of all creatures on the planet, the beings now alive and all the numberless ones that came before’.²⁸ Biophilosophically, any anthropocentrism and humanism can be countered by the fact that ‘for all our elegance and eloquence as a species, for all our massive frontal lobes, for all our music, we have not progressed all that far from our microbial forbears. They are still with us, part of us. Or, put it another way, we are part of them’.²⁹ Most importantly, this insight into the firstness and persistence of microbes takes any teleology out of evolution that might be used to rank complex life forms over less complex ones. As Margulis and Sagan explain: ‘Far from leaving microorganisms behind on an evolutionary “ladder”, we are both surrounded by them and composed of them. Having survived in an unbroken line from the beginnings of life, all organisms today are equally evolved’.³⁰

The other popular view of evolution, namely the idea of the ‘survival of the fittest’, is also challenged and replaced with ‘a new view of continual cooperation, strong interaction, and mutual dependence among life forms. Life did not take over the globe by combat, but by networking. Life forms multiplied and complexified by co-opting others, not just by killing them’.³¹ Symbiogenesis – the ability of prokaryotes (organisms composed of cells without nucleus, i.e. bacteria) to transfer genetic material (i.e. mitochondria) into eukaryotes (all other life forms with cells that have a nucleus) – is a better explanation for evolution as mere mutation. Moreover, this symbiogenetic process is ongoing since: ‘Fully ten percent of our own dry body weight consists of bacteria, some of which, although they are not congenital part of our bodies, we can’t live without’.³² The eco-biophilosophical and ethical conclusion that Margulis and Sagan draw from this new narrative are that of entanglement, cooperation and networking:

We are part of an intricate network that comes from the original bacterial takeover of the earth. Our powers of intelligence and technology do not belong specifically to us but to all life. Since useful attributes are rarely discarded in evolution it is likely that our powers, derived from the microcosm, will endure in the microcosm. Intelligence and technology, incubated by humankind, are really the property of the microcosm. They may well survive our species in forms of the future that lie beyond our limited imaginations.³³

This does not only bring humility to humans as a species – in fact, it problematizes the very category of species;³⁴ but it also has profound consequences for the idea of individuality and (biological, as well as symbolic, cultural etc.) identity.

The 'new biology' based on symbiogenesis inevitably also leads to a new 'medicine' (and to the emergence of new fields of knowledge that integrate developments within the life sciences and the humanities – i.e. the medical humanities (see below)). As Dorion Sagan explains, the 'medical model of the body-as-unity-to-be-preserved... is besieged by the new biology'.³⁵ This 'new biology' sees the body as 'chimerical' in that the 'animal cell is seen to be a hybrid of bacterial species'.³⁶ As a result, 'the body can no longer be seen as single, unitary. It is multiple, even if orchestrated by vicissitudes and the need for harmony over evolutionary time. We are all multiple beings'.³⁷ The ethical and medical consequence of being-multiple is thus far-reaching: 'If the body-brain is not single but the mixed result of multiple bacterial lineages, then health is less a matter of defending a unity than maintaining an ecology'.³⁸

In terms of posthumanism, animal studies and biopolitics, these insights from new biology and the biophilosophy it underpins can be shown in connection with two concepts that are currently at the centre of the discussion within the medical humanities, namely autoimmunity and the microbiome.

4. Microbiome and autoimmunity

The changes that have been underway in the 'new biology' in the last few decades have been described as a 'paradigm shift': 'Animals and plants can no longer be considered individuals, but rather, all are holobionts consisting of the host and diverse symbiotic microorganisms. During the last two decades, numerous studies have demonstrated that these symbionts play a critical role in the physiology of all holobionts including metabolism, behaviour, development, adaptation, and evolution'.³⁹ Recent scientific focus on the 'microbiome' is thus also a sign of the shift away from seeing organisms as autonomous entities and towards understanding human and animal bodies as human-nonhuman-environmental 'ecosystems' or even as some kind of 'social networks'. The resulting 'assemblages' in fact constitute a specific 'biotope' that can be used to identify and understand the specific history of an organism. It even outlasts the death of that organism and raises new biological, ecological and therefore also ethical and political questions about cohabitation, interface and (auto)immunity.

The OED defines 'microbiome' (first used in 1952) as 'a population of microorganisms inhabiting a specific environment; a microbial community of ecosystem, now esp. that of the body'. It goes on to add a second usage: 'The collective genomes of all the microorganisms inhabiting a specific environment, esp. that of the body'. Further 'symptoms' of the outlined revaluation of the microbial and the new focus on the microbiome in science are initiatives like the Human Microbiome Project

(since 2007) – an extension of the Human Genome Project – and the recent foundation of an entire medical journal dedicated to the microbiome. Now in its third year, *Microbiome* recently published an article entitled ‘Being Human is a Gut Feeling’ which summarises the premises of microbiome studies as part of the ‘new biology’ of entanglement:

With respect to most biological research projects, human beings are so well integrated with their microbiomes that the individuality of human beings is better conceived as a symbiotic entity. Insofar as biological research is concerned, to be human is to be multispecies.⁴⁰

The (medical, ethical, ecological, political etc.) conclusions that may be drawn from this symbiotic state is that of a ‘common fate’: ‘being a human biological individual is to be a community of *Homo sapiens* and microbial symbionts whose degree of functional integration (and degree of individuality) is a function of the potential of that community to persist and evolve as a whole’.⁴¹ In terms of evolution and speciation this means that ‘it is the sum of an organism’s genome and microbiome – the hologenome – and the processes they make possible that are linked by a common evolutionary fate (extinction, speciation) and selected together as a whole’.⁴² It is hardly a coincidence that the scientific authors conclude their short commentary by quoting Walt Whitman’s famous ‘proto-ecological’ line ‘I am large, I contain multitudes’ (from his *Song of Myself*).

The fallout of the biological problematization of identity which more or less coincides with decades of similar tenets in cultural theory and philosophy (notably in poststructuralism and postmodernism, and now posthumanism and animal studies) points towards an increasing convergence between certain sectors of science and the humanities of which the ‘medical humanities’ are maybe the most recent and arguably the most important variant. The common denominator here is usually the ethico-ecological implications of a problematized or entangled identity for both humans and non-humans and their environments. ‘Our microbes, ourselves’ thus becomes the slogan for a number of interventions in ‘science news’ and popular science articles.⁴³

The second implication of this shift from biological individuality/identity towards multispecies community is the reassessment of what may be called the ‘immunitarian’ paradigm. Microbiology – in many ways the modern science par excellence – has understood itself as ‘the study of the microorganisms associated with a particular disease, habitat, etc.’ (OED). Its function has been a policing of the porous boundaries of human and animal organisms and bodies, in the identification of pathogens and studying and assisting (auto)immunitarian processes. It is thus both a reflection of and a force within modern biopolitics.⁴⁴ However, the immunitarian or defensive focus is now also receiving many qualifications as a result of the more ‘ecological’ view of life in ‘new biology’ and the ‘posthumanities’ (of which the medial humanities are one branch).

The boundaries of bodies have been redrawn both internally and externally. Human or nonhuman animal cells within any species are vastly outnumbered by 'foreign' cells only that most of these are not foreign at all but have been in symbiosis with that specific species for a long time and have been passed on and evolved with and through generations. The immunitarian fight of modern microbiology-based medicine against bacteria and 'germs' under these circumstances is now seen as much more ambiguous, esp. in the context of the dramatic rise of autoimmunitarian diseases particularly in 'ultra-clean' Western cultures with a high use of antibiotics (and increasing resistance to them). One of the main fears that arises under these circumstances is articulated thus: 'Are we losing the bacteria we have coevolved with? If that is the case, then this is yet further evidence supporting the idea that the loss of good bacteria is partly to blame for the increased rates of autoimmunity that we are now seeing'.⁴⁵

Ecology, so to speak has become a problem not only of the environment but of the body, the 'interior', as such. In 'Your Inner Ecosystem', Jennifer Ackerman refers to the 'balancing act between the microbiome and human immune cells that has taken some 200,000 years to calibrate': 'Over the eons the immune system has evolved numerous checks and balances that generally prevent it from becoming either too aggressive (and attacking its own tissue) or too lax (and failing to recognize dangerous pathogens)'.⁴⁶

Autoimmunity – and the problematisation of the notions of 'self' and 'other' (or nonself) on which it relies – as a consequence has become another shared concern between the 'new biology', cultural theory and the 'posthumanities'.⁴⁷ As Thomas Pradeu explains, the question of 'what makes the identity of a living thing' has always been at the heart of immunology.⁴⁸ The 'uniqueness' and 'individuality' on which the classic definition of self and nonself are based, and which as a result of the 'microbial turn' in the life sciences (and associated turns in the new or posthumanities) are contested by the new symbiogenetic approach. This is particularly visible in the 'politicisation' of the notion of 'contagion':

...the politics of viral [or microbial] containment relentlessly plays upon the contingency of the human 'we'. It conceptually and materially confounds our understanding both of how individuals constitute our collectives and of how we exclude other collectivities that might not belong to them – whether these 'others' are individuals, other populations, other species, or other non-vital entities, such as [microbes].⁴⁹

It should be clear therefore that the microbial view which problematizes biological individuality and species identity is not something that ultimately divides posthumanism from animal studies but instead allows for a common conceptual and ecological framework. This does not, however, invalidate the distinction between human and nonhuman animals and the question of their

relationship to each other but provides the very foundation of a multispecies ethics in the name of which both animal studies and posthumanism find their legitimation.

It is worth recalling once again that the political context in which all of this is happening, is the global biocapitalist politics of life and death. The microbial dimension and our common dependence on it, like a *pharmakon*, acts both as 'poison' and 'cure', while 'contagion' is both the worst nightmare and absolute necessity:

The microbial is not only a terrifying means of death (given its invisible nature) but also a killing of death itself, in the putrid obfuscation of contagion. Contagion becomes neither death nor life but protracted life, a state of never quite being dead – an undeadness not of the living dead but of dead living... Contagion forces life and death into the same generative slime.⁵⁰

5. Medical humanities and *Being Dead*

A good illustration of this 'slimy' contagious state of 'dead living' that provides the substrate for all life on Earth, from single cell to complex human-nonhuman animal and plant life, can be seen in Jim Crace's novel *Being Dead*. The novel's main protagonists are dead almost from the start. The decomposition process of the couple of 'zoologists' who are brutally killed at exactly the place where they began their respective PhDs, doing fieldwork on the seashore, forms the background for the 'quivering' or wake during which the narrator provides flashbacks of their lives. In doing so, the novel also forms what might be called a 'medi-fictional' commentary on the 'great bacterial takeover'⁵¹ after the death of the host organism. As Anna Williams writes in the *New Scientist*: 'Millions want you dead... The cells in your body are outnumbered 10 to one by microbial cells, and like it or not, eventually the microbes will win'. She reports on what scientists have called the 'thanatomicrobiome' – 'the army of gut microbes that take over your internal organs once you are dead... While we are alive, the 100 trillion bacteria resident in our gut work on our behalf. They ease digestion and keep the immune system functioning smoothly, in exchange for a constant supply of food... After we die, however, our gut flora have a party'.⁵²

The novel meticulously, graphically, morbidly but, most importantly, without moralism, follows the evolutionary unravelling of the two corpses as their 'everending days of being dead'⁵³ give rise to new forms of symbiogenesis:

By final light on the ninth day since the murder all traces of any life and love that had been split had disappeared. The natural world had flooded back. The brightness of the universe

returned. If there was any blood left from Joseph and Celice's short stay in the dunes then it could only help to fortify the living murmur of the grass.⁵⁴

How can a posthumanist ethics mindful of our microbial symbiotic eco-ontology turn that which could be seen as a very humanist *memento mori* moment into something more worthwhile? For a 'biophilosophy of the 21st century', Eugene Thacker contends, 'life = multiplicity',⁵⁵ while individual human or nonhuman animal bodies, or indeed, plants, are not (or at least not only – and this is the important qualification) singular subjects but are also irreducibly entangled in their past, present and future environments. Arguably the most influential of these environments might prove to be not the 'cultural' or 'technical', but the microbial one. This has huge implications for everything from medicine to politics and concerns animal studies as much as every other posthumanist venture as well as any current or future formation of the (post)humanities and biosciences.

Tracing the history of human and nonhuman animals' relation to microbes on an interdisciplinary map, locating various instantiations in biology, literature/culture and theory/philosophy, this essay is therefore meant as a contribute to a cosmopolitics⁵⁶ based on the vulnerability and multiplicity of life regardless of species belonging. As a figure of thought, microbes are relevant for posthumanism and critical animal studies in their reconceptualising of subjectivity and what it means to be 'human et al.'. However, this is not to devalue neither our animal nor microbial existence, nor does it imply an uncritical argument for the ontological indistinctness between humans and all other creatures. Our evolution through and symbiogenesis with microbes, who are obviously not only friendly but more often lead to a rather deadly co-habitation, is a historical and social fact that as human beings we need to learn to live with – emotionally, ethically, pragmatically, but above all critically.

Notes:

¹ Olivia Judson, 'Microbes "R" Us', *New York Times* 21 July 2009; available online at http://opinionator.blogs.nytimes.com/2009/07/21/microbes-r-us/?_r=0 (accessed 12/01/2016).

² Dorion Sagan, *Cosmic Apprentice: Dispatches from the Edges of Science* (Minneapolis: University of Minnesota Press, 2013), p.167.

³ Stephen Jay Gould, 'Planet of the Bacteria', *Washington Post Horizon*, 119 (344): H1 (1996); available online at http://stepnejaygould.org/library/gould_bacteria.html (accessed 12/01/2016).

⁴ David Eagleman, *Sum – Tales from the Afterlives* (Edinburgh: Canongate, 2010), pp. 34-5 (further references are given in the text as *Sum*).

⁵ The phrase ‘the new biology’ usually refers to work in theoretical biology that counters the ‘genocentric’ approach prevalent in neo-Darwinian biology, which privileges natural selection and competition as a way to explain the emergence of new life forms. ‘New biologists’, by contrast, tend to look to the molecular level for ‘creative acts’ to take place and which point towards the idea of a ‘symbiotic evolution’ (cf. Manuela Rossini, ‘Bodies’, in: Bruce Clarke and Manuela Rossini, eds., *The Cambridge Companion to Literature and the Posthuman* (Cambridge: Cambridge University Press, forthcoming in 2016).

⁶ Joan Slonczewski and John W. Foster, *Microbiology: An Evolving Science*, 2nd ed. (New York: Norton, 2009), p. 5.

⁷ Karen Barad’s term, see her ‘Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter’, *Signs* 28.3 (2003): 801-31.

⁸ Cf. Stacy Alaimo, *Bodily Natures. Science, Environment, and the Material Self* (Bloomington: Indiana University Press, 2010), 2. For the ethics of such posthumanist ‘corpo-realities’ see also Patricia MacCormack, *Posthuman Ethics: Embodiment and Cultural Theory* (Farnham: Ashgate, 2012).

⁹ Martin Rees, *Our Final Century* (London: Heinemann, 2003), pp. 56-7.

¹⁰ See Nikolas Rose, *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century* (Princeton: Princeton University Press, 2007) and Melinda Cooper, *Life as Surplus: Biotechnology and Capitalism in the Neoliberal Era* (Seattle: University of Washington Press, 2008), as well as Kaushik Sunder Rajan, *Biocapital: The Constitution of Post-Genomic Life* (Durham: Duke University Press, 2006).

¹¹ Jacques Derrida’s term, cf. *Dissemination* (London: Continuum, 2004 [1972]).

¹² Cf. Eugene Thacker, *Biomedica* (Minneapolis: University of Minnesota Press, 2004) and *After Life* (Chicago: University of Chicago Press, 2010).

¹³ Denise Kimber Buell, ‘The Microbes and Pneuma That I Am’, in *Divinanimality: Animal Theory, Creaturely Theology*, ed. Stephen D. Moore (New York: Fordham University Press, 2014), p. 64.

¹⁴ Buell, p. 82.

¹⁵ Buell, p. 85.

¹⁶ Cf. Myra J. Hird, ‘Meeting with the Microcosmos’, *Environment and Planning D*, 28 (2010): 36-39.

¹⁷ Donna Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008), p. 3; quoted in Hird, p. 36.

¹⁸ Hird, pp. 36-7.

¹⁹ Hird, p. 37.

²⁰ A reference to Jacques Derrida’s interview ‘“Eating Well”, Or the Calculation of the Subject’, in *Points... Interviews 1974-1994* (Stanford: Stanford University Press, 1995)pp. 255-87.

²¹ Hird, p. 38.

²² See Zipporah Weisberg, 'The Trouble With Posthumanism: Bacteria Are People Too', *Critical Animals Studies: Thinking the Unthinkable*, ed. John Sorensen (New York: Brown Bear Press, 2014), p. 109.

²³ Cf. Weisberg, p. 109. For a more detailed analysis and commentary on the ideological split between what might be called an 'abolitionist', animal rights and animal liberation approach within (critical) animal studies and a more philosophical theoretical (posthumanist) stance, taking its cue from Derridean deconstruction – as illustrated for example in the online polemic 'What Is Critical Animal Studies' by the Animal Liberation Front: www.animalliberationfront.com/Philosophy/ICAnimalStudies.htm (accessed 12/01/2016) - see Cary Wolfe's *Animal Rites: American Culture, the Discourse of Species, and Posthumanist Theory* (Chicago: University of Chicago Press, 2003) and his *What Is Posthumanism?* (Minneapolis: University of Minnesota Press, 2010, chapter 4). For a discussion of the value of the 'critical' in Critical Animal Studies see also the rationale of Helena Pedersen's book series 'Critical Animal Studies' at: <http://www.brill.com/products/series/critical-animal-studies>. The different politics that are at stake in the split is maybe best articulated by Richie Nimmo: 'Crucially, a genuinely posthumanist politics is never just about seeking to transform human relations with non-human animals, however important this may be; it is always also about seeking ways to simultaneously transform our most fundamental relations with ourselves as human, changing how we see and experience ourselves and our relationship with the world – our mode of existence, our very way of being human' (Nimmo, 'Apiculture in the Anthropocene: Between Posthumanism and Critical Animal Studies', Human Animal Research Network Editorial Collective, eds., *Animals in the Anthropocene: Critical Perspectives on Non-Human Futures* (Sydney: Sydney University Press, 2015), p. 194.

²⁴ See Julie Livingston and Jasbir K. Puar, 'Interspecies', *Social Text* 106, 29.1 (2011), p. 5.

²⁵ Livingston and Puar, p. 4.

²⁶ Cf. Bruce Clarke's 'Introduction: Earth, Life, and System', in his edited collection *Earth, Life, and System: Evolution on a Gaian Planet* (New York: Fordham University Press, 2015), pp. 1-12; as well as Dorion Sagan, *Lynn Margulis: The Life and Legacy of a Scientific Rebel* (White River Junction, VT: Chelsea Green Publishing, 2012).

²⁷ Lynn Margulis, *The Symbiotic Planet: A New Look at Evolution* (New York: Phoenix Books, 1998), p. 5.

²⁸ Lynn Margulis and Dorion Sagan, *Microcosmos: Four Billion Years of Evolution from Our Microbial Ancestors* (New York: Summit Books, 1986), p. 9.

²⁹ Margulis and Sagan, p. 11.

³⁰ Margulis and Sagan, p. 14.

³¹ Margulis and Sagan, p. 15.

³² Margulis and Sagan, p. 19.

³³ Margulis and Sagan, p. 22.

³⁴ The major challenge that the 'new biology' referred to above poses to traditional post-Darwinian models of evolution, and which, in turn, problematizes the very notion of species, lies in the 'extent and promiscuity of lateral gene transfer and the difficulties this raises for defining a "tree" of life, the importance of symbiosis and cooperation, and the reinstatement of the group [or species; SH] as an important – perhaps the most important – unit of selection are all problematic...' (Maureen A.O'Malley and John Dupré, 'Towards a Philosophy of Microbiology', *Studies in History and Philosophy of Biological and Biomedical Sciences* 28 (2007), pp. 777-8). See also the full quotation from Thiago Hutter et al., 'Being Human Is a Gut Feeling', *Microbiome* 3.9 (2015), p. 1 (below) which concludes with the statement: 'Insofar as biological research is concerned, to be human is to be multispecies'.

³⁵ Dorion Sagan, *Cosmic Apprentice: Dispatches from the Edges of Science* (Minneapolis: University of Minnesota Press, 2013)p. 167.

³⁶ Sagan, *Cosmic Apprentice*, p. 168.

³⁷ Sagan, *Cosmic Apprentice*, p. 173.

³⁸ Sagan, *Cosmic Apprentice*, p. 173.

³⁹ Eugene Rosenberg and Ilana Zilber-Rosenberg, *The Hologenome Concept: Human, Animal and Plant Microbiota* (Cham: Springer, 2013), p. vii.

⁴⁰ Thiago Hutter et al., 'Being human is a gut feeling', *Microbiome* 3.9 (2015), p. 1.

⁴¹ Hutter, p. 2-3.

⁴² Hutter, p. 4.

⁴³ Cf. for example Alexandra Goho, 'Our microbes, ourselves', *Science News* 171.20 (2007): 314-316; David Cameron, 'Our microbes, ourselves' (2012), available online at <http://hms.harvard.edu/news/our-microbes-ourselves-6-21-12> (accessed 12/01/2016); *Economist*, 'The human microbiome: me, myself, us', 18 August 2012; online edition; and Jennifer Ackerman, 'Your Inner Ecosystem', *Scientific American* 306.6 (June 2012), pp. 20-27.

⁴⁴ Cf. Bruno Latour, *The Pasteurization of France* (Cambridge: Harvard University Press, 1993).

⁴⁵ David Cameron, 'Our microbes, ourselves' (2012), online.

⁴⁶ Ackerman, 'Your Inner Ecosystem', p. 26.

⁴⁷ Cf. the discussion initiated by Jacques Derrida, 'Autoimmunity: Real and Symbolic Suicides. A Dialogue with Jacques Derrida', in Giovanna Borradori, *Philosophy in a Time of Terror: Dialogues with Jürgen Habermas and Jacques Derrida* (Chicago: Chicago: University of Chicago Press, 2003), pp. 85-136; and followed up by Roberto Esposito, *Immunitas: The Protection and Negation of Life*

(Cambridge: Polity Press, 2011); and Timothy Campbell, *Improper Life* (Minneapolis: University of Minnesota Press, 2011).

⁴⁸ Thomas Pradeu, *The Limits of the Self: Immunology and Biological Identity* (Oxford: Oxford University Press, 2012), p. 1.

⁴⁹ Ed Cohen, 'The Paradoxical Politics of Viral Containment; or, How Scale Undoes Us One and All', *Social Text* 106, 29.1 (2011), p. 15-6.

⁵⁰ Ben Woodward, *Slime Dynamics* (Winchester: Zero Books, 2012), p. 19.

⁵¹ Anna Williams, 'Death: the great bacterial takeover', *New Scientist* (30 August 2014), p. 10.

⁵² Williams, p. 14.

⁵³ Jim Crace, *Being Dead* (London: Penguin, 2000), p. 210.

⁵⁴ Crace, *Being Dead*, p. 209.

⁵⁵ Cf. Eugene Thacker, 'Biophilosophy for the 21st Century (2005)', *1000 Days of Theory*, eds. Arthur and Marilouise Kroker; available online: www.ctheory.net/articles.aspx?id=472 (accessed 12/01/2016).

⁵⁶ Cf. Isabelle Stengers, *Cosmopolitics*, 2 vols (Minneapolis: University of Minnesota Press, 2010-2011).