‘Deep Shit: Subsurface Waste and Bacterial Becoming’

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Abstract

This essay considers the inverse to an Anthropocene characterized as an era of human-induced loss of species and life forms on earth. The global practice of burying increasing amounts and kinds of waste in landfills precipitates the mixing of wildly heterogeneous materials, which diverse kinds of bacteria avidly metabolize. As they relentlessly feed on our detritus, bacteria both proliferate and, we suggest, diversify. However, this is not a numbers game, nor is it one which is solely or even primarily about interconnectivity, networking, and entanglement. The ontological provocation of the human waste-bacterial conjunction is the fact of our total dependence on life forms whose life-worlds and trajectories are likely to remain overwhelmingly unknown to us. If this offers a cautionary note about our own increasingly hyperbolic perturbations of the Earth’s constitutive strata, perhaps its more profound prompting is about the force of the stratifications and destratifications proper to the planet itself.

Bacteria and Human Waste

An observation that is as awe-inspiring at is it obvious: every extant being on this planet belongs to an unbroken chain of bodies that wends its way through time, from one birthing or fission to another, all the way back to the emergence of life itself from non-living matter. Each bacterium, each angiosperm, each vertebrate is part of a continuous thread which neither continental nor genetic drift, volcanic winter nor snowball glaciation, meteor impact nor paleo-atmospheric crisis has been able to sever. However much we celebrate non-filial transfers and couplings, the lateral interchanges of networks and assemblages, or the indefatigable flux of life, any snuffing out of a genus or species of living beings, any severance of this 3.5 billion-or-so years of living is worth taking seriously. Extinction matters. Some consolation may be found in the capacity of inanimate matter to self organise into more complex arrangements. However, it's worth dwelling on the fact that the mass of once living organisms that have returned to base matter may been estimated at somewhere between a 1,000 – 10,000 times the mass of the Earth itself (see Davis 1996, 73), while as far as scientists have been able to ascertain, matter has only organised itself into life but once on our planet. There is, then, something of an asymmetry between the transition from base matter to life and the traffic that passes in the inverse direction.

Even the practice of anticipating, documenting and mourning the passing of a species - the melancholic publicity so pivotal to contemporary environmentalism - falls short of embracing the fullness of extinction's loss. For as, Kathryn Yusoff (2012, 580) reminds us, a great many of the living lineages which are now likely to be 'disappearing' have never appeared to us in the first place: their extinguishing taking place unattended and unannounced, beyond the reach of our technologies of presence. Too small, too obscure, too reticent to have graced our archives, these beings blink out of existence without ever making their presence felt. If there might be such a thing as a dark ecology, a green so deep as to emit no glimmer of light, perhaps it lies here, in the contemplation of the finality of a withdrawal from the ranks of the always already withdrawn.

But what if there is a flip side to the anonymous eclipse of so many species or strains? Not a lightness to the darkness and occlusion of the unregistered extinction event, but

something more in the nature of an evil twin. What if, without trying, without knowing, without even the possibility of our finding out, we humans were *increasing* the sum total of biological diversity on Earth?

As evolutionary biologist Lynn Margulis (1998) liked to remind us, life on Earth was, is - and most likely will be as long as it endures - thoroughly dominated by microbial communities. For the first two and a half billion years of terrestrial life, single- and multi-celled organisms from the Bacteria and Archaea domains were the only life forms around: a microscopic throng whose proliferation, promiscuous exchanges and evolutionary radiation collectively generated our solar system's only biosphere. Bacteria invented all the basic metabolic processes, including photosynthesis and chemical conversion that every other life form remains utterly dependent on (Hird 2009, Ch 2). And it is this peerless proficiency at metabolising available matter-energy – everything from solar radiation to organic matter, metallic ores to acidic sulphates – that makes bacteria so important when it comes to disposing of our own stockpiles of surplus and unwanted matter.

Which brings us to the ecological predicament of most of the planet's human communities. The waste products of human productive and consumptive activity need to go someplace, and the exponential rise in productivity over the brief span of industrial modernity means that those places must be ever-more capacious. Our counterpart to the wholly organic jetsam of our ancestors is a concoction of inorganic and organic detritus, our answer to their middens – a transglobal multiplication of landfill sites. Eventually, whatever we stash underground comes into contact with the bacterial life that dwells in the soil. Or rather, given a populace of some 40 million per gram, we might say they *are* the soil. Bacteria do what they have been doing since the Eoarchean era: they figure out ways of metabolizing whatever matter-energy they encounter. And in its own way, each landfill is a unique bundle of materials, at once an ancient and a novel challenge to bacterial communities.

The landfills of contemporary industrial societies include variable amounts and kinds of seven million or so known chemicals (and the 1000 new chemicals which enter into use each year), along with a full spectrum of organic matter, which includes the 14,000 food additives and the manifold contaminants found in our food scraps. The

liquid material or 'leachate' into which organic landfill dissolves frequently consists of a heterogeneous mix of heavy metals, endocrine disrupting chemicals, plthalates, herbicides, pesticides, and various gases including methane, carbon dioxide, carbon monoxide, hydrogen, oxygen, nitrogen, and hydrogen sulphide.

The point is that when it comes to what bacteria ultimately make of these ingredients, and what in the process they make of themselves - we simply have very little idea. Neither landfill nor waste more generally is the only incitement that human activity provides for the proliferation and transformation of bacterial life. But the unfathomably rich and complex feedstock that we are pumping underground has a special significance in the magnification of the insensible and the unknown, its unintended consequences comprising one of the deepest and darkest ecologies of the current material-historical juncture.

We propose, then, that a quite feasible – but utterly unconfirmable – consequence of human subterranean waste disposal is a stimulation of bacterial proliferation that is likely to involve diversification. Given the vast populations and the huge variety of bacterial kinds, such augmented diversity might even exceed the accelerating extinctions about which we are variously ignorant and hyper-informed. But this is not a numbers game, at least not one in which the divisions, subtractions or multiplications belong to us. Nor is it one which is solely or even primarily about interconnectivity, networking and entanglement. The biggest ontological provocation of the human waste-bacterial conjunction, we suggest, is the fact of our total dependence on life-forms whose life-worlds and trajectories are likely to remain overwhelmingly unknown to us. If this offers a cautionary note about our own increasingly hyperbolic perturbations of the Earth's constitutive strata, perhaps its more profound prompting is about the force of the stratifications and destratifications proper to the planet itself.

A Good Soup

Social analysis of the accelerating horizontal movements, encounters and admixtures that go by the name of globalisation has frequently drawn on Latour's notion of multi-actor networking along with Deleuze and Guattari's take on territorial dynamics.

Recent social scientific engagement with human waste works this general terrain: tracking the circulation of assorted human refuse through increasingly globalised networks, and showing how this occasions more-or-less unpredictable transformations of both the waste products themselves and the networks and environments through which they are mobilised.

This is in keeping with the rise of various 'relational materialities' whose priority is to bring to light spatial orderings and transformations involving a range of human and more-than-human participants. But however stretched out, reticulated or enfolded we imagine the spaces in question to be, there has been a pronounced reluctance to prise beneath the 'uppermost' stratum of worldly activities over the last few decades of critical social thought. While a multitude of 'things themselves' have been followed across the globe, their pursuit has rarely extended far into regions that are devoid of human presence or indifferent to human entreaty.

In the case of the subsurface depositing of waste, we suggest, there is a need to delve beneath the relations that compose or decompose territories, and to burrow into the underpinnings of the Earth's exterior organization and patterning. Deleuze and Guattari's notion of strata - relatively self-consistent layers or belts of substances which composing the body of the Earth – have not quite attracted the same enthusiasm their concepts of de- and re-territorialisation. Where Deleuzo-guatarian strata have featured in social and philosophical thought, it is usually with regard to their capacity to cut across each other or to be traversed and mixed. Deleuze and Guattari's own foregrounding of destratification offered a necessary corrective to timeworn tendencies toward foundational determinisms. But it is worth recalling that, although they rejected any simple uni-directional or teleological relationship between one stratum and the next, they broadly accepted that an earlier stratum offered the conditions of possibility for strata which followed, proposing 'a coded system of stratification' made up of 'hierarchies of order between groupings; and, holding it all together in depth, a succession of framing forms, each of which informs a substance and in turn serves as a substance for another form' (1987, 335).

Biological life, Deleuze and Guattari noted, forms a stratum of its own, but at the same time has a particular propensity for destratifying, for traversing and perturbing

the geological accretions which provide its underpinning (1987, 336). Human life too – the 'anthropomorphic' stratum - participates actively in the cross-cutting and back-blending of other strata. As Deleuze and Guattari famously put it: 'it is possible to reverse the order with cultural or technical phenomena providing a fertile soil, a good soup, for the development of insects, bacteria, germs, or even particles' (1987, 69).

One of the most public manifestations of this possibility in recent years was the 2011 Deepwater Horizon oil spill. In this event, massive volumes of hydrocarbons extracted from deep beneath the seabed were accidently released into the different vertical layers of the ocean, the oil plume entering the various webs of marine life inhabiting these layers. Samples taken from the Gulf of Mexico during the spill indicated that there were 951 distinct bacterial taxa in the vicinity of the leaked hydrocarbons. Of these, 16 taxa appeared to have been 'significantly enriched' through their exposure to the oil plume of hydrocarbons leaked during the spill - all of which were known to have members capable of consuming and degrading hydrocarbons.

As researchers summed up: 'These results indicated that a variety of hydrocarbon-degrading populations exist in the deep-sea plume and that the microbial communities appear to be undergoing rapid dynamic adaptation in response to oil contamination' (Hazen et al 2010, 207). But the more uncertain effect of this efflorescence of oil-metabolising bacteria was what became of contaminants as they moved through the successive levels of the marine food web. Evidence further suggested that the enhanced oxygen consumption of the bacteria that were consuming the spilled oil had a seriously deleterious impact on oxygen-producing microorganisms such as photosynthesising marine bacteria (Widger et al 2011).

In other words, the ultimate impact of the 2011 Gulf oil spill on marine life – both micro- and macroscopic - remains fundamentally inconclusive. In many senses, the practice of putting human refuse underground might be viewed a kind of terrestrial Deepwater Horizon – on a massively extrapolated and temporally extended scale. But whereas the relatively narrow spectrum of the marine bacterial phyla that benefitted from the Gulf spill were fuelled by a fairly uniform feedstock of petroleum

hydrocarbons – waste matter intentionally deposited in landfills is generally characterised by heterogeneity of ingredients unique to each individual landfill. Depending on its spatial location and the period in which it was operative, any given landfill might contain chemicals whose health and environmental consequences are well known, chemicals that have since been prohibited or are banned elsewhere, and those whose long-term consequences are scarcely known at all. The various 'cells' that compose a modern landfill may themselves have a very different composition, an inconsistency which is in turn greatly intensified when we consider the wildly uneven geography of disposal contents, practices and regulations across the globe.

At least in some highly regulated western social formations, sophisticated techniques of lining landfills extend the period of containment. But containment is always ultimately imprescriptible given a long enough time line, raising the issue of how micro-organisms in the surrounding soil will respond to the leachate that sooner or later seeps from landfills. Which bacterial taxa are present, which populations will be deleteriously impacted by the specific mix of chemicals they are exposed to, and which will adapt and proliferate under novel conditions are queries of almost unfathomable complexity – questions that are effectively unanswerable. There is no conceivable tally sheet of microbial diversity extinguished against diversification that is stimulated and engendered. This is Yusoff's invisible, non-presentable extinction – indistinguishable entangled with an equally non-presentable becoming.

Destratification

Whether conceived in terms of Deleuzo-guattarian *agencement*, Latourian networking or more classical ecological systemicity, the inter-connectivity of bacteria with each other - and with other entities –would seem to be an exemplar of inhuman object-relations. Bacteria have largely bypassed the territorialisation referred to as 'speciation' in regard to so-called more complex organisms. Their reproductive habits are as wildly variable as their capacity to form symbiotic couplings with other organisms of varying scale and complexity. But alongside and in collaboration with such geological forces as sedimentation, volcanicity and the ocean-bed upwelling of magma, bacteria are also inveterate composers of strata. The progenitors of the Earth's biosphere, as we have seen, bacteria are also the shapers of an anaerobic and

later aerobic atmosphere, play a significant role in rock weathering and the production of metallic ores, and provide the basic componentry of more complex life. Without photosynthesising bacteria there would be no reserves of fossilised biomass to fuel human industrial production, without the bacterial building blocks of multicellular life, there would be no humans to extract and set to work this subterranean energetic reservoir.

However much the materials that humans assemble and dispose of traverse the surface of the Earth, it is our accelerating capacity for destratification that the waste problem throws into relief. Like upside-down department stores or inverted hypermarkets, landfills thrust their discard cargo into the planet's geologic layers. Subsurface flows of water extend this interjection, conveying leachate through the pores and seams of the Earth's crust, drawing it deeper into the stratigraphic column; effectively mixing the residue of our contemporary object relations with temporalities radically anterior to our own. But this is only half the story. The reinsertion of heterogeneous and composite materials into the Earth is a haphazard echo of an earlier set of destratifications, the prising of useful energy and raw materials out of geological formations. In the era of industrial production, most of what becomes landfill has one way or another been forged from subterranean ingredients. Whether it is metallic ores tunnelled from the ground, plastics fashioned from fossil hydrocarbons, or organic matter plumped by petrochemical energetic subsidies, the better part of what goes (back) down has first been brought up.

Deleuze and Guattari's (1987, 503) cautioning about the destructive consequences of a too rapid destratification feels like an understatement when we consider the current velocity of both extraction and re-interment. The bauxite that is the basis of aluminium derives from volcanic ash deposited tens of millions of years ago, the fossilised hydrocarbons from plastics or fertilizers are produced has been hundreds of millions of years in the making, while an important source of commercial iron is banded rock laid down in the Precambrian era - over two billion years ago. Given that the human deployment of a foil food wrap or drink bottle may last no more than seconds before the moment of discard and the long durée of subsurface disposal, we are positioning ourselves in the midst of temporal dis-junctures that defy our own sensorium. In this sense, the current scale of the extraction of minerals, deep-sea oil,

and unconventional hydrocarbon - together with the hyperbolic rate of landfilling - might be seen as a kind of massive conveyor belt of destratification. This is a traversing and mixing of the productions of deep, planetary time for which the largely spatial dynamics conveyed by the term globalization cannot begin to do justice.

Asymmetry

We may dig deeper and do our hefting in more spectacular quantities, but next to traversal artistry of bacteria, humans are crude and clumsy destratifiers. To migrate across strata while extracting and reprocessing available elements - this is the forte of microbial life: those miniscule metabolic engines whose negotiation between the most diverse formations of the Earth has been constantly fine-tuned and retuned over billions of years. Whether the accelerated destratification wrought by our own species over the geological eye-blink of the industrial age ultimately serves to augment or subtract from the largely microbial biological diversity of the Earth may not be the key point. As Isabel Stengers puts in, in a voice that could be conversing with Lynn Margulis, 'Of the Earth …we can presuppose a single thing: it doesn't care about the questions we ask about it' (2000, 145). And neither, most of the time, do bacteria, the planet's organic prime movers.

But what bacteria do with the substances to which we expose them, or what this exposure does to bacterial populations, may have profound consequences for humans and other complex organisms. In an empirical sense we lack access to the vast majority of bacterial losses, gains and transformations: dynamics which are obscured by the scalar mismatch of bacteria and ourselves, by the immensity of their numbers, strangeness of their forms, and the difficulty of accessing many of the environments in which they thrive. In an ontological sense what it is to be a bacterium, or more appositely – a vast meshwork of interacting bacteria – is equally beyond our grasp. But the subtending relationship of the bacterial stratum to our own dominion goes beyond the challenges of negotiating coexistence in and through our mutual unfathomabilities. We have discovered enough about them to know that bacteria are the condition of our own possibility as multicellular beings: that they are at once our origin and our continuing vital support system. In an age of accelerating anthropogenic destratification, bacteria catch the fallout of our local and globalised

transformations of earth systems. But we ourselves *are* the fallout of the dynamics of bacterial becomings; the incidental inheritors of ancient bacterial symbioses and the recipients of the gifts of ceaseless microbial metabolism. Whereas Bruno Latour (1988, 192) permits other actants to compose worlds of their own, the point about bacteria is their capacity to compose worlds for others. And by the same logic, their ability to withdraw or undermine the vital support which they provide for all other forms of life.

What some of us have lately taken to calling the Anthropocene, is a human signature - a superficial flourish - on what remains, indelibly, a bacterially-orchestrated biosphere. Even the most profound awareness of the hyperbolic destratifications that are now surcharging the Earth's own destratifying tendencies should not detract from the profundity of our reliance on the world-making capacities of these other beings. And in this way, even the notion of ecological *inter*dependence may conceal as much as it discloses. For we are, above all, *dependent*. As is the case with other multicellular beings, the constitutive ecological transactions of human beings are profoundly and profusely asymmetrical (Clark 2011, 46-50). Our existence is subtended and conditioned by bacterial life in ways that vastly outweigh the occasional localised dependence of bacteria on our offerings - an observation in keeping with Graham Harman's (2010) insistence on the prevalence of asymmetrical relations in the known universe and on the corresponding rarity of truly symmetrical causalities. By the same token, we ought to recall that Manuel De Landa's (1997) couching of a flat ontology some decades ago was entirely consistent with his exploration of a deeply stratified materiality – his positing of an hierarchical structuring of the conditions of material existence which in no way implied an hierarchical valorisation of all that exists.

Ontologically speaking, then, our point in sifting through the pits of accumulating human waste is less to highlight some grand anthropic rupture with the integrity of earth processes, and more to prompt some sense of our inescapable, non-reckonable and irrecompensable debt to other entities. We may well spread our shit around to signal possession of the spaces in which we dwell, as Michel Serres (2011) suggests. We may even inject our excrement deep in the Earth, to extend this stain into the

layerings of geological time. But either way, what finally becomes of our defecations is up to the swarms of miniscule beings who ultimately engendered our existence.

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