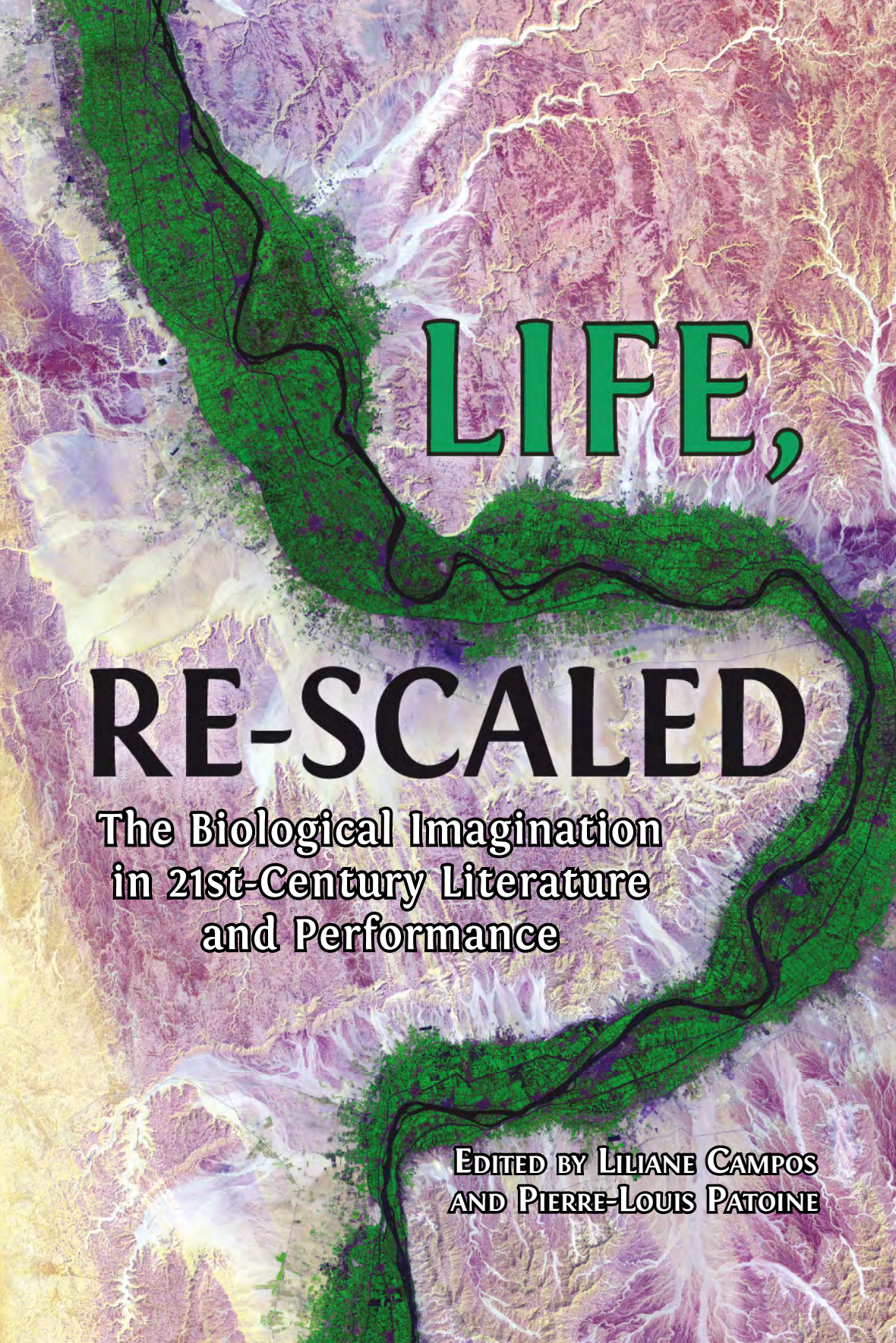
LIFE,
RE-SCALED
The Biological Imagination
in 21st-Century Literature
and Performance
Edited by Liliane Campos
and Pierre-Louis Patoine

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2. Human Environmental Aesthetics

The Molecular Sublime and the Molecular Grotesque

Paul Hamann-Rose

Never before has more knowledge existed about the invisible workings of life within and around us. In the twentieth century, biology became molecular. With the molecular make-up of DNA deciphered in 1953, a new mode of thinking biological organisms was afoot, and previously abstract processes in living organisms acquired a new biochemical substance and depth. This complex shift to the molecular level, especially in genetics and microbiology, 'entails a change of scale', as Nikolas Rose underlines: 'It is now at the molecular level that human life is understood, at the molecular level that its processes can be anatomized, and at the molecular level that life can now be engineered'.[1] The completion of the Human Genome Project in 2003 appeared to mark the pinnacle of what Evelyn Fox Keller has aptly described as 'the century of the gene'.[2] The problematic dimension of this shift to the molecular level is that it frequently gives rise to forms of genetic reductionisms that exaggerate the explanatory power of genome sequencing and reduce highly complex and interdependent organismic processes to the protein-coding

1 Nikolas Rose, *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century* (Princeton: Princeton University Press, 2006), p. 4.

2 Evelyn Fox Keller, *The Century of the Gene* (Cambridge: Harvard University Press, 2000), p. 1.

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nucleic acids of DNA. However, new endeavours like the Earth Genome Project and the Human Microbiome Project make it clear that molecular research, along with its ever-growing impact on social and cultural life, has only accelerated after the turn of the millennium, especially following the development of rapid sequencing technologies in the late 1990s. This mounting store of information about the molecular realms of existence presents the twenty-first century with a historic challenge to the imagination, for molecular biology deals with a scale of being that is inevitably invisible to the naked eye.

Making sense of the molecular realm involves imaginatively crossing the chasm between the domains of the visible and the invisible; this is true for both science and culture. Within the discipline of molecular biology, access to the newly molecular level of life requires specific forms of mediation, from experiments to large-scale computation. Such forms of mediation are imaginative in multiple ways, from the figurative and often metaphorical language of science—think 'genetic book of life', 'genetic editing' or 'genetic blueprint'[3]—to the speculative element of experimental hypotheses. Once biological representations enter cultural discourses, they are subjected to further imaginative mediation as the cultural imaginary attempts to gauge the meaning, relevance and potential of molecular knowledge and discourse. This imaginary takes its cue from the scientific representation of the molecular, but transforms it according to its own conventions, desires, and anxieties. In recent decades, such cultural imaginings of the molecular and microbial world have produced an increasingly rich vision of life at the level of the invisibly small. They also provide a key indicator of the pressing social and political issues around molecular science. My central argument in this chapter is that two aesthetic forms are particularly characteristic of this twenty-first-century vision of the invisible domains of life: what I call the molecular sublime and the molecular grotesque.[4]

The aesthetics of the sublime and the grotesque as they manifest in the cultural imagination of the molecular and the microbial indicate a

3 For an in-depth discussion of the metaphorical status of key genetic concepts see Lily Kay, *Who Wrote the Book of Life? A History of the Genetic Code* (Stanford: Stanford University Press, 2000).

4 I would like to thank Greg Lynall for his brilliant suggestion of a molecular grotesque when I presented an earlier version of this research at the 2019 annual conference of the British Society for Literature and Science.

particular cluster of concerns and anxieties about the relation between the human and the molecular scales. These concerns are epistemological, representational and, in light of the joint crises of climate change and COVID-19, ontological and existential. The mechanics of contagion have made front-page news during the global pandemic that is poised to define the early twenty-first century, while personalised medicine seems likely to assume an ever-greater role in genetics and immunology research, as well as in people's everyday lives.[5] This context alone signals an untoward need to imaginatively engage with the molecular dimension of human existence. Moreover, imagining the life around us and questioning the often unsettlingly porous boundaries between individual and environment has acquired special urgency as humanity is attempting to re-define its ecological practices and self-understanding. In order to facilitate a new and less myopic perspective on human-environment relations, ecocritic Timothy Clark has suggested large-scale readings of literary texts: inviting the reader to zoom out and consider fictional life at timescales of hundreds of years to reveal characters' imbrication in deep time and the fate of the planet.[6] Contrary to Clark's zooming out, my focus in this chapter will be on zooming in on the hidden *microscopic* rather than *macroscopic* connections between planetary and human life.

Realising that a biologically material continuity exists between the human organism and its environment, both through the imagination and the practices it inspires, has the potential to challenge some of the deep-seated assumptions of human exceptionalism and anthropocentrism that are frequently cited as foundational to anthropogenic climate change.[7] As I will show in the following, the epistemological and affective connotations of the sublime and the grotesque can illuminate such human-environment continuities but also obstruct the self-awareness that would make such connections meaningful to readers and

5 Ian Tucker, 'Daniel M Davis: "Unbelievable things will come from biological advances"', *The Guardian*, 3 July 2021.

6 Timothy Clark, 'Derangements of Scale', in *Telemorphosis: Theory in the Era of Climate Change, Vol. 1*, ed. by Tom Cohen (Michigan: Open Humanities Press, 2012), [n.p.], https://dx.doi.org/10.3998/ohp.10539563.0001.001.

7 See, for instance, Timothy Morton, *Ecology Without Nature* (Cambridge: Harvard University Press, 2009), or, for an overview, Andrew Brennan, 'Environmental Ethics', *The Stanford Encyclopedia of Philosophy*, 2021, https://plato.stanford.edu/archives/sum2022/entries/ethics-environmental/.

spectators. In Edmund Burke's canonical theorisation of the sublime, 'the imagination is lost as well as the sense';[8] so can it really represent and afford an understanding of the microscopic life forms that live in, around and on us, not to mention an understanding of their meaning for our macroscopic lives? I will suggest that, while the sublime affords spectacular vistas on the very small scales of the processes of life, it may be the grotesque molecular and microbial distortions of our familiar selves that prove the more productive aesthetic for crossing the distance between the visible and the imagined that often precludes an understanding of how the molecular relates to us.

The forms of the molecular sublime and molecular grotesque which I identify can be found across multiple media and genres. For the purposes of this chapter, I have limited myself to textual instantiations of these forms. I will, however, discuss the sublime and grotesque imaginations of the molecular in a representative, and non-exhaustive, variety of genres. I begin by outlining my conception of the molecular sublime, drawing on examples from recent novels informed by genetic science. As will become apparent, I use the term "molecular" as a shorthand to describe not just such molecular forms of biological organisation as genes, but also slightly larger organisms like microbes. This is partly for the sake of simplicity, and to avoid adding too many new monikers to an already long and possibly endless list of sublimes, and partly because, like all other beings, microbes not only consist of molecules but inhabit a similar scale of being, equally invisible to the human eye. I then move to the genre of popular science writing, especially Ed Yong's *I Contain Multitudes* (2016), to show the particular role of the imagination in these texts' representations of the very small and how the sublime in such descriptions of the molecular and microbial often morphs into the grotesque. In the concluding section I address selected poems from Adam Dickinson's collection *Anatomic* (2018). The last two sections in particular zoom in on the exciting perspective afforded by the sublime and grotesque molecular and microbial landscapes these texts envision, on and off the human body, and the human-environment relations they construct and uncover.

8 Edmund Burke, *A Philosophical Enquiry into the Sublime and Beautiful* (Oxford: Oxford University Press, 2015), p. 59.

The Molecular Sublime

When the early pioneers of microscopy, such as Robert Hooke (1635–1703) and Antonie van Leeuwenhoek (1632–1723), confronted their audiences with very small levels of life at previously unknown powers of magnification, they did not just offer the world a better resolution of life at those scales. In many instances, their work revealed that those scales housed living organisms at all. Hooke's account and drawings of the flea, for instance, or the fly, in his 1665 *Micrographia*, depicted them in never-before-seen detail, but Leeuwenhoek's even more powerful microscope showed many micro-organisms for the very first time.[9] The history of microscopy is thus also the history of the discovery of new worlds within the cosmos; at least that is how it was often framed. From Hooke's *Micrographia* to contemporary narratives of the molecular, encountering the miniscule scales of being has repeatedly been aligned with interplanetary travel; Hooke, for example, discusses his microscopic observations of minute organisms alongside observations of the surface of the moon, and the very title of Theodor Rosebury's *Life on Man* frames the human body as a mysterious planet. This rhetoric exemplifies not only that the miniscule is frequently imaginatively associated with or even conflated with the gigantic—microscopes and telescopes rely on similar optical technologies after all—but that the small levels of life on earth also evoke a sense of the unfamiliar more commonly attributed to the uncertainty of outer space.

The notion of the sublime is routinely associated with vast, awe-inspiring magnitudes such as those characterising mountain ridges, the night sky or travel to distant moons. It has often been overlooked that Edmund Burke, when outlining the sublime in his canonical 1757 treatise on the subject, *Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful*, also includes the very small in his catalogue

9 Such scientific representations of the very small levels of life sparked the cultural imagination already in the early modern period, for instance giving rise to such fantastic creatures as the hybrid bear-men in Margaret Cavendish's *The Blazing World* (1666), a text which at the same time sharply criticises the epistemological veracity and utility of the microscope. See Ian Lawson, 'Hybrid Philosophers: Cavendish's Reading of Hooke's *Micrographia*', in *The Palgrave Handbook of Early Modern Literature and Science*, ed. by H. Marchitello and E. Tribble (London: Palgrave, 2017), 467–88, https://doi.org/10.1057/978-1-137-46361-6_22.

of potential sources of sublimity. At first, he generally declares that '[w]hatever is fitted in any sort to excite the ideas of pain, and danger, [...] is a source of the *sublime*'.[10] When experienced not 'too nearly' but 'at certain distances', the ideas of pain and danger can produce a sublime delight which, in its highest form, is expressed as reason-defying 'Astonishment'.[11] Burke's list of sources that evoke such a passionate response includes the widely known examples of infinity, power, magnificence and vastness. Yet, in the midst of these grand iterations of sublimity, and in his section on vastness no less, he also points to the very small as evocative of the sublime:

> However, it may not be amiss to add to these remarks upon magnitude; that, as the great extreme of dimension is sublime, so the last extreme of littleness is in some measure sublime likewise; when we attend to the infinite divisibility of matter, when we pursue animal life into these excessively small, and yet organized beings, that escape the nicest inquisition of the sense, when we push our discoveries yet downward, and consider those creatures so many degrees yet smaller, and the still diminishing scale of existence, in tracing which the imagination is lost as well as the sense, we become amazed and confounded at the wonders of minuteness; nor can we distinguish in its effect this extreme of littleness from the vast itself.[12]

Here, Burke already foreshadows the molecular sublime's central questions and concerns. First of all, the miniscule realms of life, the 'excessively small, and yet organized beings', are granted the same sublime effect as the gigantic and establish vastness as sublime in both visible and invisible dimensions. Further, whether the sublime can be a source of rational self-knowledge about one's relation to the invisible molecular realm is addressed *avant la lettre* in the assertion that at the ever-smaller scales of life 'the imagination is lost as well as the sense'. This denies those who experience the sublime any rational grasp ('sense') of the sublime object, championing an affective reaction instead. Finally, the classification of the excessively small as a source of sublimity implies that these obscure, unimaginably minute levels of life are terrible precisely in their confounding conjuncture of being obscure,

10 Burke, *Philosophical Enquiry*, p. 33 (emphasis in the original).
11 Ibid., pp. 34, 47.
12 Ibid., p. 59.

as well as possibly infinite, and at the same time connected to human life. This latter aspect of the sublime as challenging human hubris and confronting the boundaries of the human subject with subversive interconnections to its perceived others, both animate and inanimate, is a central characteristic of the aesthetic of the sublime. This is particularly significant in the case of the molecular and microbial sublime which derives most of its terrible power from imagining and revealing human bodies, to an untoward degree, as part of an environmental ecosystem in which the boundaries between human and nonhuman appear increasingly porous.

As I will shortly demonstrate with two examples taken from recent genetic fictions, the molecular sublime predominantly manifests itself as variations of a Burkean sublime. The most notable theorisation of the sublime besides Burke's, that of Immanuel Kant, fails to capture the molecular sublime's radical challenge to human-environmental boundaries. Kant's conception of the sublime is highly differentiated and evolves throughout his career. What is characteristic of his larger sense of the sublime, however, and particularly of the most widely known version of his theory, as laid out in his *Critique of the Power of Judgement* (1790), is that the sublime marks a transcendence of sensual impressions achieved through the rational powers of the mind.[13] Whatever initially confounds the senses, roughly that which Burke would consider terrible, is eventually recuperated into a sublime rationalisation. The true source of sublimity thus lies not in the natural or imagined object but in 'the superiority of the rational vocation of our cognitive powers'.[14] This emphasis on human superiority effectively eliminates the challenge to human subjectivity and agency that characterises Burke's theory.[15] Moreover, from the beginning, Kant views only the large and powerful as productive of a sublime reaction,[16] neglecting the sublimity of the very small.

13 See also Robert Doran, *The Theory of the Sublime from Longinus to Kant* (Cambridge: Cambridge University Press, 2015), p. 201, https://doi.org/10.1017/CBO9781316182017.

14 Immanuel Kant, *Critique of Judgement*, translated by W. Pluhar (Indianapolis: Hackett, 1987), p. 114.

15 See also Vanessa Ryan, 'The Psychological Sublime: Burke's Critique of Reason', *Journal of the History of Ideas*, 62.2 (2001), 265–79, https://doi.org/10.2307/3654358.

16 Doran, *The Theory of the Sublime*, p. 181.

With Burke's emphasis on the excessively small a rare exception, the confrontation of the human with super-humanly grand scales has persistently defined the sublime experience, from Romantic to more recent iterations of sublimity. Peter B. Hales, for instance, suggests an atomic sublime and focuses specifically on the iconography of the mushroom clouds at Hiroshima and Nagasaki. For him, the clouds mark 'the presence of absolute scale', their off-the-charts magnitude leaving the spectator awe-struck.[17] Frances Ferguson, in turn, speaks of a nuclear sublime as the experience of 'the thing that is bigger than any individual, and specifically bigger in terms of being more powerful and, usually, more threatening'.[18] Both Hales and Ferguson prepare the ground for a molecular sublime by finding sublimity on atomic and nuclear scales, yet it is the magnitude of what the atomic can do rather than the atomic scale itself that is seen as sublime. Jos de Mul's sense of a biotechnological sublime similarly identifies the magnitude of biological, especially genetic databases and the infinite possibility of genetic recombination as the source of a new sublime.[19] As I conceive of it here, the molecular sublime can equally be connected to such notions of molecular vastness and endlessness, while twenty-first-century representations of molecular realms showcase a sublime aesthetic that is more specifically driven by the very smallness of the molecular levels of life.

For example, in Simon Mawer's novel *Mendel's Dwarf*, a description of the pioneering biological work of Gregor Mendel suggests the sublimity of a perspective that brings life at the molecular scale into focus:

> He was one of those men whose vision goes beyond what we can perceive with our eyes and touch with our hands, and no one shared his insight. The word *insight* is exact. Mendel had the same perception of nature as Pasteur, who could conceive of a virus without ever being able to see it, or Mendeleyev, who could conceive of elements that had not yet been discovered, or Thomson who could imagine particles yet smaller than the atom. Like them, Mendel looked through the surface of things deep

17 Peter B. Hales, 'The Atomic Sublime', *American Studies*, 32.1 (1991), 5–31 (p. 9).

18 Frances Ferguson, 'The Nuclear Sublime', *Diacritics*, 14.2 (1984), 4–10 (p. 6), https://doi.org/10.2307/464754.

19 Jos de Mul, 'The (Bio)Technological Sublime', *Diogenes*, 59.1–2 (2013), 32–40, https://doi.org/10.1177/0392192112469162.

> into the fabric of nature, and he saw the atoms of inheritance as clearly as any Dalton or Rutherford saw the atoms of matter.[20]

The passage introduces the sublime vista Mendel uncovered on the processes of what we now know as Mendelian genetic inheritance. The sublimity of this vista derives as much from the image of Mendel gazing 'deep into the fabric of nature' as from the smallness of the level of life he has revealed. Fittingly, because Mendel himself had no idea of the material make-up of the units of inheritance he described, these units are imagined here through the analogy of atoms. Yet, in the overall passage, the physicists John Dalton and Ernest Rutherford are only two in an extended roll-call of important figures from the history of science. This list of scientists and their discoveries has two functions: firstly, by including Mendel in this hagiographic list, he is retrospectively given the recognition he was denied during his lifetime; secondly, and more importantly, the list emphasises the crucial role of the imagination in each of the scientists' sublime revelations about the hidden realms of atoms (Thomson, Dalton, Rutherford), microbes (Pasteur), chemical elements (Mendeleyev), and molecules (Mendel).

Another example from Mawer's novel illustrates how quickly and seamlessly the molecular sublime can morph into the molecular grotesque. Later in the narrative, a discussion about genetics is initially framed through a sublime aesthetic that zooms in on the invisible recesses of the cell nuclei in the human body. In the passage, the geneticist protagonist explains to his friend and soon-to-be lover Jean—yes, pun intended—some of the basics of genetic science:

> The molecule in question—the celebrated double helix, the acronymic DNA—is by now known to all in one way or another. Even high-court judges need to have some idea of it, even readers of the popular press recognise it, if only as a way of catching out a rapist by analysing his sperm. When I speak of this, Miss Piercey makes a face which signifies disgust and disapproval.
>
> "But it's there," I assure her, "whether you like it or not, there in the nuclei of all your cells."
>
> "The sperm?"

20 Simon Mawer, *Mendel's Dwarf* (London: Abacus, 2011), p. 4 (emphasis in the original).

> "The DNA. The molecules are there in every cell, carefully folded away like linen in a bottom drawer. Every function of every cell depends on it."
>
> "You mean"—a frown puckers her forehead—"it's there at this moment, wriggling round inside me?" She shifts on her seat, as though things are moving beneath her skirt.[21]

Leaving aside the sexually charged aspect of the dialogue, the conjured image of carefully folded DNA strands 'in every cell' may be argued to gesture towards a genetic network spreading through the human body that, in its ubiquity, evokes the sublimity of the vast. However, I would argue that the main focus in the passage lies on Jean's reaction. She displays astonishment and a certain incredulity in the face of this genetic revelation, as well as an alienating sense of invasion of her physical privacy from within the bounds of her own body. Her complex affective reaction as she struggles with the image of DNA in her cells transforms the molecular sublime into an experience of the molecular grotesque, which, as I will outline in a moment, is characterised precisely by the unsettling of personal agency and of personal—and often taboo—bodily boundaries experienced by Jean in this passage.

Both molecular sublime and molecular grotesque challenge perceived notions of human control over the body and its boundaries. However, it is the molecular sublime in particular which is marked by its power to astonish but confound the understanding. In the first passage quoted from *Mendel's Dwarf*, Mendel's knowledge of the molecular may be the sublime object, but the text's aesthetic and affective emphases lie on the awe-inspiring, but ultimately elusive, molecular 'fabric of nature'. Different theories of the sublime, as well as different representations of the molecular sublime, can be described in terms of how they are positioned towards a dialectic between rational understanding and affect. Whereas Kant suggests the rational transcendence of feeling as the very condition of sublimity, Burke champions the complex passion of the sublime, which explicitly confounds the sense and understanding. Ferguson's nuclear sublime keeps close to Burke by using the sublime to denote precisely what eludes reason about the power of the atom. This dialectic has significant ramifications for the cultural negotiation

21 Mawer, *Mendel's Dwarf*, p. 117.

of the molecular through the aesthetic of the sublime. As Jean's amazed but puzzled and uneasy reaction illustrates, the crux of the molecular sublime appears to be that it emphasises wonder—or even disgust, when it tips into the grotesque—over comprehension. And it seems indeed a challenge, at least to this author, to reconcile the sense of anxious astonishment felt at the vision of one's own hand as teeming with DNA, with a rational account of how DNA affects cell processes in that same hand. This sense of wonder affords to undermine the unity of the human body, especially with regard to the environment, as we will see. But if it thrives on a confounded understanding, then this will have implications for how this aesthetic shapes the cultural awareness of genes, viruses, and microbes. In addition, Burke's emphasis on a safe distance as a precondition for the sublime further complicates the possibility of the sublime to really reveal the individual's connection to the molecular. There is hence an inherent and paradoxical tension whenever the sublime object is in fact the body of the observing human subject, or the imbrication of that body in surrounding molecular environments. To the extent that comprehension of this connection is required to understand the concrete relevance of the molecular levels of life for the individual and for communities, the molecular sublime's affective emphasis entails a consequential epistemological limitation.

A purely rational account, however, for example of gene action or of microbes on the skin, is limited in its turn because it rarely achieves to convey the immediate and intimate significance and sense of scale of the molecular afforded by the aesthetic of the sublime. At the same time, sublime representations of the unfathomable scale of molecular life frequently become abstract, imagining the molecular in less concrete terms than Mawer's wriggly, neatly folded DNA. For instance, in Richard Powers' *The Overstory*, genetics' subversive potential to unearth hidden connections between human beings and plants acquires great emotional force, both for the characters and potentially the readers, but the genes themselves become an abstraction of their biochemical specificity:

> You and the tree in your backyard come from a common ancestor. A billion and a half years ago, the two of you parted ways. But even now, after an immense journey in separate directions, that tree and you still share a quarter of your genes…[22]

22 Richard Powers, *The Overstory* (New York: Norton, 2018), p. 132.

The human-tree kinship described here, taken from the opening of a book on forests written by one of the characters, is an awe-inspiring, hard-to-compute concept that thrives on genetic science but elevates it to a form of connection that transcends time and space, to the point where it becomes almost immaterial. The sublime here represents the invisible sphere of genetic interconnection through an abstraction that resembles Jean-François Lyotard's sense of the sublime 'absolute', which indicates that which lies outside of representation.[23] Following Lyotard, the sublime affords to show the awe-inspiring nature of trans-species genetic kinship, which is often lost when the concrete materiality of genes is foregrounded, especially through scientific methods of description and observation. Such foregrounding—or making visible—of genetic materiality is prone to emphasise the particular genetic object rather than broader scales of connection because it relies on scientific modes of mediation; the zoom lens of the microscope is necessarily particular. The abstraction of genetics in the excerpt from Powers' novel, in contrast, transcends the particular genetic object in favour of a sublime ecological vision of genetic interconnectedness that extends into the overall aesthetics of the novel, in which multiple storylines come to connect multiple characters across several decades and across the United States. The stress on reciprocal ties between characters and their environments supports Christopher Hitt's claim that an ecological sublime can offer a 'new, more responsible perspective on our relationship with the natural environment'.[24] Powers' sublime perspective on molecular relationality ironically entails affectively overshadowing the more specific and particulate genetic science that inspired it in the first place.

This dynamic of the sublime's dazzling obfuscation of the science that informs it is a common feature not only of the molecular sublime. In Powers' example, genetic knowledge enables the sublime representation but gives way to the challenging experience of imagining a seamless imbrication of humans in the life of plants. Similarly, Lynne Heller argues that in the conception of a microscopic or subatomic sublime,

23 Jean-François Lyotard, 'Presenting the Unpresentable: The Sublime', *Artforum*, April 1982, 64–69 (p. 68).

24 Christopher Hitt, 'Toward an Ecological Sublime', *New Literary History*, 30.3 (1999), 603–23 (p. 605).

technology and reason enable the emotion of sublimity, even if that emotion finally transcends rationality.[25] Burke himself, in his reference to the 'discoveries' of the 'small, and yet organized beings', already concedes that contemporary biological knowledge is the basis for the imagination of the minute life forms which then confounds the sense. And more generally, as Allen Carlson notes, eighteenth-century conceptions of sublimity were heavily informed by emergent scientific descriptions of the natural world, even if those scientific origins were often glossed over in the final sublime experience.[26] The molecular sublime's reliance on—and eventual overshadowing of—molecular science is hence quite a traditional feature of its aesthetics.

An initial sublime experience of molecular levels of life, as represented in both genetic examples above, may lead to a later rationalisation or excavation of the scientific explanations of those molecular levels. Often, the experience of sublimity is reduced with repetition, in any context.[27] Whether this holds true for the admittedly provocative realisation that our bodies are ecosystems we share with other molecular and microbial beings, reconciling the affective perception of their scale and presence on the individual body with a rational understanding of their organisation and materiality, remains to be seen.

I will now open my discussion of the molecular sublime to include another genre, popular science, and the aesthetic of the molecular grotesque, which frequently accompanies cultural representations of molecular sublimity. The grotesque, I will argue, can be seen to combine affective anxiety about new forms of human imbrication in living environments with more concrete imaginaries of the materiality of such environments. This also enables the grotesque to proffer not just an emotive but also a more rational understanding and imagination of how the molecular levels, in this instance in the form of microbes, directly touch and shape the human individual.

25 Lynne Heller, 'The Intrinsic Irony of the Future Sublime', *Canadian Review of American Studies*, 50.3 (2020), 377–98, https://doi.org/10.3138/cras-2020-006.

26 Allen Carlson, *Aesthetics and the Environment: The Appreciation of Nature, Art and Architecture* (London: Routledge, 2000), p. 85, https://doi.org/10.4324/9780203981405.

27 Ibid., p. 79.

Imagining Microbes: From the Molecular Sublime to the Molecular Grotesque

Ed Yong's 2016 bestselling popular science book, *I Contain Multitudes*, is emblematic of the increasing visibility of microbes in cultural discourses, from reports in the media about new discoveries to supposedly microbiome-stimulating yogurts in the supermarkets. The true pioneer of the microbial popular science book, however, was Theodor Rosebury's 1969 *Life on Man*. Yong's text is driven by a markedly heightened sense of urgency to grasp the impact of microbes on human lives and the environment, which is characteristic of the twenty-first-century fascination with the microbiome. Rosebury's book, in contrast, while no less urgent in its desire to illuminate the significance of microbes, is more locally informed by what he perceives as a contemporary mania for disinfectants, trying to reform his contemporaries' attitudes towards germs and "dirt". I include Rosebury's text here because it prefigures many of the aesthetics which later come to characterise the twenty-first-century treatment of microbes which can be identified in Yong's writing. In addition, Rosebury offers a particularly imaginative style which demonstrates that popular science writing on microbes, while non-fictional, is indeed marked by the same aesthetics as the genetic fictions discussed above. It also provides exceptionally rich examples of both the molecular sublime and the molecular grotesque.

In a particularly striking passage, Rosebury uses a scene from the film adaptation of *Tom Jones* as the medium through which he describes the microbial life in the human mouth:

> The biologist—the old-fashioned kind who uses a light microscope—knows that while the picture changes as we move closer, as we bring a smaller and smaller area into focus, it loses none of its fascination [...]. This is one way in which we see the continuity of the living world, its never-ending wonder and magnificence, from the greatest to the smallest. And so, adding an imaginary zoom microscope to [director Tony] Richardson's color camera, I was able in my mind's eye to zero in on the little fleshy crevices around Tom's and Jenny's teeth as they ate their meal, and to see the turmoil of microbic life there, the spirochetes and vibrios in furious movement, the thicker corkscrew-like spirilla gliding back and forth, and the more sluggish or quiet chains and clusters and colonies of bacilli and cocci, massed around or boiling between detached

> epithelial scales and the fibers and debris of cells and food particles. Like the great and beautiful animals in whose mouths they live, these too are organisms, living things; and I could imagine them, quite like Tom and Jenny, making the most of the sudden accession of nourishment after a long fast.[28]

The microbial imaginary evoked here, informed by Rosebury's scientific background, reveals a rich density of life at an otherwise invisible scale. Collapsing visible and invisible scales, Rosebury produces a sublime aesthetic of microbial variety and movement. The uneasiness likely to be experienced by the reader at the previously unknown life forms on seemingly smooth gums and membranes is also likely mixed with the 'wonder' and 'fascination' invoked by Rosebury himself. This is not the abstract sublimity of Powers' genetic vision but a concrete, material sublime perspective on the troublingly and astonishingly diverse life inside the human mouth.

The passage, however, may also be said to present a grotesque aesthetic of the human microbiome. Following Bakhtin, Susan Stewart defines the grotesque body as confusing the established boundaries between 'what is the body and what is not'.[29] Stewart describes fragmentation of the body and the blowing out of proportion of body parts, especially of culturally taboo ones like those marking boundaries between inside and outside, like mouth and genitalia, as typical features of the grotesque.[30] While Stewart identifies this aesthetic as primarily belonging to the gigantic exaggeration, I argue that her sense of the grotesque equally applies to the very small levels of microbes. Even when imagined into the visible spectrum, the microbes are still minute within Rosebury's representation. In typical grotesque fashion, the passage quoted above zooms in on 'fleshy crevices' and in between 'epithelial cells', thus fragmenting the body and turning, in Stewart's words, the 'inside out'.[31] The 'turmoil' and 'furious movement' of the microbial communities depicted here further underline the grotesque alienation of the familiar surfaces of the mouth.

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28 Theodor Rosebury, *Life on Man* (New York: The Viking Press, 1969), p. 8.

29 Susan Stewart, *On Longing: Narratives of the Miniature, the Gigantic, the Souvenir, the Collection* (Durham: Duke University Press, 1993), p. 105.

30 Ibid.

31 Ibid.

Traditionally, the grotesque often involved the merging of human and animal features, relishing the species' disorder while testing the differences between them. In the context of microbes, the grotesque can be observed to entail a similar boundary challenge, though in this case between human body and its microbial environment. This is already evident in the passage above, where microbes and humans are shown as symbiotic organisms within the 'continuity of the living world', but becomes even more pronounced in another passage from *Life on Man*. Here, Rosebury first invokes what I call the Gulliver trope, which denotes a common technique to imaginatively explore and represent what is usually invisible, namely by embedding a shrunken fictional character within the invisible levels of the universe. Michael Crichton and Richard Preston's 2011 science thriller *Micro*, for example, brings the Gulliver trope to Hawaii, where the novel's shrunken scientist-heroes battle with the sublime wonders of the microbial and insect ecosystems of a tropical rainforest. With such a 'perspective like Gulliver's in Brobdingnag', Rosebury in *Life on Man* invites the reader to

> land on a gently curving plain of relatively hairless skin, say a shoulder blade. We could hardly miss the growing things, but our first impression [...] would be one of plants rather than animals. We would probably find no creeping, crawling, or darting things here. The ground, made up of flat stones like slate but whitish, would show layers of more translucent stones beneath [...]. Among the stones would be standing hairs and the open pits of sweat and sebaceous glands. [...] We would see bundles of soft translucent sticks, stalks, and twiglike things. [...] We would see movements like those of plants growing or flowers unfolding in speeded-up or "time-lapse" movies, because the microbes would be growing before our eyes.[32]

Rosebury presents the surface of the human body as a microbial landscape. Stylistically, Rosebury uses frequent analogies, likening microbes to flowers and plants, and skin-cells to stones, to convey the alien environment of the skin to the reader; a technique, as Stewart points out, typical of representations of the miniature.[33] However, while Stewart identifies the miniature as mostly static, for action would push it into the background,[34] there is distinct movement in this and the

32 Rosebury, *Life on Man*, pp. 43–44.
33 Stewart, *On Longing*, pp. 44, 46.
34 Ibid., p. 54.

previous passage while the minute scale remains in the foreground. Rosebury's zooming-in on a minute speck of skin fragments the body and reveals it to be host to a strange world of independently growing organisms. This, together with his focus on minuscule orifices in the whitish translucent skin—the gland pits—clearly mark this microbial landscape as a grotesque representation of the human body, which, besides the mixture of wonder and anxiety it may provoke, bears little trace of the sublime.

The vision of a landscape on the surface of the human body effects an inversion typical of the grotesque, here between body and environment. Even more strongly than the sublime representation of life on man, the grotesque challenges us to reimagine the relation between a human individual and his or her living *umwelt* as one of fluid symbiosis rather than across clear fault lines. The particular strength of the grotesque, in comparison with the sublime, appears to be its retention of the materiality of the microbial world. Its scientifically informed representation of microbial life, while imaginatively portrayed, is not overcome by the complex passion of the sublime. This comparison should not suggest that the sublime and the grotesque are mutually exclusive, just as the sublime should not be reduced to affect and the grotesque to reason. Rather, each aesthetic emphasises a particular constellation of affect, imagination, and rational understanding; and in some texts, sublime and grotesque aesthetics are closely intertwined, as my later analysis of Dickinson's poems will show. In Rosebury's text, the particular affordance of the grotesque is to enable a more rational understanding of the microbial scale of the human body. This, though, requires the grotesque not to become a spectacle, which would cause a 'distancing of the object and a corresponding "aestheticization" of it', marking it as an 'aberration' and thus precluding the reader from relating the microbial vision back to his or her own body.[35] I would argue that the proximity to the grotesque object created through Rosebury's imaginary zoom-lens functions as an equivalent to the proximity characterising the carnivalesque grotesque, which overturns hierarchies between object and onlooker, between inside and outside, and highlights the human imbrication in the microbial environments around and within the body.

35 Ibid., p. 107.

In Yong's *I Contain Multitudes*, this emphasis on the human body as microbial environment is even more of a central concern. Yong's description of human bodies as hosts to microbial 'ecosystems' betrays his text's twenty-first-century context of climate change and its foregrounding of ecological discourses, but also the changing epistemological frameworks of microbiology, towards a stronger focus on microbial communities, since the publication of Rosebury's *Life on Man*.[36] This is particularly evident in his comparisons, from a microbiological perspective, of human and animal disease to 'a dying coral reef' or 'a lake that's smothered by algae or a meadow that's overrun with weeds—ecosystems gone awry'.[37] These analogies reiterate the notion of humans as microbial landscapes. Such images of humans as environments evoke the grotesque. 'It can be weird', Yong states, 'to consider [...] our body parts as rolling landscapes'.[38] This weirdness, which is largely due to the fact that 'microbes subvert our notions of individuality', also contains the potential of a sublime perspective on the human body as an 'entire world' of minute microbial life, a perspective more impressed by affect than reason, since these concepts, as Yong himself remarks, 'can be hard to grasp' and 'deeply disconcerting'.[39] Yong's emphasis on the beauty of this 'dizzying shift in perspective' further underlines its sublimity.[40]

In comparison to Rosebury's often flourishingly imaginative style, Yong's overall account of microbial life on and around the human is characterised by a more restrained, matter-of-fact tone, which communicates large quantities of information but gives less weight to imaginatively imbuing the microbes' minuscule scale with either abstract grandeur or particular materiality and form. Even though the book's subtitle promises 'a Grander View of Life', thereby already announcing the sublime, the text's general tone indicates its generic stress on science communication. This arguably limits its ability to rouse an affective response that brings home the conceptual and intimate implications

36 Ed Yong, *I Contain Multitudes: The Microbes Within Us and a Grander View of Life* (London: Vintage, 2016), p. 4.
37 Ibid., pp. 4, 23.
38 Ibid., p. 4.
39 Ibid., pp. 3, 24.
40 Ibid., p. 262.

of the human as microbial environment. A rare moment of zooming in on 'our skin', revealing microbes as 'spherical beads, sausage-like rods, and comma-shaped beans', contains traces of a grotesque microbial imaginary but pales in comparison with Rosebury's vision of furious microbial movement.[41]

Towards the end of Yong's book, however, his focus shifts again to microbial human-environment relations which are presented through an extended sublime aesthetic of microbial life. Considering the city of Chicago, Yong explains 'how different everything seemed with microbes in mind'.[42] He then imagines 'the city's microbial underbelly—the rich seam of life that coats it, and moves through it on gusts of wind and currents of water and mobile bags of flesh'.[43] This representation combines elements of sublimity with the grotesque. While the 'mobile bags of flesh' appear grotesque, recalling Yong's earlier description of humans as 'vessels full of microbes', the main effect here, though supported by the grotesque imagery, is of a wondrous and strange vision of seemingly inanimate city space suddenly filled with life. This sublime description includes the image of humans as microbial 'clouds of themselves', where again the human form is likened to a feature of the landscape and metaphorically subsumed under the wealth of its microbial symbionts.[44] While this vision defamiliarizes the city of Chicago as well as the bodies of its inhabitants, its sublimity is particular because it retains a high degree of rational understanding. The passage indeed foregrounds the faculty of the imagination as crucial for access to the ubiquitous but otherwise invisible scales of microbial life. This form of understanding enabled by the imagination is also highlighted by Yong when he states that although the microbial world 'is still invisible to my eyes, I can finally see it'.[45]

Both Yong's and Rosebury's texts imaginatively depict the human body as microbial landscape and ecosystem, revealing the vitally porous boundaries between humans and their microbial and molecular environments. In Rosebury's case, identifying his microbial landscapes

41 Ibid., p. 10.
42 Ibid., p. 262.
43 Ibid.
44 Ibid., pp. 26, 262.
45 Ibid., pp. 26, 264.

as ecosystems is the result of a retroactive analytical reading informed by the transformations characterising the study and representations of microbes in the twenty-first century. Microbiology today is not only itself shaped by a new focus on microbial communities and meta-organisms but, as Bapteste and Campos et al. outline, the connective ubiquity of microbes has led to a larger, cross-disciplinary trend away from the analysis of ever-smaller units of enquiry and towards the study of ecological systems and interconnected networks within and between living organisms.[46] Against this background, Yong's extensive use of explicit and analogical references to ecosystems is thus an expression both of the renewed and topical concern with the workings and futures of ecologies in the era of climate change, but also of a distinctly twenty-first-century microbial imaginary.[47]

In the final section of this study, I will now turn to discuss an aesthetics that even more explicitly zooms in on the human impact on their environments.

Molecular Landscapes: New Ways of Reading the Anthropocene

In Crichton and Preston's *Micro*, the natural world comes alive for the shrunken scientists at a previously unknown scale in the Hawaiian rainforest. The soil underneath their boots suddenly heaves with life forms; when they take a bath in a puddle of water, they have the sublime experience of swimming with paramecia, unicellular microbes, a strange but astonishing encounter with life at the level of a single cell that conjures up the origin of life both at a planetary and an individual developmental scale.[48] The novel's rich and scientifically informed imaginary of human-environment encounters and ecological

46 Eric Bapteste et al., 'The Epistemic Revolution Induced by Microbiome Studies: An Interdisciplinary View', *Biology*, 10.651 (2021), 1–15, https://doi.org/10.3390/biology10070651.

47 See also Liliane Campos's argument that popular representations of microbes, such as Yong's, increasingly draw on environmental imagery, displacing 'agency away from human individuals' and 'towards collective actors', in Bapteste et al., 'The Epistemic Revolution Induced by Microbiome Studies', p. 4.

48 Michael Crichton and Richard Preston, *Micro* (New York: Harper, 2011), pp. 159, 354–56.

interdependencies is set against the backdrop of the capitalist exploitation of natural resources perpetrated by the text's villain. By highlighting the ecological diversity of soils and puddles and showing the human enmeshment in their diversity of life, *Micro* produces a form of what Heather Sullivan calls 'dirty aesthetics', collapsing perceived boundaries between human and natural environments.[49] In his 2018 poetry collection *Anatomic*, Adam Dickinson takes this concern with the impact of capitalism and industry on environments at microscopic scales even further, constructing a molecular and microbial poetics of environmental connection that explores biochemical ways of reading and writing the Anthropocene.

As part of the writing process of *Anatomic*, Dickinson underwent extensive tests for various chemicals and microbes. In the final collection, the epigraphs signal the chemicals or micro-organisms that are the central concern of each poem. Within the overall aesthetic Dickinson lays out for the collection, the presence and impact of these biochemical entities on his body are framed as ways in which the outside writes onto and into his inside: 'I am an event, a site within which the industrial powers and evolutionary pressures of my time have come to write. I am a spectacular and horrifying crowd'.[50] The mixture of astonishment and terror that characterises his vision of himself as intricately connected with an outside environment, again constitutes a form of the sublime. The whole collection partakes in this aesthetic to the extent that it locates his body in almost endless forms of microbial and biochemical connections to and from the outside world.

More specifically, the sublime is evoked when Dickinson describes the plethora of life on his bodily surface, negotiating the porous outer boundaries of his self:

> My gut is a tropical forest of microbes. Their cells, which cover my entire body, are at least as numerous as my own. These microbiota live on and within me as a giant nonhuman organ, controlling the expression of

49 Heather I. Sullivan, 'Dirt Theory and Material Ecocriticism', *Interdisciplinary Studies in Literature and Environment*, 19.3 (2012), 515–31 (p. 515), https://doi.org/10.1093/isle/iss067.

50 Adam Dickinson, *Anatomic* (Toronto: Coach House Books, 2018), p. 9.

> genes and the imagined sense of self maintained by my immune system's sensitivity to inside and outside.[51]

The sublime is caused as much by the instability of the self's outer limits, only an 'imagined' by-product of the immune system, as by the vastness of the microbial mesh covering the body as a 'giant nonhuman organ'.[52] The evocation of the microbial dimension of his self, which seems to be both part of and exterior to his body, is infused with the discourse of a global politics of Western imperialism which is also directly related to his metabolism by way of bacteria and food: 'I house bacterial colonies that have become empires of the Western diet, fuelled by sugar, salt, and fat'.[53] Besides microbes and bacteria, Dickinson emphasises the chemical plurality of his body, which is equally influenced by outside forces. In the long poem 'Hormone', sections of which run through the whole collection, this sublime chemical multiplicity of his being, recalling Ed Yong's microbial 'multitudes', is repeatedly emphasised: 'A body/ is a crowd/ getting out/ of bed', and 'with its/ chemicals/ it can never/ be lonely'.[54] In its imagery, this molecular sublime remains largely an abstraction. The materiality of the forest-like microbes in the speaker's gut reinforces the notion of a human microbial landscape rather than revealing the microbes themselves. Whereas, if its familiar materiality is emphasised, the image of a gigantic microbial organ seems more to disrupt the sublime by a grotesque inversion of inside and outside.

The sublimity of the body as a crowd is a paradoxical sublimity; it collapses the safe distance characteristic of Burke's sublime between onlooker and sublime object. This paradoxical sublime reveals even more strongly the instability of the human subject whose physical borders are already undermined by their manifold molecular and microbial environments. This instability is further underlined in Dickinson's text by the agency attributed to the external forces shaping the self and body of the poet—they are shown to be literally 'controlling' vital processes such as gene expression. This agency stands out against other

51 Ibid., p. 42.
52 Editors' note: This description of the nonhuman is comparable to the weird 'mycoaesthetics' studied by Derek Woods in this collection (chapter 4).
53 Dickinson, *Anatomic*, p. 10.
54 Ibid., p. 107, lines 1–4, 23–26.

contemporary poetic treatments of microscopic beings, as identified by Sarah Bouttier, which tend to downplay their agential power.[55] This agency of the molecular environment—understood in its most inclusive sense—is further highlighted by Dickinson's poetics, which depicts the environmental impact on his body as a form of writing. The microbes, as well as other natural and artificial biochemical substances, are said to 'enact a form of biochemical writing through their integral involvement in the metabolic processes' of his being.[56]

Dickinson's aesthetics of biochemical writing is most pronouncedly concerned with environmental pollution, especially its origins and impact on the body, when he describes his fat cells as an 'archive of the historical moment':

> Military, industrial, and agricultural history bioaccumulate in adipose tissues. I have found one of the most widely distributed environmental contaminants on the planet in my body: polychlorinated biphenyls, PCBS. Principally manufactured by Monsanto for industrial and commercial applications, these lipophilic pollutants collect like comment sections in the fat of creatures everywhere. If we test for them, we will find them. PCBS constitute a form of writing in the Anthropocene, a recursive script where industrial innovations find their way back into the metabolic messaging systems of the biological bodies that have created them.[57]

Dickinson depicts a circulatory process of writing in which man-made chemicals are released into the environment through industry, where they accumulate in the fatty tissues of human and nonhuman organisms and subtly but manifestly transform their hormonal pathways. This form of writing is marked out as specific to the 'Anthropocene'. In the epoch in which humans have wreaked havoc with the planet's ecosystem, such a chemical form of writing is testimony to the human molecular imprint on the environment, as well as to the intimate human-environmental connections through which this imprint comes back to mark and haunt them.

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55 Sarah Bouttier, 'The Right Amount of Agency: Microscopic Beings vs Other Nonhuman Creatures in Contemporary Poetic Representations', *Épistémocritique*, 17 (9 May 2018), 1–14, https://epistemocritique.org/the-right-amount-of-agency-microscopic-beings-vs-other-nonhuman-creatures-in-contemporary-poetic-representations/.

56 Dickinson, *Anatomic*, p. 42.

57 Ibid., p. 31.

This molecular poesis of environmental chemospheres turns grotesque when the fatty tissue as archive becomes material and constitutes a carnivalesque inversion of outside and inside. In the poem 'Agents Orange, Yellow, and Red', Dickinson describes how the chemical '2,3,7,8-Tetrachlorodibenzodioxin', a highly toxic by-product of producing bleached paper—as well as the defoliant used during the Vietnam War to reveal enemy combatants hiding under the rich foliage of trees—, has seeped into the writing of his youthful fat cells:

> Northern rivers are warmed
> by the paper mill's piss, which,
> like making the world safe for democracy,
> slowly leaked into my childhood, yellowing
> the lipophilic paperbacks of my
> adipose fat[58]

The complex image of the stained and tautological 'lipophilic paperbacks of my adipose fat' produces a grotesque scriptural embodiment of the fat as written archive. The toxic pollution of rivers and human as well as nonhuman ecosystems finds a record in a body-part-turned-object. This biochemical grotesque, in contrast to Rosebury's grotesque microbial landscapes, arguably appears as spectacle rather than carnival, in which Dickinson's fragmented body is aestheticized as an object and potentially distanced from the reader. The self-exploratory stance of Dickinson as speaker in the poems also instils a certain overall distance between the revelations of his particular body as an environmental archive and the reader's own body; even though Dickinson insists that '[w]hat is inscribed in me is in you, too'.[59] For the reader, the more insightful and affectively intense aesthetic may ultimately be the volume's sublime vista of the environment writing back.

Together, though, the sublime and grotesque molecular landscapes in which Dickinson embeds the human form highlight a powerful imaginary of human environmental aesthetics as transformed by capitalist-industrial molecular writing, and thus a new way of reading the Anthropocene.

58 Ibid., p. 15, lines 14–19.
59 Ibid., p. 10.

Conclusion: The Big Moment of the Very Small

The twenty-first-century imaginations of the very small levels of life on and off the human body discussed in this study all share the sense that imagining the genetic, biochemical, and microbial scales of this planet has acquired a new urgency. The big moment of the very small seems to be now. This may seem a provocative claim to make at the tail end of the century of the gene but, as I hope to have shown, the accelerating environmental crisis and increasing interest in molecular forms of ecological interdependence can be observed to drive, at least in some degree, nearly all of the above representations of molecular human environments. The molecular sublime and the molecular grotesque emerge as key aesthetics in the cultural imaginary of this new perspective on the human imbrication in environmental networks, in which the human is revealed as both a polluting and polluted life form.

All of the above imaginations of the molecular exhibit a fascination with the smallest scales of life which have gradually come to light over the centuries, with such discoveries coming to a head in the twenty-first century. While scientific revolutions have revealed smaller and smaller units of life and environmental interconnection, it falls to cultural representations of these levels of life to ask how such insights affect and renegotiate human societies and human bodies in their relation to one another and to their ecological surroundings. Both the molecular sublime and the molecular grotesque entail specific affective and epistemological affordances and limitations, sometimes emphasising the vast scale of the very small and its material proximity to the human body, sometimes distancing the molecular object from the individual human frame, either as abstraction or spectacular aberration. On the whole, however, I would argue that the cultural imaginary has never before been engaged this closely and intensely with the smallest levels of life. The different perspectives opened up here on the human as rolling molecular landscape evince that it remains an awe-inspiring challenge to reconcile the human scale with the strange and astonishing levels of life beyond the visible spectrum.

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