Redefining Waste: A Review of Faecal Matter Inspiring Novel Life Forms

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In this article, we describe how human "shit," often overlooked as waste, serves as a valuable "commons." In the past, feces were used as a fertilizer and as an enema to treat diarrhea during war. With the development of smart feces, which are probiotics and psychotropic medicines developed from feces, the recycling of feces has gained renewed importance. These biopsycho pharmaceuticals work by transferring behavioral patterns and emotions through the transfer of fecal microbes from donors to recipients.

The debate over feces ownership between private property and common good is renewed today, as valuable fecal bacteria are now widely collected from individuals in medical "feces banks."

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The use of valuable natural or synthetically produced fecal microbes in emerging industries raises questions about the immaterial labor of non-human beings, as commons are now defined to include non-human beings. The ability of fecal microbes to thrive in the environment, whether naturally or artificially, makes them an "exemplary organism." This organism bridges between different species, bodies, and the environment and between organic and inorganic matter. Departing from "mock copy shit" and extended semiotic selves, it potentially creates new synthetic organisms at the markets. Overall, feces play a crucial and multi-layered role that goes beyond their perception as waste and has implications for various industries and ethical considerations for society. Fiction writers, in particular, have explored the relationship between engineered and recycled feces and the desymbolisation of language, revealing a perspective on the limits of the commercialization of the human body.

"Shit" as an Externality Within— Perspectives on Nature's Intimacies

For centuries, "shit" has been viewed as a passive and inferior substance compared to living organisms. It was considered incapable of movement, apparently lacking intelligence or sentience, and embodied the concept of disgusting waste.

This negative perception was reinforced by a lack of understanding about the sentient and decision-making abilities of the microbial inhabitants of feces. It is only with the advancement of microbiological knowledge that we can now appreciate feces as crucial extended

habitat for the microbes that reside in the human body, leading to a new perception of it.

The unique composition of feces as a material substance is highlighted by Dave Praeger in his book "Poop Culture," where he describes how each individual fecal sample represents a distinctive combination of nutrition, metabolism, and environment that will never exist again. Praeger likens feces to snowflakes in their uniqueness.[1]

As philosopher Timothy Morton emphasizes, in today's society, with the pressing issues of climate change, environmental destruction, and biodiversity loss, it is essential to see nature as an intimate process that occurs within ourselves.[2] Karen Barad uses the example of a hybrid organism, the Brittlestar, which communicates with its environment through material interactions.[3] When the Brittlestar loses one of its limbs, it does not sever itself from the environment, raising questions about whether the severed part belongs to the Brittlestar or the environment. Based on these considerations, we can interpret fecal microbes as an "internal externality" or "intimate outside."

In contrast to the Western emphasis on the visible totality of the body, judged by its external contours and "beauty," "shit," as an organism with quasi-entity, exhibits emergent intelligence through its effects and interactions within its habitat, which also is the human

1 David Praeger, *Poop Culture: How America Is Shaped by Its Grossest National Product* (Port Townend: Feral House, 2007), 17.

2 Timothy Morton, *Ecology Without Nature: Rethinking Environmental Aesthetics* (Cambridge & London: Harvard University Press, 2007); and "Queer Ecology," *PMLA* 125, nr. 2 (2010): 273–282.

3 Karen Barad, "Invertebrate Visions: Diffraction of the Brittlestar," in *The Multispecies Salon*, ed. Eben Kirksey (Duke University Press, 2014), 221–241.

body. The way in which these newly recognized entities challenge the traditional separation of inside and outside is indicative of their unique intelligence.

In this article, we explore the role of feces and its microbial components in connecting the external environment with the internal environment of the body. We will illustrate this through two assertions: First, their fertilizing function for the surrounding soil, and second, their "fertilizing function" for the human central nervous system and brain. We will reflect on various mediating factors between the outside and inside, including the concept of "institutionalized feces" in medical feces banking systems and language.

In order to comprehend the diverse capacities of feces and expand the horizons of their applications, we will examine selected geographical and historical contexts. Our definition of the scope of feces will encompass physical transplantation as well as the immaterial work of fecal microbes from a contemporary perspective. Finally, to highlight the hidden potential of "shit," we will consider forms of synthetically engineered and artificial feces for new commercial markets.

The Fecal Microbiota as an Intelligent Ecological Commons

The human fecal microbiota constitutes a significant proportion of human feces, accounts for thirty percent of the total volume, and contains an astonishing ninety percent of the genetic diversity of the human body.[4]

Because the microbiota is genetically alien to its host, it plays a crucial role in a new "posthuman" expe-

4 Alison M. Stephen and J.H. Cummings, "The microbial contribution to human faecal mass," in *J Med Microbiol* 13, nr. 1 (1980): 45–56.

rience by accurately representing our shifting boundaries and fluid identities.[5] From this perspective, it may seem useful to consider the capabilities of these microbial symbionts.

Microbes inhabiting human feces far surpass their human hosts in their capacities for sexual metamorphosis, cooperativity, and boundary crossing: compared to human cultures, they tend to reproduce more in collectives, as noted by Wloch-Salamon et al.,[6] and they are able to adapt to changing environmental conditions much faster than humans due to their greater adaptability through rapid mutations. Biologists are just beginning to apply various genetic hybridization techniques that prokaryotes have used for billions of years, as Lynn Margulis points out.[7]

In addition, microbial metabolism and sexual reproduction are very sensitive to environmental changes, especially pressures associated with industrial profit motives, leading to rapid changes in microbial community life and sexual behavior, with prokaryotic microbes switching from asexual to sexual replication to ensure their DNA diversity.[8] "Programmed cell death" also represents an interesting model of the collective intelligence of microbial communities: A group of cells in a

5 Scott F. Gilbert, Jan Sapp, and Alfred L. Tauber, "A Symbiotic View of Life: We Have Never Been Individuals," in *The Quarterly Review of Bioogy 87*, nr. 4 (December 2012): 325–341.

6 Dominika M. Wloch-Salamon, Roberta M. Fisher, and Brigitte Regenberg, "Division of Labour in the Yeast: Saccharomyces cerevisiae," in *Yeast* 34, nr. 10 (2017): 399–406.

7 Lynn Margulis, *Origins of Sex – Three Billion Years of Genetic Recombination* (New Haven: Yale University Press, 1990).

8 R.Craig MacLean and Ivana Gudelj, "Resource Competition and Social Conflict in Experimental Populations of Yeast," in *Nature* 441, nr. 7092 (2006): 498–501.

culture dies whenever environmental conditions require a reduction in the culture's resource consumption.[9]

In its communication with the environment, the fecal microbiota displays previously overlooked abilities for information processing, learning, memory, and communication with the environment. It continuously interprets information from its environment and responds to challenges in remarkably nuanced and complex ways, providing an alternative understanding of environmental intelligence.[10] As Buzzini points out,[11] microbes thus play the crucial role of mediators between humans and the ecosystems that surround them. These microorganisms have evolved sophisticated mechanisms to attract vector species, making them true cosmopolitans.

Applied architectural considerations of "shit" aside,[12] the fecal microbiota also exhibits molecular features that warrant its study as a model for an immanent semiotic system of language and money. As Nobel laureate Lederberg (2006) suggests,[13] circulation is as crucial for microbes as it is for language and money.

9 MacLean and Gudelj, "Resource Competition and Social Conflict in Experimental Populations of Yeast," 498–501.

10 Fabrice Caudron and Yves Barral, "Mnemons: encoding memory by protein super-assembly," in *Microb Cell* 1, nr. 3 (2014): 100–102.

11 Pietro Buzzini, Marc-André Lachance, and Andrey Yurkov (eds.), *Yeasts in Natural Ecosystems: Ecology* (Berlin: Springer, 2017).

12 Lydia Kallipoliti, *The Architecture of Closed Worlds: Or, What is the Power of Shit?* (Baden: Lars Müller Publishers, 2018).

13 Joshua Lederberg, "The Microbe's Contribution to Biology – 50 Years After," in *International Microbiology* 9, nr. 3 (2006): 155–156.

Enriching the Soil, Nourishing the Mind

Enriching the Soil

The process of fertilizing and enriching the soil through composting is not only a means of promoting the growth of plants and other organisms but also involves complex social and cultural dynamics in relation to human feces.

Fertilizers, whether natural or synthetic, are substances that are used to enhance the growth of plants by supplying essential nutrients to the soil. Compost, which is a fertilizer created through the decomposition of plant and food waste, is a rich source of plant nutrients and beneficial microorganisms like bacteria, worms, and fungal mycelia. Compost acts as a soil conditioner, increasing the humus or humic acid content of the soil and introducing beneficial microbial colonies that help suppress harmful pathogens in the soil. Bacteria in compost play a crucial role in breaking down carbon and nitrogen and releasing nutrients such as phosphorus and magnesium that are vital for the growth of plants and other organisms. Most importantly, these bacteria are capable of continually collecting information about their environment.[14]

The use of human feces as fertilizer has been a common practice in many countries, including Japan. In Tokyo, compost dealers used to collect feces from individuals and sell them to farmers until the 20th century. The feces of wealthy individuals were sold at higher prices due to their better diet, which resulted in higher

14 Jingtao Li et al., "Rhizosphere Microbiome: The Emerging Barrier in Plant-Pathogen Interactions," in *Froniers in Microbiology*, October 29, 2021; DOI: 10.3389/fmicb.2021.772420.

nutrient content in their feces.[15] This practice also had social and spatial dynamics, as the hierarchical relationship between the landowners and the feces donors became an issue. In some communities, poor individuals who did not own land would fertilize the land of the wealthy landowners with their feces, resulting in the landowners appropriating the feces of the poor for their own benefit.[16]

The process of fertilizing highlights the interconnectedness between the social wealth of humans and different elements of the ecosystem.

Nourishing the Mind

It is now well known that microbial biodiversity and human cultural behavior are intertwined at many levels.[17] Particularly urban areas have seen a decline of fifty percent in both human and soil microbiota diversity compared to native rural communities.[18] Microbial habitats like the soil or the human gut are negatively impacted by

15 Patricia Ebrey and Anne Walthall, *Modern East Asia: A cultural, social, & political history* (Boston & New York: Houghton Mifflin Company, 2006), 337.

16 Assa Doron & Ira Raja, "The cultural politics of shit: class, gender and public space in India," in *Postcolonial Studies* 18, nr. 2 (2015): 189–207.

17 Egija Zaura and Alex Mira, "The Oral Microbiome in an Ecological Perspective," in *Frontiers in Cellular and Infection Microbiology*, July 1, 2015; Gao L., Xu T., Huang G., Jiang S., Gu Y., Chen F. (2018). "Oral microbiomes: more and more importance in oral cavity and whole body," in *Protein Cell* 9(5), pp. 488–500; Dassi, Erik, Ferretti, Pamela, Covello, Giuseppina, Bertorelli, Roberto, Denti, Michaela A., De Sanctis, Veronica, Tett, Adrian and De Segata, Veronica "The short-term impact of probiotic consumption on the oral cavity microbiome," *Scientific Reports* 8: 10 (2018), 476.

18 Clement Jose C. et al., "The microbiome of uncontacted Amerindians," *Science Advances* 1, nr. 3 (2015): DOI: 10.1126/sciadv.1500183.

factors such as high caloric intake, antibiotics, hygiene, fertilizers, and dehydration, preserving microbial diversity is crucial, and it is essential to restore microbial flora through the administration of appropriate strains.

Stool transplants, an ancient and effective medical therapy, were historically used on soldiers with severe diarrhea who showed visible recovery after receiving a stool transplant from a healthy comrade.[19]

Surprisingly, these transplants have revealed that eating habits and mental characteristics are transmissible through feces.

Recent research has shown that fecal bacteria transplanted from a donor can impact emotional behavior and related neuro systems of the recipient, indicating that the microbiota has the potential to influence affect and cognition.[20] In fact, fecal transplantation studies have demonstrated that bacteria can even transmit behavioral traits, such as depression or addiction, from one person to another because bacteria are the producers of neurotransmitters such as serotonin and the pleasure-stimulating dopamine.[21] A growing body of scientific literature has emerged on this topic, introducing terms such as "psychobiotic" or "melancholic" microbes, suggesting that humans are under strong control of the trillions of microorganisms that inhabit them. This new understanding has led to a paradigm shift in psychop-

19 Jiunn-Wie Wang et al., "Fecal microbiota transplantation: Review and update," *J Formos Med Assoc.* 118 Supplement 1 (2019): 23-31.

20 Zaura and Mira.

21 de Groot P.F., Frissen, M.N., de Clercq N.C., Nieuwdorp M. (2017). "Fecal microbiota transplantation in metabolic syndrome: History, present and future," in *Gut Microbes.* 4;8(3):253-267; Evrensel, Alper and Ceylan, Mehmet Emin (2016) "Fecal microbiota transplantation and its usage in neuropsychiatric disorders," in *Clinical Psychopharmacolgy and Neuroscience* 31;14(3): 231–7.

harmacology, with the recognition of the therapeutic potential of microbial behavior modification.[22] Psychobiotics, which are live microorganisms used as remedies, are being promoted for their potential benefits on the human central nervous system by improving or restoring the microbial flora in the gut.[23] Consequently, there are speculative papers that explore how microbes may even encourage their human hosts to perform certain rituals that promote microbial transmission and replication.[24]

Despite having been a highly effective therapy, fecal transplantation was condemned and forgotten in the modern age of hygiene hysteria characterized by the overuse of antibiotics, excessive use of detergents, and immunological surveillance, and the new insights into stool transplantation have challenged our understanding of immune defense, revealing a more nuanced relationship that includes symbiotic relations with foreign substances. Fecal transplantation has compelled a rewriting of the history of immune defense, which was previously understood as a largely hostile response to foreign substances.

Other-than-humans Acting in Feces

In Western high modernism, the idea of "alien" or non-human forces controlling human behavior "from

22 Mayer E.A., Knight R., Mazmanian S.K., Cryan J.F., Tillisch K. "Gut microbes and the brain: paradigm shift in neuroscience," in *Journal for Neuroscience* (2014), 34:15490–15496.

23 Jennifer Abbasi, "Are Probiotics Money Down the Toilet? Or Worse?" *Journal American Medical Association*, Vol. 321, nr. 7, February 19, 2019: 633-635; Dassi et al.

24 Alexander Y. Panchin, Alexander I. Tuzhikov, and Yuri V. Panchin, "Midichlorians – the biomeme hypothesis: is there a microbial component to religious rituals?" in *Biology Direct* 9 (2014): 14.

within" has been viewed as negative, even tragic. However, the new-found understanding that gut microbes, although not human, not only control our behavior in their own interest but also manipulate our pleasure by secreting neurotransmitters challenges this perspective and calls for a re-evaluation of mutual benefits between species. It suggests that humans are no longer the sole masters of their own bodies, and this shift in agency is not a failed goal but rather the loss of a futile illusion.

From a post-anthropocentric perspective, the question of who is acting in this situation becomes complex.

As humans themselves become a milieu for microbial life and change, the concept of *milieu* as a medium for the development of individuals is challenged, giving way to the idea of microbial "shit" as an operative space.[25] Just like the inside of a cell, the environment in which an organism resides is not just a place for resource consumption but also becomes an integral part of the organism itself. In Haraway's words,[26] the human being becomes humus, serving as compost for others.

Fecal Bankers, Operative Spaces, and New Subjectivities of Value

When considering the valuable bacteria in fecal matter in our society, the question of ownership arises: To whom do the fecal bacteria or the cloud of bacteria surrounding our bodies belong? These composites of fertilizers consist of numerous, often unknown species with the potential to produce unique or undiscovered

25 Gilbert Simondon, *Du mode d'existence des objets techniques* (Paris: Aubier, 2001).

26 Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016).

enzymes or to be manipulated in various ways to enhance enzyme multiplication, making them valuable for commercial interests.[27]

In the midst of significant changes in ecology and economics, also non-human life forms such as microbes today have become commodities. As the diversity of microbes in habitats, including the human body, declines, each microbe becomes a precious resource. This knowledge has prompted the establishment of numerous stool banks with the goal of collecting and preserving as many fecal samples as possible to conserve the diminishing diversity of microbes.[28] Stool banks aim to provide high-quality donor fecal solutions that are ready-to-use for the treatment of patients with recurrent or refractory diarrhea and intestinal damage. Several successful biobanking projects, such as the American Gut Project, have emerged, which involve sequencing, comparing, and archiving stool bacteria from participants. Purified feces, containing only relevant bacterial species without potentially pathogenic ones, not only offer a wide range of applications in the bioindustry but also represent a form of recycling of human waste in its most primal form.

The emergence of stool banks and the practice of fecal transplants challenge the traditional Western notion of the human body as a discrete, individual entity. In this new paradigm, the body is no longer solely governed by the host, as it becomes a thriving ecosystem of microbial activities. As a result, the body cannot be easily

27 Industrial Enzymes Market Report 2023, https://www.marketsandmarkets.com/Market-Reports/industrial-enzymes-market-237327836.html (accessed April 19, 2023),.

28 Clement Jose C. et al., "The microbiome of uncontacted Amerindians."

categorized as mere property of the host or a shell for microbial activities.

This shift in perspective transforms the body into an ambiguous space. As Maria Fannin suggests,[29] the body becomes a blank canvas that belongs to no one, blurring the boundaries between the self and the microbial community within. Biobanks, therefore, represent a novel form of life that transcends individuality and highlights the interconnectedness of diverse communities. This transformation also challenges conventional notions of subjectivity, objectivity, space, territory, and the public sphere.

The Pleasures of Defecation—"Defecation Euphoria"

The topic of the pleasure associated with defecation is often overlooked from a scientific standpoint. However, there are several plausible physiological reasons why people may physically enjoy the act of defecation.

One major factor is the role of the vagus nerve, a cranial nerve that sends signals between the gut and the brain. The vagus nerve has two main functions: sensory feeling and motor muscle movement. It helps to regulate muscles in the throat, heart, stomach, and bowel.

The strain of pushing during defecation triggers a signal to the brain, which can stimulate nerve responses such as goosebumps and other muscle signals that control heart rate. Additionally, changes in the shape of the rectum during defecation can result in an effect known as "defecation euphoria." This term describes the feeling of excitement or satisfaction that some people experi-

29 Maria Fannin, "Revisiting a Bodily Common: Enclosures and Openings in the Bioeconomy," in *Releasing the Commons: Rethinking Futures of the Commons*, ed. Amin Ash and Philip Howell (London: Routledge, 2016), 177-191.

ence when their rectum muscles and content pushes on their vagus nerve. This sensation is supported may by the lowered heart rate and blood pressure that occurs when the vagus nerve is stimulated during defecation.

The pleasure of defecating leads to several suggestions concerning the pleasures of talking while defecating.

Double Pleasure: The Intersection of Defecating and Talking

The act of defecation is a unique experience that connects the human body with its environment in a sensual way, and the connection between talking and defecation can be seen in various cultural practices and contexts. We here describe how the understanding of the physiological aspects of the pleasure associated with defecation may provide meaningful explanations for the observed association between speaking and defecation. The involvement of the vagus nerve, which plays a role in both defecation and vocalization, could potentially explain why some people may feel the urge to speak or vocalize during or after defecation. Furthermore, the psychological relief and satisfaction that comes with elimination may also contribute to this association.

Rohinton Mistry's novel *A Fine Balance* depicts how Indians from impoverished backgrounds squat on railway tracks and engage in discussions about the techniques of "shitting" on the tracks, including knowing the train timetable better than the station master themselves. Their embodied sense of space and time allows them to safely navigate the dangers of their surroundings. "There's only one problem with squatting on the track," said their long-haired neighbor. "You have to

stand up when the train comes, whether you're ready or not. The railway has no respect for our open-air sundaes." "Tell me, O great Goo Guruji, do you recommend that we buy a timetable if we are to squat on the tracks every morning?" "There is no need, my obedient disciple. In a few days, your stomach will know the train times better than the stationmaster."[30]

In the film *Le Fantôme de la Liberté,* directed by Buñuel in 1974, there is a scene at a dinner where the guests are seated around a table on the toilets. They politely discuss various issues around defecation while appearing to use the toilets they are sitting on. However, if a guest is hungry, they excuse themselves and retire to a private booth to eat.

This juxtaposition of speaking and defecation in different cultural contexts shows defecation as a unity of physiological and social, which will be emphasized even more in the next section.

There also is an ecosexual dynamics involved, as Paul Preciado points out in his term of anal compost,[31] especially with the orifice through which compost exits the body and enters the earth. The anus is threatening to patriarchal capitalism, though, precisely because it is sexy and reproductive—as long as anal sex is understood as sex and feces is understood as manure from which new life grows. On the other hand, Moshfegh compares the process of writing with self-fertilizing, producing, and feeding her own compost.[32]

30 Assa Doron, Ira Raja, "The cultural politics of shit: class, gender and public space in India," in *Postcolonial Studies* 18, nr. 2 (2015), 199.

31 Elvia Wilk, "This compost-erotics of rot," in *Sex ecologies*, ed. Stefanie Hessler (Cambridge, Massachusetts: MIT Press, 2021), 45–57.

32 Ottessa Moshfegh, "How to Shit," in *The Masters Review Blog*, October 20, 2015, https://mastersreview.com/how-to-shit-by-ottessa-moshfegh/ (accessed April 20, 2023).

Does the Desymbolisation of Language Reveal the Limits to Engineered Feces?

A more critical perspective on the relationship between feces (recycling) and language comes from Margret Atwood, who describes the effects of engineered feces recycling on language, in particular, the de-symbolisation of language as an indication of the limits of capitalist growth. In her dystopian narrative *Oryx and Crake* (2003), the protagonists feed exclusively on their own excrement, which results in their inability to experience feelings and conflicts, as their communication is limited to concrete references from the material world. Atwood portrays a precarious relationship between the material and the symbolic in the context of "posthumanism." From a semiotic point of view, this exuberant materiality damages the iconic and symbolic capacities of language and even renders language itself indexical, where every bodily utterance and its relation to bodies becomes a mere causal signifier of the signified. When Atwood foresees a flattening of language in contrast to the expected beneficial increase in microbial diversity through the transmission of microbes via feces, she describes the influence of feces on the brain early on, anticipating current scientific understanding of fecal bacterial neurotransmitters.

Atwood's dystopia leads to our next sections, in which we describe a society that discovers feces as a new operational space that gains value by extending the capabilities of natural fecal microbes to synthetic and artificial fecal matter.

The Immaterial Labor of Fecal Microbes

The concept of "immaterial labor" covers a wide range of activities that create value under neoliberal capitalism. We apply the concept to feces because they perform biological labor.A particular role has been played by manipulated E. coli, a species of microbe that is commonly found in human feces and has a leading role in the production of various medical agents.

Through synthetic manipulation, E. coli has become a "workhorse" that can not only produce important medical cures such as insulin and other drugs in the lab but also digest plastics, break down pollutants, produce biofuels, and generate electricity. This process illustrates that biology is no longer being replaced by machines but is becoming so interwoven with technology that the boundaries between biology and technology are becoming blurred.

What is remarkable in this context is that the source of value creation in this industry is not human labor but the work of enzymes and genes as biomedia. This "life activity" of biomedia represents a form of labor that is not tied to human subjectivity but acts as a non-human, autonomous force. This leads to the interesting questions posed by Eugene Thacker:[33] He ponders whether exploitation and/or alienation can still exist in a scenario where there is no longer a human subject and, instead, waste cells do the work. Thacker's perspective challenges traditional notions of labor and subjectivity by highlighting the agency and productivity of non-human entities in the production process. The immaterial labor of feces mediated through biomedia presents a

33 Eugene Thacker, "Biomedia," in *Critical Terms for Media Studies*, ed. W.J.T. Mitchell and Mark B.N. Hansen (University of Chicago Press, 2010), 123.

novel paradigm that encourages us to rethink our understanding of labor, value, and exploitation in the context of contemporary capitalism. It challenges us to rethink our assumptions about labor as exclusively tied to human agency and instead consider the multiple ways in which immaterial labor can manifest itself in the interconnected world of biological and technological systems.

Mock and Copy "Shit"—Fecal Microbes Expanding the Organism

Microbial organisms possess the ability to connect with their environment through non-arbitrary signs, to transcend the boundaries of their organismal existence, and to change their environment. These eco-semiotic relationships show that all organisms perceive and modify their environment by modeling and interpreting both their internal processes and their external environment. Certain forms of such "niche construction" can lead to the emergence of an "extended organism" in which energy, matter, and waste associated with microbes do not accumulate in their cells, but the environment itself is manipulated to store energy, matter, and waste in a way that benefits the microbes.[34] As a result, the environment itself becomes a reflective source of information.[35]

Thomas Sebeok goes further by describing the behavior of insects that adapt their environment to their own advantage by creating mock copies of themselves to

34 J.Scott Turner, *The Extended Organism: The Physiology of Animal-Built Structures* (Cambridge, Massachusetts: Harvard University Press, 2000).

35 See Turner, *The Extended Organism* and F.J. Odling-Smee, "Niche-constructing phenotypes," in *The role of behavior in evolution*, ed. Henry C. Plotkin (MIT Press, 1988), 73–131.

attract the attention of predators to one of their copies.[36] The agency of mimetic organisms is not limited to the boundaries of their primary bodies but extends beyond their organismic boundaries to form an extended "semiotic self." These semiotic processes create organic niches for living beings. Cultural signs such as money or language can also be seen as indicators of this extended "semiotic self" or represent an extended "semiotic self."

Through communicative processes, perceptual and sign complexes that exist in the subjective world of the receiver are translated into physical properties of this mimetic organism. This creates a non-arbitrary link between meaning and sign since the traces of subjective perception are direct effects of the physical properties.

When microbes create copies of themselves by using the functions of cultural signs,[37] this process is often accompanied by symbiosis, manipulation, or deception. In contrast to the mimetic operation referred to above, this mimicry disrupts the original-copy relationship and becomes acausal to the extent that the adapted systems mutually change through non-causal mimicry.[38] In this "biomimicry" process, microbes adapt environmental and the aforementioned cultural sign systems, such as language and money, to their own needs. However, the basis of similarity is not specific forms but meanings.[39]

36 Thomas A. Sebeok, "The Semiotic Self," in *A Sign is Just a Sign* (Indiana University Press, 1991), 36–40.

37 Sebeok, "The Semiotic Self."

38 Andreas Becker, Martin Doll, Wiemer Serjocha et al., "Einleitung," in *Mimikry: Gefährlicher Luxus zwischen Natur und Kultur,* ed. Andreas Becker, Martin Doll, Wiemer Serjocha et al. (Schliengen: Edition Argus, 2008), 7–27.

39 Timo Maran, "Semiotization of Matter: A Hybrid Zone Between Biosemiotics and Material Ecocriticism," in *Material Ecocriticism,* ed.

Ontomutation of Fecal Matter

In the realm of fecal microbes, perception, and existence, as well as sexuality and metabolism, are inextricably interwoven. For microbes, substance and form, materiality and intelligence, being and knowledge are interdependent because they do not adhere to fixed boundaries of metabolism, sexuality, or migration. They embody the malleability of matter within themselves and experience their perceptual relationship to the environment as lived materiality, as Barad also explains.[40]

The boundary between organic and inorganic matter cannot always be clearly drawn when both types of matter exhibit characteristics of both. In particular, the question arises of how humans can operate cultural signs as part of their own biochemical processes through their microbiota. Luciana Parisi, following Lynn Margulis's ecology of symbiogenesis, calls this sensory perception of information between organic and inorganic matter "symbiosensation."[41] Symbiosenation represents a state of constant overlap between information and perception, with new media ecologies serving as a model.

When this techno-ecology of perception extends from the realm of organic matter to non-organic states of matter, it leads beyond the biological fusion of dif-

Serenella Iovino and Serpil Oppermann (Indiana University Press, 2014), 141–154.

40 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham: Duke University Press, 2007).

41 Luciana Parisi, "Technoecologies of Sensation," in *Deleuze/Guattari & Ecology,* ed. Bernd Herzogenrath (Palgrave Macmillan, 2009), 182—199.

ferent entities to an "ontomutation" of microbiota, in our case, of the feces themselves.[42]

These considerations lead to pragmatic questions regarding the bioanalogical properties of feces. What responses to the environment, growth and change, replication and homeostasis, consistent with some but not all definitions of life might faeces actually exhibit? These include neural network-based artificial intelligent faeces and the development of a simple, self-sustaining, self-organising and self-regulating distributed "organism" as an operationally closed system that could meet basic criteria for life.

Towards a Faecal Microbiota-Inspired New Life Form: The "Shitoid"

Finally, we now speculate on useful applications of the artificial life forms described in the previous section, referred to here as "shitoid" in reference to the concept of the plant-based robot "Plantoid" by Barbara Mazzolai.[43]

Applied "shitoids" offer some capabilities over biological life. These capabilities could include monitoring the replication and adaptive behavior of its own organism, as well as environmental monitoring for pollutants. Shitoids have the ability to sense and respond to various environmental stimuli as they slowly move through the environment. Their enhanced sensory abilities allow them to develop specific growth responses to changing external biotic and abiotic conditions and to transmit

42 Erich Hörl, "Introduction to General Ecology," in *General Ecology: The New Ecological Paradigm*, ed. Erich Hörl and Burton James Edward (London: Bloomsbury Academic, 2017), 1–74.

43 Barbara Mazzolai, "Plant-inspired growing robots," in *Soft Robotics: Trends, Applications and Challenges*, ed. Cecilia Laschi et al. (Berlin: Springer, 2017), 57–63.

and receive information to and from other feces, humans, plants, animals, or fungi, leading to the development of complex adaptive behaviors. This process would generate data with which the "shitoid" could then be fed. Based on their technical equipment and potential controllability as artificial intelligence, they have some evolutionary capabilities. These advantages include a more objectifiable precision of perception, a greater speed, a direct transmission of characteristics to the offspring, and the associated potentially unlimited lifespan.

Applications are also in the medical field, where shitoids strategies can inspire the development of new forms of transplantation.[44] Public fecal banks can be more communally regulated via decentralized, non-fungible fecal tokens in the service of sophisticated "shit commons" banking.

Building such "shitoids," with their enhanced sensory actuation mechanisms and behavior in time and space, would certainly require an interdisciplinary approach that goes beyond traditional manufacturing methods and incorporates knowledge from fields such as biology, materials science, engineering, and robotics.

The "shitoid" can ultimately also be used as an educational platform to give new defecating generations a better understanding of how their real "shit" works. A "shit-literate" bot can teach people to view their "shit" as a complex organism in its own right, fundamentally endowed with sensory capabilities, a special form of intelligence, and adaptive abilities that foster respect for its potential and capabilities that are often overlooked.

44 Barbara Mazzolai, Lucia Beccai, and Virgilio Mattoli, "Plants as model in biomimetics and biorobotics: New perspectives," in *Frontiers in Bioengineering and Biotechnology* 2, (2014): 2.

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What's vilest in the world if not the Mind? It is the body that recoils from filth and crime. Like the fly, the Mind settles on everything. Nausea, disgust, regrets, remorse are not its properties; they are merely so many curious phenomena for it to study. Danger draws it like a flame and if the flesh were not so powerful would lead it to burn its wings, urged on by a fierce and fatuous lust for knowledge.
— Paul Valéry, *Analects* (trans. 1956)

Loathing an item of food, a piece of filth, waste, or dung. The spasms and vomiting that protect me. The repugnance, the retching that thrusts me to the side and turns me away from defilement, sewage, and muck. The shame of compromise, of being in the middle of treachery. The fascinated start that leads me toward and separates me from them. Food loathing is perhaps the most elementary and most archaic form of abjection.
— Julia Kristeva, *Powers of Horror: An Essay on Abjection* (1980)

Lord! said the Partridge, Cock, Puet,
Snite, and Quail,/
Pigeons, Larks, my Masters,
why d'ye rail?/
You're kept from Winter's
Cold, and Summer's heat,/
Are taught new Tunes, and
have good store of meat./
Having a Servant
you to wait upon,/
To make your Cages clean
from filth, and Dung:/
When we poor Birds are by
the dozens killed,/
And luxuriously us eat, till
they be filled:/
And of our Flesh they make
such cruel waste,/
That but some of our Limbs
will please their taste./
— Margaret Cavendish, *A Dialogue of Birds* (1664)

Violations of conventional values (immorality) by others are included here. For example: "Seeing crude sexual behavior." "Drinking, breaking the law."