DATAPOLIS

EXPLORING THE FOOTPRINT OF DATA ON OUR PLANET AND BEYOND
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VIBRANT DATA: THE SEWER AS INFORMATION INFRASTRUCTURE
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(An Archaeology)

This is a transcription of social movement and the transmission of bodies, complete and incomplete. It is a record of circulations past and present. It moves at the horizon between political techniques of objective totalization and technologies of subjective individualization, and their expressions through code and protocol on the one hand, and desire and consumption on the other.[1] A peristaltic—and thus moving, changing—image of the social, through the sewer.

This is a reading of excrement through theories of information.[2] It is a materialization of flows of information and social circulations of belief and desire. To excavate the sewer as a site of vibrant[3] data is not only to contend with millennia of civilizations built and eroded, or with the management of bodily fluids, disease and populations, but it is also to confront a symbolic structure of the state form,[4] and the convergence in contemporaneity of a high-speed networked global economy with the slow-moving sludge of bodily waste. It is an archaeology that peers into the depths of our own ex-embodied excreta. But rather than suspending excrement in a realm of abject self-alienation,[5] this study recuperates our shit to reveal the glimmers of its potency in historical and contemporary fertilization and medicinal practices, as well as its potential as a source of collectivized data. Reading shit in this way has implications for an embodied (meta)physical approach to data as a social substance. This is not to say that we must instrumentalize and capitalize on even those residues of excrement that are passively produced by the shared labour that is our digestion.[6] Instead, what we trace here is a 'zone of irreducible indistinction', indeed, a zone of biopolitics that can—and must—be extricated from the realm of semiotic biopower and quantifiable code.[7]

By bringing together the recent use of sewage surveillance for public health and Covid-19 monitoring with the installation of fibreoptic data cables in existing sewers, I propose a reconsideration of the metaphysics of data that gestures towards a communal and biosocial understanding of information. The vibrant data of the sewer might revitalize the notion of the multitude via Gabriel Tarde's concept of the microsocial, tracing the flows of the social through the dynamic material flows of the sewer and the coded informational flows of the fibreoptic cable. In Tarde's theory, the binary of individual versus collective is set aside for the concept of the microsocial, in which social flows—beliefs and desires—are in motion,

aggregating into social forms like institutions.[8] The notion of vibrant data might also reveal a semantic valence of biopolitics, one that can offer a mode of engaging information that refuses immediate reduction to positions of greater or lesser value and instead attends to the contextual, relational aspects of transmission and communication. Can we treat the use and study of data not as individualized points of consumer preferences or overcoded collective masses, but instead as sets of social flows that produce and allow for multiple and overlapping meanings?

In foregrounding the sewer as an infrastructure for the circulation of information, perhaps we can better understand collective pictures of local, communal microbiometrics, their correlations with ecological factors and their implications for public health. By acknowledging the vibrancy of data and its relational status, perhaps we can also shift our notions of public and collective, of life and matter, of how the social forms and flows—even in the bowels of our cities.

Viral Data: Biopolitics of the Sewer

In *History of Shit*, Dominique Laporte describes the institution of protocols around hygiene, including the handling of all manner of waste and the building of cesspools in the year 1539 in France. In the same year, these hygienic codes collided with an edict establishing the official language of France, thus unifying and reinforcing the power of the monarchy. Together, these protocols, where shit and language coincide, can be read as a registration of the idea of the nation-state.[9] Here, base bodily function meets with the establishment of the institution of language—which might be considered the basis for and which makes possible political life.[10] Giorgio Agamben describes biopolitics as the 'zone of irreducible indistinction', where bare life and political life, where inside and outside, can no longer be separated. He calls for a new politics to be invented.[11] Why wallow in the sewage of our already existing present? The sewer is a site for the collision of bare life and political life. What has historically been an infrastructural necessity has become once again an index of the biopolitical.

The Covid-19 pandemic has created new global circumstances that have demanded large-scale responses and technological developments at a previously untested scale and speed. The pandemic has brought with it new governmental protocols, social behaviours and economic problems. One of the innovative by-products of the pandemic has been the initiation of sewage surveillance, which studies and monitors the prevalence of the SARS-CoV-2 virus and the RNA of specific virus strains in sewage.[12] For example: the National Institute for Public Health and the Environment of the Netherlands first monitored sewage from Schiphol Airport in mid-February 2020 and has now partnered with the 21 regional water boards of the country to monitor all of the more than 300 sewage treatment plants in the Netherlands for SARS-CoV-2 virus particles.[13] In the United States, the Centers

for Disease Control and Prevention and the US Department of Health and Human Services initiated the National Wastewater Surveillance System to understand the prevalence of SARS-CoV-2 in local communities.[14] In the UK, the Health Security Agency has started testing for SARS-CoV-2 RNA in the Environmental Monitoring for Health Projection wastewater programme, taking samples from sewage treatment works and sewer network sites.[15]

Sewage surveillance can provide a collective picture of the scale of infection in a community or communities, even when virus symptoms are not present or when testing is unavailable or not used. Sewage surveillance can thus provide local health administrators and citizens with early warnings of possible spikes in infection localized in particular communities, prior to detection through testing or clinical presentation. Importantly, sewage surveillance is not dependent on behavioural compliance or changes in policy. It is based on the bare, material fact of regular bodily functions. These sewage surveillance programmes have potential uses in other public health initiatives—for studying populations and their health, or for looking at broader ecosystems and watersheds and the effects of climate change on them. For instance, sewage and wastewater surveillance has been used to monitor other viruses, such as noroviruses, hepatitis E and polio; to examine antibiotic resistant bacteria or antimicrobial resistance; to monitor spatial and temporal trends of recreational, illicit and pharmaceutical drug use on local and international scales; and to monitor the presence and possible ecological effects of microplastics in wastewater.[16] Collecting excrement and studying it has become a source of vital information about local public health.

Shit itself is vital. Humans have long used the excrement of both humans and animals as fertilizer. Consider, for example, the pigeon towers of Isfahan, which were built solely to house pigeons and their excrement to be used as manure.[17] More recent initiatives have returned to ancient practices of converting human faeces into fertilizer to deal with waste accumulation while nourishing poor soil, or to process excrement for use as fuel after removing water and sanitizing it.[18] We use excrement now not just to fertilize land or to burn as fuel, but also to support life and living. Recent research into the gut microbiome and faecal microbiota transplants has made this more urgently evident. Jane Bennet has written about tracing chemical exuberances through bodies and sites, and Michelle Murphy about how microbiome research reveals that humans are collectivities, rather than discrete, contained bodies.[19] Studying the microbiome has made clear that our bodies are not singular, but instead always already irreducible and ungraspable multiplicities. Microbiomes are not bounded within the confines of our bodies, but instead spill over and out, commingling to produce new ecosystems, relations and assemblages. But while these studies are applicable on the level of broader populations, the use of faecal matter in faecal microbiota transplants is still individualized, on a one-to-one, bowel-to-bowel basis. The *United European Gastroenterology Journal* specifically states that:

Pooling (mixing) of multiple donor faeces during processing is not recommended because: (a) it hampers the traceability of the faecal preparation to the individual donor; (b) the risk of transmissible disease may be increased; and (c) the principle of transfusing a balanced microbiota preparation may be lost.[20]

Ancient historical practices, while perhaps failing to meet present-day medical and hygienic standards, might point to more collective and communal uses of faecal treatments. For instance, even as early as the fourth century CE, ancient Chinese medical texts refer to cures for the treatment of food poisoning, severe diarrhoea and otherwise incurable conditions with various faecal or fermented faecal treatments administered by mouth and otherwise, including the sealing of liquorice root in bamboo that was left in a village latrine for a year, then retrieved and ground up for poultices or other therapies.[21] Such approaches demonstrate the basis for a social and local use of faecal matter, for a socially and locally situated understanding of the internal microbiome and its co-constitution with, by and of local, social, bodies.

As individuals, we are necessarily and urgently situated in an environment, within an ecological assemblage of other humans, of networked communication, of macro-watersheds and of the microbial matter that co-constitutes our bodies. Locality matters here. Methodologies can be translated and scaled up or down, but it matters *whose* shit is mixing *where*. The vitality of our sewage, which is teeming with microscopic life—with the diversity of microbiotic bacteria and viral RNA, next to traces of environmental chemical leakages and the residues of microplastics that have also journeyed to and subsequently through our bodies—points much more to *multitude* and crowd than to the sewer's ancient architectural symbolic status of *civilization*. Michel Serres has written about the crowd and its solidification into institutions or foundations: 'The crowd is fluid. An institution stable, is solid. The foundation solidifies the crowd.'[22] Attending to the biopolitics of sewage and its data re-liquifies such solidified crowds into fluidities, into flows, into multitudes.[23] These are crowds and pluralities that exist in a state of multiplicity and motion, where they are not unified or homogenized and thus are not (yet) objectified into a people or a collective subject of the state. In *The Grammar of the Multitude*, Paolo Virno writes about Spinoza's concept of the multitude, wherein 'the *multitudo* indicates a plurality which persists as such in the public scene, in collective action, in the handling of communal affairs, without converging into a One, without evaporating within a centripetal form of motion.'[24] A centripetal form of motion focuses on a singular, central point, bringing everything together into a simultaneity, at the same speed and in the same direction. But the multitude flows freely, retaining a plurality of possible directions. Virno describes multitude as 'the form of social and political existence for the many, seen as being many'.[25] The multitude is the crowd before it becomes a people, an addressee or a targeted collectivity. It is this 'many, seen as being many' that is in dynamic motion in the circulating excrement—and chemical, biological and ecological information—that flows through our sewers. The sewer, then, or the lower stratum of the built and inhabited environment, is where the material substance of the multitude flows, alongside its potency as a streaming source of viral, vital data.

If the biopolitics of the sewer speaks multitudes, what else can we find as we trace the moving contents of these social infrastructures?

Digital Waste: The Sewer in the Information Age

Excavating sewers reveals much about the societies that built them. They are archaeological evidence of feats of engineering and can trace histories of urban development and morphology.

The contents of sewers reveal the social histories of a particular group of inhabitants, as much about cultural dietary practices as about differences in socioeconomic class.[26] In 'Deep Time of Media Infrastructure', Shannon Mattern describes how our infrastructures—and in particular, infrastructures of communication—are layered over time, rather than merely replaced or phased out.[27] The sewer presents itself as such an infrastructure that layers large-scale hygienic utilities with communications infrastructure: next to excrement, sewers also host fibreoptic cables that are installed there to avoid the expense, disruption and sometimes destruction of digging new tunnels under cities. Like excrement, which has long been sequestered underground, data cables are not ordinarily visible or present. Nicole Starosielski locates the invisibility of cable systems within 'a broader social tendency to overlook the distribution of modern communications in favour of the more visible processes of production and consumption' rather than 'any intentional desire to obscure cable systems'.[28] Making visible such communication distribution systems might be akin to attending to the concealed bodily processes of digestion and excretion that have long been ignored or overlooked in light of production and consumption.[29]

A closer look at the layered infrastructures of the sewer and the data cable shows a pragmatic coupling of the two. The use of existing infrastructure like sewers and pipes for the installation of fibreoptic cables offers financial benefits, as well as the possibility of monitoring the—often aging—infrastructures for leaks during installation.[30] The first instance of installing fibreoptic cables in existing sewers was in the United Kingdom in 1984, by the Water Research Centre.[31] Since then, different techniques have been implemented globally for installing fibreoptic cables in sewers. While early methods used robots and drill and dowel techniques, other methods include the implementation of cabling trays, or the installation of lining systems that simultaneously fortify deteriorated sewers and provide protective housing for cabling.[32] Fibreoptic cables continue to be installed in sewer lines, especially in ongoing efforts to rapidly extend broadband capacity to more and more users, particularly those outside of more densely inhabited metropolitan areas.[33] The sewer has thus become part of the conduit system of networked infrastructures that produce and circulate social media, platform-based economies and new financial instruments.

This convergence of the network and the sewer—or, the network *in* the sewer—brings the material and immaterial multitude together. The mingling of bodily and disembodied activity also muddles the already blurred boundaries of public and private. Tung-Hui Hu compares the privatization of the Internet following its initial design and usage via time-sharing to the privatization of hygiene via the sewer system: 'Centuries before computers were invented, sewers kept each household's private business private even as it extended the armature of the state into individual homes.'[34] While the sewer was designed to keep the waste of individuals private, opening up the sewer as a vital source of social data might be able to de-privatize human functions both excretal and digital.

Subterranean fibreoptic cables carry new products of biopower: digital waste and data collected from our content production and consumption; violent, digital pollution that is cleared by the invisible labour of content moderators; and platform-mediated, network-based economic exchanges. The data cable is a part of a larger network of the Internet

of things through which soft pollution—disembodied waste and its biopolitical affects—circulates. In the sewer, we come to find the circulation of multiple streams of excreted and expelled vital data. While there are myriad ways to analyse data and its social effects, one mode of analysis might point to Gabriel Tarde's early description of social flows as *beliefs* and *desires*.[35] In fact, these elements are perhaps some of the most valuable data currently collected and analysed. Marketing to beliefs allows for the shaping of political views, opinions and even electoral outcomes, and marketing to desires generates advertising revenues, optimized product development research and increased sales.[36] Might it be possible that beliefs and desires are some of the most instrumentalized aspects of digital activities? The profiles that are created from the traces of our digital activities—the digital traces of our beliefs and desires—'produce estimating patterns and anticipate potentialities: consumption preferences, economic value, behavioural inclinations, professional capacities, virtual diseases, political preferences.'[37]

> The content and composition of our collective excrement can also be studied in terms of their material manifestation of desire and belief. The consumption of food, pharmaceutical and recreational drugs, and other substances are often tied to our corporeal desires and structures of belief, whether rooted in religious observance or within a body of sociomedical knowledge. Agamben writes about the term *diet*, wherein maintenance of life coincides with a regulatory and formal process. The ancient medical term *diaita,* he writes, 'designates the regime of life, the "diet" of an individual or a group, understood as the harmonic proportion between food (*sitos*) and physical exercise or labour (*ponos*)', while also being the term for 'arbitration that decides a suit not according to the letter of the law but according to circumstances and equity'.[38] The term has further developed to mean 'a political assembly with decision-making power'.[39] As both 'mode of life' and the 'governance and regime of life', *diet* thus regulates the body at the intersection of the biological axis and the political axis of life and living.[40] Along these lines, we find that code and protocol, expressed through both digital activity and dietary practice, circulate the social through the sewer. What are the biopolitical implications of these sociopolitical flows, if we are not to be completely and immediately reduced and subsumed to mechanisms of capitalism as units or profiles of consumer and consumption? How might the multitude and the beliefs and desires—the excremental traces of data and digestion—that move and make the social offer another perspective, another possibility for life and living?

>> The confluence of digital and dietary waste in the sewer points to a composite notion of sociality. Rather than thinking through the binary of individuals versus collective mass, it might be helpful to turn to Fernanda Bruno and Pablo Manolo Rodriguez's theorization of a 'complex dividual-individual composition' that is constituted via 'biotechnologies, digital culture, and financial capitalism' and its appearance via biogenetics, digital profiles, mobile applications, wearable technology or financial subjects.[41] According to anthropological perspectives, and as described by Marilyn Strathern in her discussion of Melanesian persons and personhood, the dividual contains 'a generalized sociality within. Indeed, persons are frequently constructed as the plural and composite site of the relationships that produce them.'[42] In the sewer we find a social manifestation of the plural and composite site of relations, made up of not

only the biomass of persons, divided and 'disseminated in a "biological matter" related to, but not contained in, this individuality', or the 'traces about our lifestyles that feed huge and valuable databases' that together make up digital profiles, but also the material and immaterial expressions of our ongoing relationships.[43]

This site of relations is where, as described by Rosi Braidotti, a 'missing and virtual' people can be 'actualized and assembled'.[44] This is not the people in opposition to the multitude, created as a manageable mono-ubject of the state. Rather, it is 'the result of a praxis, a collective engagement to produce different assemblages'.[45] In the sewer we find that although 'we are not one and the same ... we can interact together'.[46] And in encountering the sewer's disparate traces of forms of living, from data to bodily waste, we might be able to view life and living as 'on-going flows and transformations of forces'.[47]

To better approach the fluid dynamics of the crowded multitude streaming through the sewer,[48] we might turn to the notion of *flow*.

Vibrant Flows: Circulating the Social

Viewing shit as data—and data next to shit—allows for a consideration of the vital materiality and movement of both digital data and physical excrement. Barbara Orland conceptualizes the history of knowledge of material, writing that '*flow*, or current, describes the directed kinetic movement of either a fluid continuum of a substance or a multitude of similar singularities'.[49] Within the sewer, the fluid continuum of excretal sludge and the multitude of digital dividuals flow together.[50] This course of movement is the terrain of biopolitics that Eugene Thacker describes in which a decomposing, disintegrated, diseased body politic is addressed by forms of governance that regulate 'networks, flows, and circulations'.[51]

Here we turn to Gabriel Tarde's concept of microsociology in which 'the social ... is a circulating fluid',[52] or the movement of flows of 'belief or desire'.[53] Tarde looks at diverse, small social interactions as the basis for analysing the social, rather than generalizing about collective social wholes, institutions or processes.[54] For Tarde, the 'distinction between the social and the individual loses all meaning since flows are neither attributable to individuals nor overcodable by collective signifiers'.[55] These flows are 'created, exhausted, or transformed, added to one another, subtracted, or combined'.[56] In Tarde's microsociology, a social unit can be understood as an 'ensemble, compound, or configuration of previously disperse flows of desires and beliefs'.[57] These compositions are subject to change, increasing or decreasing depending on what is added to or subtracted from the ongoing current.[58] Yet while the social and individual are not the primary figures in Tarde's microsociology, they can still be 'understood as open ensembles of immanent, contingent, and partial relationships of beliefs and desires in continuous change'.[59] It is such an open assemblage of immanence, contingency and partiality that we find in the swirling multitude of the sewer, and in its continuous, changing movement.

If prior practices of biopolitics have been cached in the realm of valuation, classification, quantification and regulation—practices related to signification and the semiotic—then perhaps the notion of shit as data and the vital materiality of data can shift these practices into a semantic realm, into meanings that shift and move, just as our data and excrement do. The notion of vibrant data attempts to resist the semiotic, financialized arrest of data by grounding information *through* materiality and its social flows. N. Kathleen Hayle discusses the disembodiment of information during the Macy Conferences on Cybernetics, when Norbert Wiener and Claude Shannon established a stable conception of information that was divorced from meaning and instead focused on the transmission of messages, excluding consideration of their context or the observer. For Shannon, 'defining information as a probability function was a strategic choice that enabled him to bracket semantics'.[60] What would it mean to return semantics to information? How might we allow semantics to enter into the circulation of data and shit that flush through the sewers, so that the meeting of sewage and language does not merely reproduce Laporte's recollection of the institution of centralized state power?

The semantic, according to linguist Émile Benveniste, opens up a notion of language that is a site of transformations, language as something that moves, rather than merely a linguistic system that rigidly upholds signs.[61] A reconsideration of the semantic aspect of information revisits the establishment of cybernetics and the construction of information as disembodied and dematerialized to retrace an alternate route in which information is necessarily dependent on and subject to structural, social and material conditions. The information in our data and biomass is necessarily relational, as are our biogenetics: 'Like the dividual self in an anthropological sense, genomic data gain their meaning and utility in reference to the wider genomic cohort.'[62] The sewer as an information infrastructure allows for a relational and semantic approach to individual and dividual excrement and data. For in studying sewage, it is impossible to identify individual sources. Instead, that information must be considered in the context of the other matter that flows with it, without being coded back to original addresses. If we take a similar approach and study collected sets of digital data rather than data attributed to identified individuals, perhaps we can view data in light of its relations, as sets of changing and growing social flows.[63] In this sense, data—and its meanings—are not objectified or reified, but rather, they remain in motion, as sites for transformations.

A semantic approach to the flow of information—both digital and excretal—does not instigate the creation, maintenance and subjugation of sets of individualized subjectivities, nor does it actuate the overcoded collective subjectivities that can become tools of market research or optimized product development. Rather, this is a social subjectivity that is contingent. It produces flows of information that necessarily depend on senders, observers and environs—and these not merely as positions of value. It reconfigures information as 'compositions of the multiple collective flows' of the microsocial.[64] The excess traces of our digital and bodily activities, data and excrement manifest this informational flow that is 'the social tissue [that] always both composes and overflows the social organs'.[65]

In allowing our digital and material biosocial substances to overflow, we might arrive at a notion of grotesque data by way of Mikhail Bahktin's analysis of Rabelais's writing and world. In Rabelais's writing, 'the body

and bodily life have here a cosmic and at the same time an all-people's character'.[66] The body is not individualized, and the 'material bodily principle is contained not in the biological individual ... but in the people, a people who are continually growing and renewed'.[67] This, writes Bakhtin, is why 'all that is bodily becomes grandiose, exaggerated, immeasurable', why the overflowing, overgrowing body becomes grotesque.[68] The sewer circulates the social through the continually changing flow of bodily excrement and digital waste. It is the site for the circulation of embodied information and the materialization of data as a social substance. Reading data through the vital contents of the sewer might allow the multitude to overflow both individualization and mass collectivities, to instead circulate through multiple meanings and relational compositions. These social flows might enable the creation of alternate biopolitics, of a biopolitics that escapes individual capture and collective overcoding, or subjective individualization and objective totalization.

Grotesque social overflows of the body are sites of becoming, and sites of the potency of life. The sewer is the space that hosts this immense potentiality.

Notes

1   Giorgio Agamben, *Homo Sacer*, trans. Daniel Heller-Roazen (Stanford: Stanford University Press, 1998), 5.
2   For example, Eric Hayot discusses the conflation of 'information' with 'communication' by Claude Shannon and Warren Weaver in *The Mathematical Theory of Communication* as a paradigm shift in the theorization of information. In modern history, information has come to mean 'that which has no fixed form, but can be passed on from one person to another, or one medium to another, without either being significantly altered in itself, or altering that which it touches'. Eric Hayot, introduction to: Eric Hayot, Anatoly Detwyler and Lea Pao (eds.), *Information: A Reader* (New York: Columbia University Press, 2022), 6–7.
3   Or, in line with Jane Bennett's analysis, the vital materiality of things and substances and their capacity as forces or agents. Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010), 113–119.
4   Georges Bataille, 'Architecture', in: Neil Leach (ed.), *Rethinking Architecture* (London: Routledge, 1997), 19–20.
5   See: Julia Kristeva and Leon S. Roudiez, *Powers of Horror: An Essay on Abjection* (New York: Columbia University Press, 1982). Kristeva elaborates on the abject as something other than the self that is, for instance, unclean or unhealthy, that which 'disturbs identity, system, order. What does not respect borders, positions, rules. The in-between, the ambiguous, the composite.' Within this plane of analysis, 'excrement and its equivalents (decay, infection, disease, corpse, etc.) stand for the danger to identity that comes from without.' Ibid., 4, 71.
6   See, for instance: Sabrina Chou, 'Live Tenders: An Incomplete Theory of Social Digestion', *Thresholds* 48 (2020), 176–185, for a possible notion of the political implications of collective digestion.
7   Agamben, *Homo Sacer*, op. cit. (note 1), 9.
8   Gilles Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1987), 219; see also: Gabriel Tarde, *Monadology and Sociology,* ed. and trans. Theo Lorenc (Melbourne: re.press, 2012).
9   Dominique Laporte, *History of Shit*, trans. Nadia Benabid and Rodolphe el-Khoury (Cambridge, MA: MIT Press, 2000), 2–9.
10   Hannah Arendt describes speech and action as what allows humans to appear to one another, to relate to one another, and as what constitutes the space of the *polis*, rather than any physical location. Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 1958), 174–88, 196–99.
11   Agamben, *Homo Sacer*, op. cit. (note 1), 9.
12   Tomáš Mackul'ak et al., 'Wastewater-Based Epidemiology as an Early Warning System of the Spreading of SARS-CoV-2 and Its Mutations in the Population', *International Journal of Environmental Research and Public Health* 18/11 (2021), 5629.
13   'Coronavirus Monitoring in Sewage Research', Rijksinstituut voor Volksgezondheid en Milieu (Dutch National Institute for Public Health and the Environment), https://www.rivm.nl/en/covid-19/sewage, last modified 12 September 2022.
14   'National Wastewater Surveillance System', Center for Disease Control and Prevention, https://www.cdc.gov/healthywater/surveillance/wastewater-surveillance/wastewater-surveillance.html, last modified 21 March 2022.
15   'Wastewater Testing Coverage Data for the Environmental Monitoring for Health Protection (EMHP) Programme', UK Health Security Agency, https://www.gov.uk/government/publications/wastewater-testing-coverage-data-for-19-may-2021-emhp-programme/wastewater-testing-coverage-data-for-the-environmental-monitoring-for-health-protection-emhp-programme, last modified 10 June 2021.
16   Mackul'ak et al., 'Wastewater-Based Epidemiology', op. cit. (note12), 5629; Kevin V. Thomas et al., 'Comparing Illicit Drug Use in 19 European Cities Through Sewage Analysis', *Science of the Total Environment* 432 (2012), 432–439; Jing Sun et al., 'Microplastics in Wastewater Treatment Plants: Detection, Occurrence and Removal', *Water Research* 152 (2019), 21–37.
17   Michael Hensel et al., 'Towards an Architectural History of Performance', *Architectural Design* 82/3 (2012), 26–37; Elisabeth Beazley, 'The Pigeon Towers of Isfahan', *Iran* 4 (1995), 105–109.
18   Chelsea Wald, 'The New Economy of Excrement', *Nature* 549 (2017), 146–148.
19   Bennett, *Vibrant Matter*, op. cit. (note 3), 113–119; Michelle Murphy, 'Against Population, Towards Alterlife', in: Adele E. Clarke and Donna Haraway (eds.), *Making Kin Not Population* (Chicago: Prickly Paradigm Press, 2018), 115. For a discussion of the multiplicity of bodies in relation to excrement and microbiota, see also: Anna Wolodzko, 'Bodies Within Affect' (PhD dissertation, University of Leiden, 2018), 145, 162–165.
20   Josbert J. Keller et al., 'A Standardised Model for Stool Banking for Faecal Microbiota Transplantation: A Consensus Report from a Multidisciplinary UEG Working Group', *United European Gastroenterology Journal* 9 (2021), 229–247.
21   See: Pieter de Groot, 'Fecal Microbiota Transplantation in Metabolic Syndrome: History, Present and Future', *Gut Microbes* 8/3 (2017), 253–267; 王国华, '最好的藥' ['The best medicine'], 視野 [*Horizons*] 13 (2014), 21.
22   Michel Serres, *Rome: The First Book of Foundations,* trans. Randolph Burks (London: Bloomsbury, 2015), 201.
23   Recent studies have framed the digital crowd as a 'form of contemporary collective life for practicing symbolic politics' that also extend 'the crowd's affective and cognitive attributes, well beyond its duration of physical gathering and actions'. Hazem Ziada, 'The Digital Crowd', *Architecture and Culture* 8/3–4 (2020), 653–666.
24   Paolo Virno, *A Grammar of the Multitude: For an Analysis of Contemporary Forms of Life*, trans. Isabella Bertoletti, James Cascaito and Andrea Casson (Los Angeles, Semiotexte, 2004), 21–22.
25   Ibid., 21–22.
26   Erica Rowan, 'Bioarchaeological Preservation and Non-elite Diet in the Bay of Naples: An Analysis of the Food Remains from the Cardo V Sewer at the Roman Site of Herculaneum', *Environmental Archaeology: The Journal of Human Palaeoecology* 22/3 (2017), 318–336.
27   Shannon Mattern, 'Deep Time of Media Infrastructure', in: Lisa Park and Nicole Starosielski (eds.), *Signal Traffic: Critical Studies of Media Infrastructures* (Chicago: University of Illinois Press, 2015), 95–112.
28   Nicole Starosielski, *The Undersea Network* (Durham, NC: Duke University Press, 2015), 4.
29   See: http://www.fiberatlantic.com/submarinecablemap/ for a map of undersea cables.
30   Stefan Stanko and Ivana Mahrikova, 'Implementation of Fibre Optic Cables in Sewage System', in: Petr Hlavinek et al. (eds.), *Integrated Urban Water Resources Management* (Dordrecht: Springer, 2016), 171–180.
31   Sanjiv Gokhale, 'Deployment of Fibre Optic Networks through Underground Sewers in North America', *Journal Of Transportation Engineering* 132/8 (2006), 672–682.
32   Ibid., 673–677.
33   Ibid., 672.
34   Tung-Hui Hu, *A Prehistory of the Cloud* (Cambridge, MA: MIT Press, 2016), 37–71, 41.
35   Tarde, *Monadology and Sociology*, op. cit. (note 8), 16–18.
36   Shoshanna Zuboff, *The Age of Surveillance Capitalism* (New York: PublicAffairs, 2019), 37–51.
37   Fernanda Bruno and Pablo Manolo Rodriguez, 'The Dividual: Digital Practices and Biotechnologies', *Theory, Culture and Society* 39/3 (2021), 39–40.
38   Giorgio Agamben, *The Use of Bodies*, trans. Adam Kotsko (Redwood City, CA: Stanford University Press, 2016), 225–226.
39   Ibid., 225.
40   Ibid., 225–226.
41   Bruno and Rodriguez, 'The Dividual', op. cit. (note 37), 40.
42   Marilyn Strathern, *The Gender of the Gift: Problems with Women and Problems with Society in Melanesia* (Berkeley: University of California Press, 1990), 13.
43   Bruno and Rodriguez, 'The Dividual', op. cit. (note 37), 39–40.
44   Rosi Braidotti, *Posthuman Knowledge* (Cambridge: Polity Press, 2019)*,* 101. Judith Butler writes about the potential in acts of assembly that are enactments of the gathering of bodies that allow for difference rather than mass homogeneity: '… *the assembly is already speaking before it utters any words* … To act in concert does not mean to act in conformity; it may be that people are moving or speaking in several different directions at once, even at cross purposes.' Judith Butler, *Notes Toward a Performative Theory of Assembly* (Cambridge, MA: Harvard University Press, 2015), 156–157.
45   Ibid., 101.
46   Ibid., 101.
47   Ibid., 100. Here Braidotti is discussing Deleuze's assertion that life is not one system.
48   Indeed, the movement of crowds is studied using the physics of fluid dynamics. See, for example: Muhammad Umer Farooq et al., 'Motion Estimation of High Density Crowd Using Fluid Dynamics', *The Imaging Science Journal* 68/3 (2020), 141–155.
49   Barbara Orland. 'Matter in Flux: How to Study the Dynamic States of the Material World', in: Jennifer Teets (ed.), *Electric Brine* (Berlin: Archive Books, 2021), 43–63.

50   See Manuel Castells's discussion of the network as the 'space of flows'. Manuel Castells, *The Rise of the Network Society* (Oxford: Blackwell Publishers, 2000), 442. For the engineering of sewage flows, see: Thomas Barlow, *Hydraulics: Gauging of Sewage Flows, etc.: A Handbook of Rules and Tables for Engineers and Managers of Sewage Disposal Works* (London: Lockwood, 1926); Franz Tscheikner-Gratl et al., 'Sewer Asset Management: State of the Art and Research Needs', *Urban Water Journal* 16/9 (2019), 662–675.

51   Eugene Thacker, 'Necrologies; or, the Death of the Body Politic', in: Patricia Ticineto Clough and Craig Willse (eds.), *Beyond Biopolitics: Essays on the Governance of Life and Death* (Durham, NC: Duke University Press, 2011), 152.

52   Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2007), 13.

53   Deleuze and Guattari, *A Thousand Plateaus*, op. cit. (note 8), 219.

54   Sergio Tonkonoff, 'A New Social Physic: The Sociology of Gabriel Tarde and Its Legacy', *Current Sociology* 61/3 (2013), 267–282.

55   Deleuze and Guattari, *A Thousand Plateaus*, op. cit. (note 8), 219.

56   Ibid., 219.

57   Tonkonoff, 'A New Social Physic', op. cit. (note 54), 275.

58   Ibid., 275.

59   Ibid., 276.

60   N. Katherine Hayles, *How We Became Post-Human* (Chicago: The University of Chicago Press, 1999), 50–55.

61   Émile Benveniste, *Last Lectures: College de France 1968 and 1969*, ed. Jean-Claude Coquet and Irene Fenoglio, trans. John E. Joseph (Edinburgh: Edinburgh University Press, 2019), 125–127.

62   Ian McGonigle, 'Genomic Data and the Dividual Self', *Genetics Research* 101/12 (2019), 2.

63   For instance, Mélanie Dulong de Rosnay and Felix Stalder have written about the digital commons, wherein resources of 'data, information, culture, and knowledge … are created and/or maintained online'. They posit the digital commons as 'a political institution and as a way to expand democratic participation beyond the framework of representative democracy, through self-governance, 'participation, flexibility, and collaboration throughout society'. Significantly, the notion of a data commons could provide resistance against the 'increasing centralisation and commodification of data in the hands of a small number of companies', to instead govern data as a commons. Yet, as De Rosnay and Stalder write, this commons is yet to be constituted, as it still lacks a 'conceptual and legal framework', and the differentiation between open data and members-based commons data. Mélanie Dulong de Rosnay and Felix Stalder, 'Digital Commons', *Internet Policy Review* 9/4 (2020), 2, 15, 16.

64   Tonkonoff, 'A New Social Physic', op. cit. (note 54), 279.

65   Ibid., 275.

66   Mikhail Bakhtin, *Rabelais and His World*, trans. Hélène Iswolsky (Bloomington: Indiana University Press, 1984), 19.

67   Ibid., 19.

68   Ibid., 19.

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