

Situating Microbes Within Complex Ecologies

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Abstract

The role of microbes in society has traditionally foregrounded their pathogenic character. However, this framing is being increasingly problematised as new research has shown the complex and nuanced role they have, not only in relation to humans, but also for nonhuman animals and as part of wider and complex ecologies. In the introduction to this thematic collection, we review how such shift has featured in science and technology studies (STS) research by exploring how microbes' characterisation goes beyond the pathogenic when situated in material, socio-economic, ecological, and historical settings. This introduction explores situatedness of microbes in STS – the key element that binds together the contributions included in this collection – and describes how recent literature has expanded beyond the pathogenic and towards complex ecologies. We conclude with a description of the articles featured in this collection and describe the way they engage with STS, microbes, and situatedness.

Keywords

ecology; knowledge; more-than-human; situatedness; microbes

Introduction

The role that microorganisms are seen to play in society has shifted during the last decade. From bacteria to viruses, from fungi to microalgae, changes in practices and knowledge production associated with the ongoing ecological crisis are bringing to the fore the complexity of human-microbial relations. This increased complexity is palpable in, for example, the boom of microbiome research, which has highlighted the importance and symbiotic nature of gut microbes or in concerns about the impacts of drug resistance within disease-causing microorganisms, technically known as antimicrobial resistance (AMR), which the World Health Organization has declared as one of the top ten threats for global health (WHO 2023). The last few years have also seen a growing interest in probiotic medicine, in the role of microbes in food production, and in fermentation and foraging, which has become increasingly popular since the state of exception of the Covid-19 pandemic. This broadened interest in microbes has led to an awareness of the more-than-human

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webs that microbes and humans are part of. Science and technology studies' (STS) scholarship has reflected on these trends with a multidirectional expansion of the relations between nonhuman/microbes and humans. Literature has taken various inroads to these relations, covering case studies and topics such as viral threats and zoonoses, antimicrobial resistance, gut microbiota, marine microbes, soil microbes, food production, and fermentation.

In this thematic collection, we invited authors to put microbes at the centre of their analysis. What kind of an analytical object is a microbe? Here, what holds microbes together under the same category is the reference to their microscopic character and the difficulty of grasping their sociomaterial dimensions. In other words, their definition is related to the incapacity of humans to observe them without an aid. This question organises the ways in which the collection is set out, the introduction and articles all take microbes as a starting point but do not cut out of their relations – microbes are always and inevitably situated and relational. Situating microbes, then, locates them in a web of material, socio-economic, ecological, and historical settings that shape the nature of those relations. When considered in those contexts, microbes gain multiple meanings depending on other parts of the webs in which they are immersed, becoming pathogenic, probiotic, symbiotic, parasitic, etc. All papers in this collection engage in the analytical practice of situating microbes, attending to the specific contexts in which they become relevant.

This introduction begins by reviewing STS literature about microbes in the next three sections, exploring how the field has been expanding from a focus on pathogenicity and biosecurity towards broader understandings that include nonhuman health and the role of microbes as part of broad ecologies. After this review, we introduce the notion of 'situated microbes' as a fruitful heuristic that summarises the changes the social study of microbes has seen as an emerging field. Finally, this analytic rationale is discussed in relation to the papers in this thematic collection.

Microbes in STS Scholarship

While any literature review always remains partial, in this and the next two sections, we aim at summarising the main thematic clusters included in the social study of microbes. First, we explore how microbes have been featured in STS, initially with a strong focus on pathogenicity. One possible starting point in STS literature for considering the role of microbes in society would be Bruno Latour's *Pasteurization of France* (1993) that analysed the emergence of Pasteurian understandings of microbes and disease. Rather than conceptualising microbes as such, the book primarily focused on the social networks and actors that turned Louis Pasteur into a symbolic figure for public health in France. Ideas of Pasteurian logic became foundational to modern societies where prevention of diseases by microbes was central. The 2000s saw a growing interest in microbes and disease in STS scholarship with a focus on pandemic threats of global scale, and biosecurity (e.g. [Collier, Lakoff, and Rabinow 2004](#); [Lakoff and Collier 2008](#)) – well before Covid-19. This productive line of work framed microbes as concerns over global health security and was dominated by a technoscientific mediated pathogenic characterisation of viruses ([Cañada 2019](#)). These framings have often focused on governmental levels of policy or global health knowledge production ([Lakoff and Collier 2008](#); [Dobson, Barker, and Taylor 2013](#)), paying less attention to everyday practices that constitute symbiotic relations between humans and microbes. This line of work, however, started to problematise the

interspecies boundaries around which notions of health were built by bringing attention to the zoonotic character of most infectious diseases ([Fearnley 2013](#); [Keck in Lakoff and Collier 2008, 195–226, 2015](#)). Also, the concept of ‘One Health’ as an interdisciplinary working model between human, animal, and environmental health was adopted by global health actors and gained regulatory prominence.

Informed by a more complex understanding of global health and disease, interest in viral outbreaks has remained central to STS but surpassed security framings by focusing on how viruses are configured as threats not by themselves but as the result of its entanglements with bodies, technologies, and landscapes ([Cañada and Venäläinen 2022](#)), while fear responses are informed by symptomatic histories, proximity to agents of infection, and the difficulties to determine the presence or absence of invisible microbial threats ([Shrum et al. 2020](#)). Contributions with a focus on global health security also paved way to STS analyses of antimicrobial resistance given their shared status as global health key concerns. Research has shown how antibiotics have shaped modern systems across various societal domains ([Landecker 2016](#)) such as food production ([Kirchhelle 2023](#)), veterinary medicine ([Fortané 2019](#); [Hinchliffe, Butcher, and Rahman 2018](#)), and health infrastructures ([Chandler 2019](#); [Denyer Willis and Chandler 2019](#)). These works show a new direction for understanding pathogenicity in STS in which the situatedness of microbes is an essential feature: the dangers that microbes may pose is entwined with broader processes such as failed technoscientific interventions, colonial legacies, and contemporary inequalities that produce socio-economically uneven consequences ([Giraud et al. 2019](#)).

During the last years, biosecurity framings and concerns about drug resistance in STS have been joined by new lines of enquiry, with an increasing number of scholars interested in the multispecies relations between microbes, humans, and other species rather than infection alone. Some developments have made this possible. First, new metagenomic methodologies to study the microbiome have shown that the diversity and amounts of microbes are much higher than hitherto imagined, and that they have symbiotic roles that question the view of microbes as external pathogens that threaten human health ([Benezra 2023](#); [Raffaetà 2023](#); [Rest 2021](#)). Second, the ‘One Health’ approach ([Zinsstag et al. 2011](#)), that interlinks human, animal, and environmental health as deeply interconnected ecosystems, has helped to establish the view that addressing human health issues requires attending to nonhuman health, even if the implementation of this in health policies has remained largely partial ([Kamenshchikova et al. 2021](#)). Finally, there has been a rising interest in the role that microbes play in food systems, from foraging to their role in fermented products or composting. Although such relations and practices are by no means new, the microbial ecologies that surround them have become more explicit (e.g. [Daniel 2022](#); [Kinnunen in Brives, Rest, and Sariola 2021, 64–83](#); [Paxson 2008](#); [Tsing 2015](#)). These framings have highlighted human–microbe relations as part of wider webs of human and nonhuman actors, animals, and the environment. This increasing complexity in how microbes are researched makes evident that previous presumptions of microbes as just pathogens are limited in describing the scientific and social dynamics in which microbes are currently involved.

Beyond Pathogenic Understandings of Health

Changes in how microbes are understood were spurred in the first decade of the 2000s through insights generated by the Human Microbiome Project ([Proctor et al. 2019](#)) that showed the magnitude of microbes in

the human gut and that the number of microbial genes surpass human genes manifold. This problematisation of classical microbial imaginaries in science has prompted a flourishing scene where new modes of approaching microbes in STS have been tested throughout many different empirical areas, for example, the growing interest in the work of Lynn Margulis on symbiosis ([Haraway 2008](#); [Hird 2009](#)), the turn to the microbial in biopolitics ([Paxson 2008](#)), or the attention paid to marine microbes ([Helmreich 2009](#); [Schrader 2010](#)).

The recognition of microbes as more-than-pathogenic life forms has been bestowed the status of paradigmatic shift in biomedicine and biopolitics, something that Penelope Ironstone described as ‘opening up the discussion of ‘human life itself’ to increasingly microbiopolitical interventions in which conceptions of self and other are fundamentally challenged’ ([2019, 377](#)). The work of Ironstone ([ibid.](#)), as well as Stefanie Fishel ([2017](#)), Katriina Huttunen, Elina Oinas, and Salla Sariola (in [Brives, Rest, and Sariola 2021, 121–142](#)), and Thomas Pradeu ([2020](#)) show that that research on the human microbiome, using the words of Ironstone ([2019, 377](#)), provokes us ‘to think of human life as symbiotic, multiple, mutualist, and in community with a nonself on which it depends’, questioning views of the self as autonomous, free, or sovereign. While STS critiques on notions of immunity and self can be traced back as far as the 1980s, with Donna Haraway’s ([1989](#)) *The Biopolitics of Modern Bodies*, the more complex understanding of microbes’ role in human health have brought a renewed light whereby the body and the self are not bounded but should always be considered with the microbes in tow, as holobionts ([Haraway 2016](#)). We are, as proposed by Stefan Helmreich ([2014](#)), *homo microbis*, that is, beings whose existence is made from our microbial make-up, but also the politics that shape it. Beyond the hype and hope of microbiomes, research has shown how interest in microbes has reproduced rather than solved inequalities around race and gender that forces us to consider how such social categories are also productive at microbial levels; inequalities map onto pre-existing colonial, patriarchal, and racialised power relations. Critical research has analysed how indigenous faeces are mined for future remedies ([Núñez Casal 2024](#)), microbial maternity includes vaginal birthing, breast-feeding, and avoidance of antibiotics ([Howes-Mischel and Tracy 2023](#)), and ideas of race are made and remade in microbiome research ([Benezra 2020](#)).

The resignification of pathogenic characterisations about microbes has also facilitated STS enquiries that bring forth the roles that microbes play in food production where discourse about microbes is not limited to contamination. Fermentation is an ancient biological process that involves the meeting and thriving of ‘complex collectives of humans, animals, plants, fungi and bacteria’ ([Hendy et al. 2021, 198](#)). As a human practice, fermentation has the ability to drive gut microbiomes, preserve foods, compost biological waste, and radically transform flavours. This type of more-than-human interaction involving microbes, as Maya Hey ([2019](#)) has argued (and continues to illustrate in this issue ([2025](#))), requires direct embodied contact with microbial life ‘in a relational economy of giving and taking life’ ([2019, 153](#)). Such contact allows for a performative and discursive retelling of human-microbial relations that challenges predominant simplistic understandings of microbes as health threats. But, most importantly for this issue, the resignification of discourse and performative action in human-microbial relations takes on a multiplicitous character: ‘what is true, delicious and safe in one fermentation context may not be the case in others’ ([ibid., 150](#)). The dynamic character of microbial cultures that react to ambient factors like temperature, humidity, acidity, and salinity

or the religious and cultural significance of some ferments are clear examples of how fermentation is also a situated matter. Fermentation circles around to topics of human health since the consumption of fermented products is a key element in the configuration of human gut microbiome, having a direct influence on physical and mental health ([Rest 2021](#)). Attending to ancient biological processes and their embedding into practices of food production and health management brings a crucial shift in scale in the social study of microbes that requires thinking about the long histories that have led to contemporary modes of human-microbial co-existence.

Microbes as Part of Complex Ecologies

Past STS literature has reflected on the dualisms of microbes as promises and perils ([Paxson and Helmreich 2014](#)) and these emerging notions and practices have been claimed to indicate a post-Pasteurian or probiotic turn ([Paxson 2008](#); [Lorimer 2017](#)). However, the articles in this collection show that new approaches to socially study microbes are too diverse for them to fall neatly under one paradigmatic shift. As microbial STS expands, and intrinsic pathogenicity comes further into question, STS scholarship has started addressing the complexity of microbial forms of life by looking at how they are embedded in wider ecologies and as key actors in ecological balance. In such framings, microbes are addressed not as friends or foes to humanity, but as actors in their own rights. While questions in much of this literature unavoidably retain a human perspective, there is a general trend to de-centre humans in order to inquire about the broader more-than-human living webs ([Puig de la Bellacasa 2017](#)) in which both humans and microbes are situated. This de-centring of humans as the core of social analysis makes situating microbes in their own ecological webs even more crucial. Microbes have been chiefly featured in STS research on ecological issues by highlighting their different roles in the ongoing environmental crisis, where they can appear in such diverse roles as victims, hope providers, or labourers.

For example, the work of Cristóbal Bonelli and Cristina Dorador ([2021](#)) focuses on Chilean saltpans in the Atacama Desert, 'once thought to be devoid of life' and 'now seen as oases of microbial life' ([ibid., 10](#)). Their work makes us aware that thinking microbially requires considering both large temporal scales, that involve deep-time, and the harsh environmental conditions that microbes have endured, adapting to deal with 'high solar radiation, desiccation, exposure to heavy metals, among other conditions' ([ibid., 9](#)). Extractive economies radically change the conditions that those microbes have evolved to endure, endangering their own survival and that of their surroundings. In contrast, the work of Ana Delgado ([2021](#)) offers a view of extractivism where microbes are not organisms at risk but a valuable object to be mined. Their genetic sequences become economically valuable assets with the promise of compensating for biodiversity loss by moving biodiversity from 'on site' to 'in silico'. This requires situating microbes in relation to novel sequencing technologies, inside gene clusters, genome maps, and phylogenomic trees. This digitisation of microbial data, as Erika Szymanski ([2024](#)) explains, has been framed as minimising physical violence towards extraction sites even if it redirects that violence towards human capacities to recognise and act on multispecies interdependencies, invisibilising the situatedness of human-microbial relations and of microbes themselves.

The economic potential of microbes has also been central to practices of soil care, regenerative agriculture, and waste management. In this context, ‘microbial engineering’ is framed as a more sustainable and ecological approach to deal with the byproducts and overflows of capitalist production. Microbial labour is considered to hold promise to deal with crises in areas like energy production ([Daniel 2022](#)) or electronic waste bioremediation ([Ng 2023](#)). The industrialisation of microbial labour for human purposes can happen in highly-technified contexts conditioned by a need for automatisisation ([Daniel 2022](#)), but also in much less sophisticated and intimate spaces like—home composts ([Kinnunen in Brives, Rest, and Sariola 2021, 64–83](#)), where human-microbial relations come to the fore through practices of sensing in order to favour the presence of some microbes and avoid the presence of other life forms and residues. These microbial practices appear as acts of compensation for past anthropogenic impacts, while still building on notions of human exceptionalism. Existing trends in environmental management and governance continue to define nonhuman others as resources that can be managed by humans with the objective of optimising economic production and environmental conservation through the capitalisation of microbial labour ([Krzywoszynska 2020](#)).

Situating Microbes

The shifting definitions of microbes and the various locations where they have been studied calls for attention to this multiplicity to maintain an analytical frame by which they can still be understood. In this thematic collection, we invited authors to put microbes at the centre to better understand their status as analytical objects in STS. What started as a provocation, in our aim to develop the social study of microbes, became a generative exercise in understanding the emergent character of microbes, as well as the limits of such an approach. The result is not one of erasure of non-microbial aspects but rather an exercise in grounding and situating the microbial ones that contrasts with the scientific and governmental tendency to abstract and isolate microbial actors from their localities, producing scalability issues ([Cañada in Brives, Rest, and Sariola 2021, 165-183](#)). The articles give visibility to proxy practices to understand how invisible microbes are made visible by attending to the sociomaterial conditions that give way to their emergence. Practices, objects, documents, cultures, technologies, images, and histories, to mention some examples, serve as proxies to analyse the manner in which microbes are enacted. It is important to recognise that some of those proxies are scientific practices, or even scientists themselves, but the way they are brought into the analyses featured in this collection give priority to the positioning and contextualising rather than abstraction and isolation such as laboratory, modelling, or big data practices. Hereby, the articles in this collection provide key insight in how the microbe comes to be in relation to the conditions that produce it, while retaining crucial agency as a nonhuman actor. When the microbe is situated socioeconomically, culturally, historically, geopolitically, spatially, and digitally, its definition simply as good/bad for humans becomes disentangled and can be theorised.

Situatedness has a long tradition in STS and has demonstrated its value in the literature. The concept has its roots in feminist STS scholarship that questions universalism in producing scientific knowledge and points out the ‘politics and epistemologies of location, positioning, and situating, where partiality and not universality is the condition of being heard to make rational knowledge claims’ ([Haraway 1988, 598](#)). Situated knowledge offers a critique of scientific objectivity, ‘the God trick’, and instead emphasises the

circumstances in which knowledge is produced, as well as the characteristics, partiality, limitations, and responsibilities of the knower. Our proposal to situate microbes is connected to STS traditions of situated and relational understandings of human–nonhuman interaction that tune in to the idiosyncrasies of working with invisible beings and recognising their complex and multifaceted nature.

By situating knowledge–making in relation to microbes, the articles in this collection challenge the power relations that give priority to the scientific version of the story. Situating the microbe grounds the analysis in sociomaterial settings that often disappear in scientific designs that prioritise abstraction and isolation for the sake of generalising scientific results. When situated, microbes are no longer defined according to reductionist or intrinsic mechanisms and can only be thought of in relation to their sociomaterial settings, enacting hybrid ways of distributing agency ([Michael 2000](#)) that connect with discussions about the ability of humans to control the microbes that we are entangled with ([Ironstone 2019](#)).

Applying this frame to microbes supports the necessary development of concepts and methods that can attend to human–microbe relations and look at what it means to be entangled in complex and multiple relations. First, microbes as a high–level classificatory category become multiple by definition, with different bacteria, fungi, or viruses manifesting sociomaterially in very different shapes. Second, individual instances of the same bacterium, fungus, or virus can produce completely different impacts and activate very different practices in different locations and temporalities. We see these diverse practices across scales and settings as contributing to the creation of new social forms of human–microbial relations, where existing practices are being challenged. Third, microbes conceived in this way must always be understood as situated in the complex web of relations that give rise to them and therefore the unit of analysis of ‘the microbe’ (as always inherently multiple) has to be studied within the various distributed actors, structures, and entities involved in its knowledge production. These conceptualisations of the microbial do not do away with possible pathogenic understandings. Rather, they show the dependence of the outcome to various complex factors rather than inherent to the microbe.

Introducing the Issue

We argue that STS approaches to the social study of microbes featured in this collection bring out this complexity and diversity by attending to the specific settings in which microbes become relevant. We find potential in paying attention to how new notions and claims about microbes fold unto previous ones. We formulate the trends described in this introduction – metagenomics, One Health, AMR, probiotics, fermentation, viral pandemics, extractivism, or bioremediation – not as causing a turn but rather as practices–in–time that help to understand the growing interest in microbes from scientific and non–specialist perspectives. This multiple character of microbes in knowledge production practices unfolds through time and space: all articles aim at showing how situating microbes in their historical and spatial context makes it possible to attend to their relational complexity, making visible the impact of contemporary scientific, technological, cultural, colonial, developmental, and governmental practices on how humans and microbes interact.

Doing so also introduces a diversity of methods that contribute to highlighting the complexity of human-microbial relations. Understanding the renewed role of microbes in society entails engaging with them not just ethnographically but also digitally, historically, practically, textually, and visually. While the majority of papers in this collection focus on health, they do so by situating them in the various human-microbe relations within the ecologies that surround them.

History, Development, and Colonialism

Andrea Butcher's contribution (2025) uses a historical focus to examine the relation between the prevalence of antimicrobial resistance and economic development. In global health discussions, the blame for the stark increase in AMR globally is often attributed to lax prescription practices for antibiotics in the global South. Contrary to this allegation, Butcher explores the processes by which global development regimes have created and perpetuated circumstances conducive to the production of AMR hotspots in low-income countries. Focusing on two case studies – Bangladesh's export aquaculture sector and land reform in the Republic of Benin – Butcher speculates how histories of postcolonial development potentially configure AMR hotspots. The turn towards the ecological in AMR is one where the infection is not just located in relation to the immune system of the infected body but rather in relation to the shared genetic profile of a given resistant strain. Genes that confer resistant capabilities in certain strains spread not inside the body but across species and ecologies through horizontal gene transfer. Therefore, this reading of human-microbial relationships moves the focus from the pathogenic relationship between human and bacteria towards shared evolutionary mechanisms that take place beyond the confines of the human body. This moves the site of intervention from the body (which, due to resistance is not a viable site anymore) towards the hotspot, which is defined in terms of colonial notions of economic development. Butcher contributes to rethinking dominant approaches to AMR which, by formulating it as a global health issue, homogenise the way in which resistance is made present across sites. Through statistical data processing, health actors make AMR models scalable but, at the same time, remove the *in-situ* characteristics of the resistance profiles in different parts of the world. This way, Butcher shows how specific countries, or entire regions (most commonly situated in the global South), become defined as hotspots, which, she argues, invisibilises the social and material conditions that have led to the development of resistance among local microbial communities.

The centrality of colonialism and development for the characterisation of how disease ecologies emerge as sites of injustices is also present in the paper by Victoria Koski-Karell (2025), which also challenges understandings of pathogenicity through the analysis of cholera outbreaks in Haiti. Using a sociogenic approach rooted in the work of Frantz Fanon and Sylvia Winter, the paper demonstrates how pathogenicity is not intrinsic to the bacteria *Vibrio cholerae* but a result of the centuries old blockade on the Haitian economy, the intervention of foreign powers, and the role played by international bodies like the United Nations. The way Haiti as a country has been defined by racial and colonial processes plays a role not only in the occurrence of the outbreak but also in the allocation of responsibility and the agency of the different actors involved. By situating *V. cholerae* in its historical and geopolitical context, the article shows the emergence of pathogenicity as a key characteristic of the interaction between humans and bacteria. In both Butcher's (2025) and Koski-Karell's (2025) articles, we see North-South hierarchies of development

imposing ways of managing not just disease but also environmental settings. Under the mandate of progress, ecologies are disrupted and responsibility denied. This points at a dynamic of perpetuation: while colonial and development logics have set up certain territories and regions as hotspots for undesired microbial ecologies leading to human disease, the presence of disease is used as an argument for continued intervention. The cases of cholera in Haiti and AMR in Bangladesh and Benin help to illustrate how microbial presence in specific settings, and most importantly the character of such presence, is greatly conditioned by colonial histories and Western notions of development and progress.

Proximities of Coexistence

The articles collected in this issue also explore how microbes react to their surroundings. In the case of AMR, as Butcher shows, their developing resistance is a result of the disturbances and pollution of their habitats, connected to processes such as urbanisation, industrialisation, and the pervasive presence of antibiotics across different sectors (2025). In a very different empirical context, yet following similar logics, the environmental conditions are taken into account in Hey's analysis of sake production in Japan (2025). In this case, the presence of microbes is something to nurture rather than avoid. More concretely, Hey investigates one of the two remaining natural sake breweries in Japan, also stressing practices that refuse to engage in microbial labour in industrial ways. Hey's analysis considers the relations natural sake brewers cultivate with microbes to understand what it means to practice a form of knowing that refuses to engage in highly technical, industrial, and standardised procedures of food production. In this setting, brewers approach microbes as lively entities to work with instead of objects to manage.

Luísa Reis-Castro (2025) explores yet another level in which microbes are worked with. The paper explores the use of *Wolbachia* bacteria to control epidemics in Rio de Janeiro (Brazil). This public health strategy relies on infecting *Aedes Aegypti* mosquitoes – one of the main vectors of viral diseases like dengue, Zika, and chikungunya – with *Wolbachia*, a bacterium that renders mosquito bites unable to spread pathogens. The bacterium becomes an ally and a tool to control other microorganisms that cause infectious diseases in humans. The approach is able to change the war-like approach towards mosquitoes that has dominated campaigns to reduce vector borne diseases in Brazil. The article illustrates how this experimental programme inevitably challenges traditional discourses of public health that make the mosquito an enemy as well as the political and social divisions that characterise Rio de Janeiro as urban space that conditions the spread of infectious diseases. Reis-Castro's article shows how urban space is a key aspect to understand multispecies ecologies of health and her analysis points at the relevance of considering rural-urban spaces as a distinguishing factor for the way human-microbial relations are articulated, making different types of environments matter for how microbial ecologies become relevant. Similar dynamics are present in Ritti Soncco's contribution (2025), which focuses on the bacteria *Borrelia burgdorferi*, one of the causative agents for Lyme disease in humans. In this paper, Lyme disease becomes a tolerable risk in the specific social and political context of lockdown brought by the Covid-19 pandemic in Scotland. The scarcity of safe spaces in urban areas turned the Scottish Highlands and their latent threat of Lyme disease into a tolerable risk for many. Soncco introduces the notion 'geographies of tolerance' to describe the entanglements between humans, landscapes, ticks (as vectors), and bacteria. The characteristics of *B. burgdorferi* as a threat are here not just the result of the more-than-human entanglements that potentially results in Lyme disease. In

addition, understanding risk as a variable category requires factoring in the presence of an evolving and all-encompassing risk as that of SARS-CoV-2 during the time of Soncco's study. Soncco's paper (2025) shows how rural landscapes remain threatening because of the presence of tick-borne diseases but, at the same time, offer a refuge from SARS-CoV-2, a viral disease that thrives in highly populated areas like cities. Together with Butcher's article (2025), which points at urbanisation as a key element in the dynamics of pollution that make it possible for resistant strains to thrive and travel across locations, finding their way back from rural areas into more densely populated areas, these three papers make evident how location matters for the presence of microbes, showing the need to consider local sociomaterial conditions when analysing the renewed role of microbes in society.

Dominant Knowledge Frames and Racialisation

Louise Whiteley, Nikoline Nygaard, and Cecilie Glerup (2025) analyse images of microbes during the advent of microbiome research, exploring how these images mediate new scientific knowledge into the public. They study images of the gut and the brain, identifying the various ways by which the connection is depicted. The images use different styles to illustrate that connection, playing with scales, textures, and absences. To tackle the challenge of depicting very different scales, the images present the gut microbiome often as neat and pastel-coloured, even humorous, while gore, mess, and ambiguity are absent. The analysis raises questions about why this might be the case and suggests that the relative absence of gore enables a depiction of otherwise impossible connections and uncomfortable affective tensions between excitement and scepticism, intimacy and alienation, and awe and disgust. The paper helps to understand the different ways in which humans situate microbes in relation to themselves: as separate, as content, as protagonists, or as additional reality layers. The portrayal of humans is also racialised in their analysis for humans are often represented as white individuals with a private relation to their own body. This depiction stands in stark contrast to Koski-Karell's analysis of race as crucial aspect to understand notions of pathogenicity (2025). This approach puts health responsibility on the individual, similarly to how, at a radically bigger scale, responsibility for the spread of *V. cholerae* is distributed through notions of race and colonialism. The article by Whiteley et al. helps to visualise, through their analysis of absence and connection, what happens when situatedness, dirt, mess, and disease are washed away.

Most of these articles also share a proposal to think outside dominant Western scientific frames, a move that proves key in dealing with uncertainty or with data not easily integrated into quantitative databases. Hey (2025) talks about knowing enough, Soncco (2025) about tolerance of risk in front of scientific evidence, and Butcher (2025) about nonscalable *in situ* qualitative data that does not fit global governance frameworks. Moving towards more situated and ecological ways of knowing microbes clearly requires new ways of making knowledge. Such knowledge might not be fully incompatible with dominant scientific Western frames of knowledge making, but it certainly challenges usual assumptions. This enables a questioning of knowing temporalities: technically precise methods for describing microbial presence are rarely able to keep up with the continuous change of microbial ecologies and so other approaches, such as Hey's knowing enough (2025), Soncco's tolerance of microbial presence (2025), or Butcher's *in situ* qualitative data (2025) present advantages in handling microbial presence in ways that the snapshot character of scientific methods does not.

Conclusion

These various human–microbial relations, situated within complex ecological webs, once again show the complex roles microbes play for human flourishing and suffering. Since the pioneering work of Lynn Margulis, ecosystemic understandings of the interconnectedness *with* and *among* microbes has become widespread and with the proliferation of metagenomic methods, they have entered the mainstream of both life and social sciences. Once paradigm–shifting, by now the assumption that humans provide themselves an environment for microbial ecologies has become commonplace (Formosinho et al. 2022). Therefore, specifying concrete circumstances and the practices connected with them emerges as important work to locate microbial interconnections. With this introduction, we propose that analytically centring microbes through the notion of situatedness helps to make this work of location legible and the papers in this collection contribute towards that aim by showing the historical, colonial, racialised, geographical, and visual contexts of microbes, human, and their ecologies.

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