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Future Bodies in Vaccine Trial Science Practice

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Abstract: This article will focus on temporality in how contemporary biomedical vaccine trial science imagines the human body and the immune system. It presents sociological interpretations on medical research from an ethnographic study where a pharmaceutical trial testing a diarrhea vaccine was followed for two years. The trial offers an opportunity to discuss various ways in which medical researchers view and enact their objects of research, human corporeality and relationality with bacteria, both as lived everyday experience during trials – in this case in Western Africa and Northern Europe - and during the processes of designing, carrying out and explaining the trials to diverse audiences. We suggest that the focus on time and futurity in a trial brings to the fore different conceptualizations of the human body. This has to do with indeterminacy in knowing the body as an object in the immediate present. We will argue that open-ended orientations into futurity enables the vaccine trial to hold together its diverse ontological and epistemic assumptions about the body.

Introduction

This article will discuss how the human body, the immune system, and the contours of the body, are imagined and enacted in a contemporary biomedical vaccine trial. It presents results from a three-year qualitative study in which we, a group of four social scientists[1], followed a pharmaceutical trial testing a diarrhea vaccine in a coastal village in Benin, Western Africa. We will here discuss the various ways in which we interpret the researchers and doctors to view and enact the objects of their research, human corporeality, and the immune system in particular. The body here refers to both lived everyday experiences during the project in Western Africa and Northern Europe, and the bodies emerging in the design, conduct and communication of science to diverse audiences. Drawing on feminist science and technology studies, we make no steep separation between 'scientific knowledge' and everyday experience: both design, implementation, and a researcher's expressions of their own bodily experiences and decisions, inform the ways in which ideas about the body are imagined and enacted in medical trials.

While ideas about the body in medicine have been widely discussed following the publication of Michel Foucault's The Birth of the Clinic (1963), – if not since Aristoteles' analysis of Hippocratic medicine – the theme of temporality has been less central. Foucault, for example, addressed

temporality in terms of "eras", but not experience or orientation within an era. We ask, can orientation in past, present, or future be identified in how medicine, and medical research, sees corporeality? What do such orientations do? For example, does a specific fictioning (Gunkel, Hameed and O'Sullivan 2017, 13) of the human corporeality involve a future oriented open-endedness, or is time stopped in the now of a specific "agential cut" (Barad 2007, 176), that is, a measurement? This article is situated in the tradition of feminist science and technology studies that refuses "the division of labor between science 'doing' nature and humanities 'doing' culture" (Åsberg 2021, 858), and it focuses specifically on temporality.

In this paper we suggest that a focus on time orientations and futurity is helpful when thinking about ambivalences in the conceptualizations of the human body, especially regarding the current interest in human-microbial entanglements (see Helmreich 2009, Hird 2009, Hinchcliff 2016, Roy 2018, Kirksey 2019, Lorimer 2020, Brives, Sariola & Rest 2021). Futurity here has to do with ontological indeterminacy (Barad 2007, 2003; Irni 2013) and knowing the body as an object, now and beyond. We will argue that orientation towards "the condition of an open future", (Barad 2003, 826) enables the biomedical trial to hold together its diverse ontological and epistemic notions of the body.

With this investigation on futurity in the now, we wish to join the social science discussion that argues that there is not one body in biomedicine, but vast differences in practice and theory depending on the field of specialization, the level of expertise, whether we study theory or practice, and where and when (Berg and Mol 1998, Mol 2002, Oinas 2019). The generalized notion of "Western medicine" is a bundle of diversities within what is too easily regarded as a homogeneous entity. It is therefore important to chart in detail the different ways the body is imagined and done in specific fields and practices of medicine. Annamarie Mol's important Body Multiple (2002, 152) suggests a shift from studying how sciences represent to asking how they intervene and enact their objects. In this paper we are interested in both, imagery and enactments, and consider them as closely intertwined. Biomedicine is one of the most influential discourses against which lay people build their own ideas of what a body is, and how it should be lived (e.g. Haraway 1991, 203-204). Biomedicine has authority and legitimacy to act upon the individual and population body (Riska 2010).

In The Woman in the Body, Emily Martin (1987) asked how culture influences contemporary biomedicine, and vice versa, and finds that the authority of biomedicine is closely linked to gender and, importantly, class. Further, she shows how the metaphors biomedical textbooks use are heavily inspired by their period and societal context. For example, in the

United States, images of capitalist industrial production were used to illustrate bodily processes in the post-World War II era (Martin 1987, 38), and images of the cold war crept into depictions of immunity in the 1980s (Martin 1990). Donna Haraway similarly detects cold war imagery in her 1990s work, but, interestingly, finds the ecological "holobiont" an apt metaphor for contemporary embodied entanglements (Haraway 1991, 205; 2016). Today, such questions are posed less in the form of influence from "culture" to "science" – suggesting unhelpful causality (Bennett 2004, 63) – but we still need to inquire how ideas and practices, whether lay or expert, lived or scholarly, shape one another and are intertwined and enacted in diverse ways (Mol 2002).

In debating whether to regard the body as performative (Butler 1993, 4), enacted (Mol 2003; Mol in Martin et al. 2018, 297), or as a "material-semiotic generative node" (Haraway 1991, 208), or a "holobiont" (Haraway 2016), further specification is required: we need to ask not only how, but also where and when, and with which temporal orientation, the body materializes (Butler 1993, 34; Ahmed 2004, 29). In this study, temporal orientations are detected in ethnographic moments. An instance of temporal orientation where the body is imagined in specific ways would be, for example, when the laboratorians with their equipment decide that they have found an e-coli growth on a stool droplet grown overnight in a petri dish, and therefore cultivate it further and send it with its control samples for further analysis. As social scientists, however, we would also view the choosing and eating of a certain meal during a day in the laboratory as a meaningful ethnographic moment where the contours of the body are negotiated. We will here focus on moments when real, lived experiences of the body, and discourses around it, refer to wildly different enactments of the body. They are, we claim, all real (cf. Barad 2007). Our observations include situations in the laboratory when the staff prepare stool samples and discuss lunch plans, all the while considering one colleague's worsening nausea.

In this article we wish to stay a while with observations that in our data first seemed like irritating inconsistencies: how can the contours of the body be so clear in one version of the body, and all gone in the next moment? As social scientists we struggled to notice the many ways in which knowledge in practice is not stabilized. The main argument of this paper is that the imagined and enacted bodies in vaccine trial science are never stable, but their effortless co-existence is held together by knowing the body as indeterminate and future oriented. Through diverse practices and daily incidences, the body is diffracted to many potential possibilities – it multiplies, and it is different things in different moments. We will

conclude that what holds these enactments together is futurity and a temporary investment in a selected method of investigation.

The enactments we found in our study are the following: the numerical body is imagined as numbers, produced through counting, computing, and estimating of the trial data, but also through everyday craft and tinkering, as we show here. The holobiont body is the imagined body of vaccine induced immune response where the contours of an entity no longer are definite, but a self is dispersed to an entangled co-existence with other "critters" like bacteria (Haraway 2016) - even if inactivated. Yet, we also found the individual entity-body, the borders of which must be carefully guarded. Further the contingent, vulnerable individuality of the body needs to be noted.

Furthermore, temporality also figures here in the way in which this study made us more aware of how different ideas about the body are usually historicized in social science practice within a certain period, reflecting a linear understanding of time in mainstream social sciences. In our examples, different 'agential cuts' (Barad 2007) lead to diverse diffractions in the now, presenting seemingly paradoxical accounts of the body. In the data, temporality is not always explicitly discussed, but we argue in the upcoming analysis that the differences are held together by both, openness, or indeterminacy, which we read as a future orientation, and by the inevitable 'haunting' of the past (Ahmed 2004, Barad 2007). Precisely in its openness, this future orientation is significantly different from narratives of inevitable progression and improvement, and it also resists the idea of clear 'turns', or linear shifts in how the body is understood in medicine.

The future orientation that we found in the data is based on ideas of linear progression aided by science and technological improvement – techno-optimism of a kind. On its webpages, the biotechnology company articulates commitment to giving a better and longer life for people all around the world, and biomedical innovations such as vaccines are suggested as a means to achieve the promise. While vaccines have become generally accepted as one of the greatest health innovations in history (e.g. Blume 2005), the problems that follow the material twining in capitalist logics of profit-seeking has gained broader attention especially during the COVID-19 pandemic and the early critique of the global injustice in access to vaccines (Sariola 2021). In this vaccine trial case, a biomedical innovation, capital accumulation, and 'health for all' - be it children in low- and middle-income countries, tourists or militaries – form a seemingly inevitable entanglement. We suggest that while this kind of capitalist techno-optimistic health futurity is perhaps the most visible temporality (and has resemblance with what has been termed the coloniality of

innovation economy; Tarvainen 2022, Maury 2023), it is not the only or a totalizing one. A focus on the body has helped us to notice how different kinds of futurities and temporalities emerge through different forms and ideas of embodiment. Therefore, in addition to the above discussed theorizations of the body, our analysis is inspired by queer theorizations of temporality (Muñoz 2009, Freeman 2007, see also Oikkonen 2021). While critical analysis of destructive capitalist modes of production and accumulation, and homogenizing medicine are needed, this approach allows to pay attention to different, and potentially more hopeful futurities also within Western medicine and its commercialized applications.

Data and method

The data presented here are snippets of encounters during a phase-2b vaccine trial that was conducted from 2017 to 2019. This trial, like all trials, was both standardized and unique. It tested an oral vaccine intended to prevent both travelers' diarrhea in (probably mainly high-income) tourists as well as in military forces, and infant diarrhea in so-called low- and middle-income countries. The vaccine consists of inactivated bacteria and an adjuvant that increases the immune response. The phase 2b trial is only a small part of the entire process in vaccine development, and here mainly the safety and immune response were examined, while also tentative information about the efficacy was gained. An additional benefit for the scientists was the opportunity to generate data that will improve the understanding of how human bodies deal with bacteria, for example data about anti-microbial resistance. The long-term goal of developing a vaccine for children in low- and middle-income countries was also highlighted when communicating with participants and popular media (Huttunen & Oinas 2023).

The trial population consisted of almost 800 adults from Finland who were required to travel to Benin. In batches of 7-35 tourists at a time, they spent two weeks in the here anonymized Beninese coastal village [1], giving blood and stool samples before, during and after the trip, and recording their health and bodily activity in a daily chart. A small research center with some laboratory equipment worked on-site with stool samples of the tourists over the course of nearly 21 months. We, the social scientists, followed the science-in-the-making by spending time observing, interviewing, and filling out questionnaires with the tourists, scientists, laboratory staff, tour guides, hotel staff, and villagers, in chunks of varying time periods throughout the duration of the trial. Altogether, we spent 8 months at the trial site in Benin. In addition, interviews, phone

discussions and lunches where the trial, and other aspects of the doctor-scientists´ work were discussed, took place in Finland, even after the empirical phase had ended.

A few limitations need to be mentioned: by the time we began our data collection, the trial protocol was already designed. Furthermore, we were allowed to observe neither the phases following the sample collection, when stool sample results were processed into data, nor the phase when the data that had been generated was processed, organized, interpreted, and finally presented to wider audiences and funders as a part of the evidence base for a marketing authorization application of the product. We believe, however, that the lengthy period of observation allowed us to sketch some of the contours of the body multiple and indeterminate in the everyday practice of data collection during a randomized controlled trial (RCT).

This paper focuses on the encounters and conversations with the medical team during these years, rather than the tourist-participants who will appear in other publications (e.g., Huttunen et al 2021; Huttunen 2023). The approach of the sociological study is ethnographic. All names are pseudonymized. The entire data set comprises more than 500 pages of field notes of the months of participant observation in Benin and back home, 195 qualitative interviews with staff, people living in the village, and tourist-participants, and with the latter, a two-part survey with 542 and 493 replies. We have documented both information lectures and passing chatter in meetings, buses, toilet queues and restaurants, and conducted lengthy and focused interviews. Often the beachside conversations proved to be as informative as the well-rehearsed lectures with the tourists and media. Here only a few of the jumpy conversations with experts and staff members in the laboratory and the pharmaceutical company meetings will be highlighted.

The researchers were extremely mindful of research ethics in general, and they facilitated and supported the sociological study. They were both informed about, and willing to be, characters in our study. However, ethical issues like informed consent are complicated by medical scholars not being trained in sociological qualitative methods. The onto-epistemic divide in what is regarded good scholarship in our traditions inevitably creates miscomprehension. For example, some of the scientists stated that ethnographic observations and interpretations cannot qualify as scientific data. Thus, while it was extremely helpful to have serious conversations and to co-edit manuscripts to avoid obvious mistakes, and holding respectful curiosity as our key guide, the goal in our feminist science and technology studies project is not consensus or agreement. Ethical processes were extremely important to all of us, but full mutual

understanding between us and the scientists turned out not to be possible, and the interpretations here are ours.

While nothing that is traditionally regarded as intimately personal is highlighted here, it is obvious to anyone who knows enthusiastic scientists that work is intimately personal. The moments we will discuss, thus, are examples where the varying aspects of engagement with knowing the body became apparent for us – for the scientists some of these incidents are irrelevant, as they regard the parameters of the protocol as a definite dividing line for what is "data". The analytical method here focuses on moments that we felt were rather typical and re-occurring during the data collection. We reflect on our own multiple interpretations and focus mainly on indeterminacy, paradoxes, discontinuities and breaks in logic, to valorise the differences.

Analysis

The body in numbers: achievement through a protocol and networked, creative craft

The most dominant enactment of the body in any vaccine trial is the way the trial deconstructs the body into numerical data and then re-assembles it to derive a statistical average that can prove the efficacy of the vaccine. The standardized procedure is extremely complex and involves the orchestrated labour of hundreds of people (Merz 2021). This trial is no different, but the extent of the effort, and especially the creativity and craft it required from all, remained an aspect that seemed to surprise everyone. The body depicted in reliable numbers is the recognised, "self-evident" outcome of the trial, and a massively laborious accomplishment.

For us, the first field work encounters were meetings in Finland before the trial started, often with the pharmaceutical company leaders who flew in for quick daytrips or were met on-line. The tone in these business meetings was always busy, serious, organised, but also excited and only slightly worried – will there be enough volunteers who sign up for the trip? Will the lab building be ready in time? Will buses and petri dishes pass customs? The amount of details that needed to be taken care of was dazzling, from hotel billing and logistics to concerns over US investors and collaborators. The massive effort of the double-blind randomised controlled trial with a recruitment goal of 800 participants, generating tens of thousands of stool and blood samples that are then flown across continents, is an assemblage (Latour 2005) par excellence, with

entanglements, diffractions, and unexpected risks that are hard to foresee and anticipate.

Randomised clinical trial methodology is seen to be the epitome of 20th century biomedicine in its search for universalizable reliability. Towards the end of the 19th century a need to develop methodologies that would prove the efficacy and safety of pharmaceuticals emerged in the face of the massive popularity of bogus treatments and mushrooming production of small-scale potions, lotions, and pills in the context of growing markets within a modernizing US (Sariola & Simpson 2019). The first published randomized controlled trial (RCT), in which participants were randomly divided into two (or more) groups each of which would receive different treatments, took place in the post-world-war II UK, even though the method had been shaping for longer. (Meldrum 2000; Bhatt 2010). This method was devised as a means to avoid bias and disproportional accumulation of particular background variables; randomization addressed the question of human differences (Epstein 2007, 48-50). The exploitative colonial pasts and enduring racializing presents of clinical trials (Crane 2013; Fisher 2020) cannot be dismissed when thinking about how the historical development of the methodology might inform current enactments of the body. Double-blind RCTs have since become regarded as the gold standard of pharmaceutical science, but they have also been highly contested (Wahlberg & McGoey 2007, Cartwright 2007, Will 2016; Rosemann 2019). The method is viewed as costly, slow and sometimes unconvincing, yet inevitable until a better method for efficacy and bioethics can be agreed upon (Petryna 2009; 2010, 59, Devanesan 2020). Social scientists studying RCTs from different perspectives conclude that answers to the questions of 'Does a drug work?' and 'Is it safe?' are highly complex and rarely definitive (Wahlberg & McGoye 2007; Moreira and Will 2016). RCTs are seen to generate sufficiently reliable knowledge about the body, treatment and disease under specific conditions that must be communicated clearly and transparently (Devanesan 2020).

In social science parlance in the practice of the trial the numbers and probabilities are constituted by thousands of entanglements where individual bodies are deconstructed. The trial attempts to position them specifically and transparently, yet inevitably, as living beings, they are ultimately uncontrollable. The body in numbers is thus a non-specific body. Furthermore, the individual body that participates in a trial is both the lived body of the individual in the trial site, and a constantly transforming one, a body that was entangled in an environment in the restaurants, bathrooms and aircrafts brought into the picture by trial participation. The pathways that make up these entanglements are known to an extent, and the task of the trial staff is to try to chart them in a way that makes

the trial procedure reliable according to the standards set by medical and pharmaceutical sciences, industries, and regulators. The staff also advised participants on how to protect their health, first as pre-travel advise and later as guidance in the 3-hour welcome session.

Our ethnography, regarding the details in the design of this RCT thus started far too late as the important, laborious negotiation around the protocol details would have been fascinating to observe. The simultaneously serious, excited, and optimistic spirit of the stage when we came on board is captured in one of the many early-summer meetings in Finland a month before the first trial participants were scheduled to depart. This meeting was focused on good clinical practice (GCP) and led by a consultant from the company that is recruited as the required external monitoring support. Monitoring assists the trial on a practical level to ensure compliance with the criteria established by the national pharmaceutical research regulator. It is her responsibility to check that every practical detail meets the protocol criteria. In the white, ultra-neutral meeting room of a private clinic sat the PI of the project, the monitor mentioned above, a cheerful and lively persons contradicting the formal seriousness with her energy the two trial coordinators who were stationed in Finland during the entire process; the laboratory staff; and the nurses who were recruited to meet the participants before the trip, inform them about the study, administer the vaccine, and collect the first stool samples.

Thus, most of the staff present were non-scientists, and were not to travel to Benin. Much of the actual labour of collecting samples before and after the trip was conducted by a diverse set of professionals in Finland. The meetings in the first months made it clear that while the trial was seen to happen in Benin, a lot went on in networks of craft internationally (Meskus 2018). The meeting tried to unveil, foresee and control, the many potential problems were to be anticipated and avoided in the multiplicity of entanglements of a trial.

The meeting with the monitor made clear that even as a trial follows a script and a guideline, it is always unique on the practical level. Even when everything goes well, actions related to details are constantly improvised and mini-crises creatively avoided. Sometimes events could not be foreseen, like when a connecting flight was cancelled, but the team found solutions to stick to the timing in the protocol. The daily work of the biomedical laboratory scientists (BLS) and the research nurses, too, involved innovative and creative orchestration. For example, the "mixers", the technicians who prepare the vaccine and placebo cups, proudly told the monitor that they noticed that any lab staff member who is an outsider to the trial might, in theory, guess who will receive a placebo by the absence of a walk to a fridge where the mix of the actual vaccine

compound was stored. Thus, they invented a routine of slamming the fridge door whether or not they had needed to open it, in order to confuse a potentially curious co-worker. This shows not only the commitment of the staff on all levels, but also the trial as a craft conducted by innovative human individuals. The mixers were cheered for their resourceful ideation.

Especially in the beginning of this exceptionally demanding trial, creative daily human activity was at the centre. While pharmaceutical research has a strict hierarchy, and the PI is responsible, appreciation of the skills and commitment of all staff is crucial for the trial to meet the regulators' demands. This was also apparent in the information sessions for the tourists. The participants' role in the success of the trial was underlined not least by explaining the logic of the vaccine to them in lay terms, with care.

An example of social creativity from the later data gathered in Benin is from the first information session for newly arrived participants. The team had come up with an efficient way to inform participants about how to identify the fluidity of a proper diarrhea sample to be recorded in health cards: "if it is loose enough to be drunk as if a milkshake with a straw, it qualifies as the right diarrhea". The milkshake metaphor elicited many a laugh and easily stayed in mind. This helped the participants to tick the right boxes. The identification of right type of stool was otherwise not easy, especially when ill yet trying to fill in a card with many details. The milkshake reference became a permanent way to instruct the participants throughout the study.

This everyday creativity, passion and reliability across roles and academic hierarchies was also shown during the monitor meeting in the appearance of the BLS who was about to open the trial laboratory in Ville. The responsible BLS, who was thoroughly trained and experienced in clinical microbiology and stool analysis, yet with no education or prior experience in the conduct of an entire medical research project herself, stayed in the village for the duration of the trial, and from the outset she laughingly presented herself as the Queen of Shit. She would oversee and steer a lot of the daily conduct in the Ville laboratory. The BLS labour was crucial for the trial, and for the process of achieving the reliable numerical body.

The everyday craft of the trial exhibited a sincere commitment to the end goal of reliable evidence about the safety and efficacy of the vaccine. Sociologically it is interesting, even if unsurprising, that scientific validity and reliability really appeared to be a matter of mundane, daily social conduct. Whereas for RCT scientists protocol violation is a clear matter of reporting, for social scientists adherence to methodological guidelines

always include innovation. In practice this was laborious, both in Finland, where each participant visited the clinic three times, but even more so during the two-week holiday: two formal information sessions, two one-on-one consultations with each participant, and the checking of the participants' completed health cards in which they reported bodily functions in detail, from headaches to meals and bowel activity. This meant, at times, phone calls to drunk or sick tourists whose cards were missing or messy and taking the extra trouble to collect the required information and samples from participants. Most tourists were compliant and eager, but on every trip, there were individuals the coordinators needed to babysit, or support through hardships. The hardships were numerous, as half of the participants got ill with diarrhoea, even if often mildly so, but other illnesses also occurred.

We witnessed numerous serious and humorous conversations about potential problems. Avoiding errors regarding trial was at the centre of the work of the staff and came right after the goal of keeping everyone alive, as one staff jokingly put it in the information session upon arrival. It was possible to achieve a clean record. The constant human tinkering in the troublesome situations was intended not to obscure errors, but to maintain the methodological reliability of the study. What is sociologically interesting is that while the body in numbers demands a huge amount of everyday craft and faith in its relevance, the science does not exclude other ways of imagining the body too. The execution of a method in a particular situation is needed to momentarily stabilize knowledge for specific uses. The trial result too, then, is an "agential cut" (Barad 2007, Irni 2013) needed for the pharmaceutical development, and it does create reliable outcomes for such needs.

While science as craft is a claim with long history (Meskus 2018) for us as social scientists the universality-particularity indeterminacy in biomedical views on the onto-epistemology of the body is harder to grasp. In this trial the environmental aspect of human health was acknowledged. The adult population the vaccine was tested on is from a (rather hygiene-obsessed) country in Northern Europe, Finland. The participants were required to be still "naive" to a tropical microbiome and to medical interventions too similar to this vaccine. Other differences such as gender and age appeared as variables where diversity was desired.

The results are derived from thousands of samples that were compared to information collected in health cards indicating average exposure and symptoms, and later, after careful coding and de-coding, to whether a placebo or vaccine was taken. According to Stephen Epstein (2007) the RCT holds a promise that a universalized mass body can prove efficacy, thus in practice, the RCT must also constantly observe population

characteristics and monitor diversity and population bias. The trial we studied tried to find a reliable age distribution among adults, and the vaccine will be separately tested on children in chosen African countries, thus assuming that there is no one universal human anatomy that is not shaped by its environment and age. This is nothing new or surprising in clinical science, yet questions regarding to whom results are considered to be generalizable, and on what basis, are still important. The category of 'traveler' is a rather vague one, and so is that of 'Western traveler', which was sometimes used to refer to the beneficiaries of the potential vaccine. The question is especially intriguing in this case, as the Finnish population of has been branded as genetically homogeneous and unique, and the marketing of national health data for research is seen to require careful balancing between this uniqueness and international relevance, as Aaro Tupasela has suggested (Tupasela 2021; for other contexts see also Crane 2010; Merz 2021).

As the purpose of this trial phase is not yet to produce final generalizable knowledge about the efficacy of the vaccine, the potential 'uniqueness' of the national body is only a temporary question and does not pose a problem for the reliability of the trial. This, however, allows us to ask what kind of assumptions about sameness and difference are at work even if the study recognizes the significance of environment for human immune system. As is typical in clinical trials, the availability and convenience of research subjects may be a key factor for determining on whom a particular vaccine or medicine will be tested (e.g. Epstein 2007; Petryna 2009).

Our findings question the enduring observation that medicine operates with sameness (Epstein 2007; Merz 2021), imagining one universal body, where any differentiation around social life is rendered irrelevant – geographical space, environment, gender, and even age is often seen to have no place in the biomedical anatomical ideal. For example, Margaret Lock and Vinh-Kim Nguyen argue that the dominant orientation in biomedicine is that the human body, despite its outward differences, is essentially the same everywhere (Lock & Nguyen 2010, 1). Yet the practice of phasing trials, the challenging work of sustaining a diverse trial population in terms of age and having the (microbial) environment as a starting point, indicates appreciation of diversity if not intersectionality. Overall, the large population required for the RCT produces a universal body through computation, meaning it does take sameness as its end point: the aim of the method is to make sure that differences that do not matter do not get on the way (Epstein 2007). This sameness is, however, highly differentiated in the lived body by its context and individuality. The trial assumes variety in how each individual body works, but the number of

participants generalizes individuality to a probability of the vaccine working well enough for certain kinds of people. The body can be generated into universality by counting until difference can be overlooked, but it does not make individuality disappear epistemologically.

The ecological, symbiotic holobiont alongside human exceptionalism

In the next scene a sociologist and a scientist sit comfortably in the hotel lounge chairs in Benin, sipping pre-dinner drinks after a long day of work at the trial laboratory. The scientist, never too tired, explains vividly how the vaccine works in an individual body. The story is not about the body of large numbers of the trial population, but a body emerging in an intricate interplay of entangled elements. The depiction reminds us of Donna Haraway's holobiont (Haraway 2016). Approached from the perspective of the holobiont, the human body is a seamless participant in the ecosystem where bacterial and genomic flows are inevitable and hard to control by a human. We read the description to suggest that this vaccine does not fight the bacteria but teaches the body to live with them – through an exposure to a modified version of the ETEC bacteria. The body learns to interact with ETEC in the next encounter in such a way that no harm occurs to the body. The vaccine imitates a mild exposure that helps the body to cope better in the abundance of gut-level entanglements found in tropical conditions. One significant element is that this vaccine is administered as an oral liquid, and therefore, the mucosal immune system has a key role in the immune reaction. When ingested, the gut processes the confrontation in a similar way to how it would interact with actual bacteria, but in a safer way for the human. The dynamic learning process within the gut was the key issue.

One important interpretation in social scientific terms is that a less cautious, more ecologically dynamic holobiont life is possible with such vaccines, compared to an every-day where one constantly "micro-protects" against invasive, harmful microbes (Huttunen et al 2021). Another one is that the holobiont body is constantly evolving in its environment. It is not stable but a vital, embedded organism within a larger whole. Importantly, the vaccine is a human-made element, or technology, introduced into the ecology of the gut, and thereby challenges the stark divide drawn between nature and culture/technology. The distinctive human-centeredness is in question here, and a holobiont-cyborg mode of existence prevails (Haraway 1985; 2016). A natural, dynamic bodily learning process is not in opposition to biomedical technologies.

The renowned biologist Lynn Margulis, who introduced the concept of the holobiont in 1991, underlined the importance of multi-species symbiosis for mutual and collective development. Following Margulis, embryologist Scott F Gilbert (2020) suggests that there is a paradigmatic shift from 20th century biology focusing on entities, competition, and stability towards the holobiont view of living-with in unstable but necessary entanglements. The gut is the metaphor and lived reality for human entanglement with an abundance of "critters" (Haraway 2016, 1) we would not survive without (Wilson 2015). The entanglements undo our contours. Corporeal material relationality is temporal, and the embodied (dis)entanglements "queer time" by undoing normative temporal forms such as heterosexual reproduction, suggests McCormack (2021; see also Edelman 2004, Muñoz 2009, Freeman 2007, Shildrick, 2019).

We suggest that the vaccine logic in itself queers what Oikkonen (2021, 22) names "culturally prominent ideas of immunity" that "mobilize normative assumptions of bodily boundaries and encounters between bodies", complicating mainstream ideas about biomedicine as a coherent whole (Dolezal et al. 2021). The ecological-technological holobiont logic of the vaccine also challenges the suggestion that individual immunity automatically "resonates closely with the imaginaries of eugenics and racial hygiene" (Oikkonen 2021, 34), as Oikkonen recently maintained in her study on "post-pandemic futures". Based on our study on this trial, we argue that to condemn the affective appeal of immunity as inherently negative overlooks the possibility that immunity can mean a desire to live with. The immune response means that an organism like bacteria or virus is incapacitated and destroyed in the gut, but does not need to be eliminated in the immediate environment: co-existence is made possible.

The gut is here a vital organ that constantly learns and changes according to its environment: its capacity to adjust, even if temporarily, to new influences is the key to the vaccine – as for vaccines in general. This vaccine is based on inactivated bacteria that train the body to live with them in the environment, in very similar (but less painful and dangerous) ways to how the body learns when living through an illness. The grown-up trial participants are seen to be like enormous, healthy but vulnerable babies when exposed to tropical microbiota. The vaccine alleviates the pain and danger of that encounter by prompting the body to do what healthy bodies do: they learn and become skilled in co-existence and mutual attunement as the immune response is activated (Frost in Tamari 2021, 91; Frost 2020).

In this view, the immune response is not regarded as a form of war, in which the body that encounters 'foreign' antigens, mobilizes an array of biochemical agents to "eliminate the putative threat of otherness"

(Shildrick 2019, 15). Here, rather, immune response is understood as a pre-requisite of co-existence. The idea of such co-existence and acquired immunity generated with a vaccine as "natural" is especially interesting in the light of research on vaccine denialism and hesitancy; one reason to abandon vaccines is said to be a preference for a natural, and therefore assumedly healthier immunity and immune system, developed through encounters with actual pathogens (Nurmi 2021). The notion of naturalness is in question; similarly to what Helosvuori (2021) suggests in her research on infertility treatments, technology – here, the vaccine – connects immunity to specific forms of naturalness rather than prevents natural bodily processes. The holobiontic views of the vaccine and the immune system complicate the boundaries of what is seen as 'natural' or 'unnatural' and suggest new forms of 'naturalness' to emerge.

Yet, the scientists also expressed views that go against holobiontic contourlessness. However ecological their approach may be towards the gut, a holobiont view of co-existence was often confronted with a human-centered view and a need to maintain some boundaries. Human medicine harbors a commitment to human exceptionalism and human – -non-human boundary work. The entity that medicine is designed to care for is the human, one of the doctors said when we discussed multi-disciplinary collaborations. In a conversation about the One Health paradigm which recognizes the intertwinement of the health of humans with that of other animals and the environment, one staff member stated that medicine is per definition human-centered, and this is not an ethical dilemma for them, despite many being devoted animal-lovers. In this way the body is not imagined as fully immersed in an ecosystem characterized by total fluidity; rather there is species-specificity, some individuality and entity borders (cf. Pradeu 2019, Gilbert et al 2012).

When discussing pathogenicity, the scientists often underscored that bacterial encounters are not to be feared as such. A healthy body needs microbes, and copes with some pathogens in reasonable amounts. This came up for example when discussing the assumption that the trial could put the participants' health at risk, but also when observing staff members' personal eating behaviors, which varied a lot. Many a chat had an element of minor "war and border controlling" (see Huttunen et al 2021), recalling the metaphor of the human body as a well-functioning state where some level of border control is assumed to be a necessity (Martin 1990; Haraway 1991). Every bite could be a moment of consideration and discussion, perhaps due to the trial topic's presence, but also because of the foreign food environment. For example, at a buffet table when she considered a leaf of lettuce, one staff member explained that what matters is the amount of bacteria and rejected the salad this time. Another staff

member underscored the importance of pre-exposure health status and prior immunity.

Here co-existence with bacteria is not a life in "natural" harmony (Halberstam 2020, 7), but one seeks to find a relaxed balance between a good life with friendly bacteria, and an awareness of a potentially vulnerable individual body in sometimes a potentially hostile situation where one does not wish to be surprised by a crowd of nasty critters. Later, in her comments for this article, a scientist described her view followingly: "Bacteria are mostly friendly and I make very little effort to avoid them, less than many others. So for me life is not at all fight against bacteria. Then there are those often causing health problems. It is like ice in a lake: great to ski and skate, but stupid to go there when the ice may be too thin to allow you to enjoy it. So no constant struggle but caution when you know that there may be bad consequences".

As in the salad situation, there are many private meal situations where caution rather than a willing ecological merging of oneself to the local natural microbiota comes up. Some did not approve of the choice of a staff member who went so far in the ecological practice that they started to drink tap water, but colleagues did not interfere either, as personal integrity and freedom to make choices were valued. When sitting with the lab staff at lunch, the conversations easily became more private and personal styles of exposure were discussed as a constant balancing between being careless and various every-day practices – how much effort is worth the trouble to limit exposure to pathogens? The body is also a work tool and thus an individual entity one must protect, yet not think about constantly. Frequently someone fell severely ill but was never blamed for carelessness. At the trial site, some also mentioned not having taken antibiotics for a decade, referring to intentional avoidance. For the trial participants, antibiotics were not advised unless the situation was decidedly serious as their use would affect the study participation, but also because general concerns about the spread of resistance intensified by careless use of antibiotics. Many, but not all, staff members expressed a similar way of thinking regarding antibiotics: one should avoid them, if possible, but at times they simply are needed. The trial could actually prove that monitoring by a doctor helps in itself, and unnecessary antibiotic use could be avoided through a doctor's evaluations, for example regular, supportive phone calls checking moods and well-being.

These private and professional behaviors of the trial scientists exhibit some similarity with the imagined 'immunity as warfare' typical for the cold war era (Haraway 1991), alongside the contemporary emphasis on co-existence and holobiome (Lorimer 2020, Mills et al 2020). As explored by the feminist classics on imaginaries and discourses on human immune

systems, Donna Haraway's Simians, Cyborgs, and Women (1991) and Emily Martin's Flexible Bodies (1994), in the context of the US the 1980s' human immune system was depicted as a militarized field of warfare. The human-centered entity-approach in our case moves away from these metaphors drawn from the situation of one hegemonic nation-state during the cold war era, in which it defended itself with threats of deploying a nuclear arsenal. If in this conception the immune system fought bacteria with an explosion of antibiotics, the vaccine trial's nation-state body today defends itself from overwhelming numbers of particular kinds of evident pathogenic outsiders, while still knowing that interaction is inevitable, even desirable.

If the 1980s' cold war influenced the metaphors of the human defense system, reflecting societal tensions of the time, the influence is not entirely over yet, even if the bodily imagery today also accommodates the more subtle analogies of a surveillance war, and the symbiosis of the holobiont. Our analysis focusing on the tourist-participants (Huttunen et al. 2021) points to the ways in which ideas of microbes and immunity are entangled with broader societal and global relations of racialized imaginaries at play when notions of purity, hygiene, dirt, and illness are negotiated (Chigudu 2020). Despite the logic of the vaccine, in private the staff regularly noted that hygiene in the village should be improved, and ways of educating the local people on the matter were pondered. This was a shared discussion topic with the tourist-participants. To our surprise they did not comment on the local adults having better immunity than the Finns, even if regular encounters with various bacteria may strengthen the body eventually. Such an environment is seen as too risky, with a high childhood mortality.

To summarize, by its design, the vaccine trial stages the body in ecological multi-species entanglements. The trial assumes that regardless of human choices, contact is likely, as microbes are among us, in and on us in hitherto unimaginable quantities. Trial staff members mentioned frequently that microbes are crucial for well-being and not essentially pathogenic. Antibiotic warfare against them should be avoided as far as possible. There is an undercurrent of relationality, interaction, and mutualistic outcomes also in the (oral) vaccine logic. In the enactments of the body here, some traces of the discourses of war against microbes emerge, and are complemented by what Haraway comes to view later, in Staying with the Trouble (2016), as the human-microbial co-existence of the holobiont.

This combination of ideas about the body does not seem to bother the medical staff in this trial. It is noteworthy that as Pradeu (2012), for example, argues, within scientific publications in immunology there are vast

differences in how the relationality of self and the microbiota are described. The assumed ontological shift in the contours of the human body being fluid, open-ended, porous, and processual (e.g. Roy 2019) resonates with the imagined body in the design of the vaccine - but it does not exclude the ontology of the clearly demarcated, defensive 'nation-state' body in some of the personal, and professional, practices. The medical researchers managed the body multiple (Mol 2002, 158) in their daily practices and the fictioning of the future body they engage with by shifts in methodology and attention.

These approaches, the ecological holobiome, and the human-centered, individualized warfare conception of immunity, are often described as contradictory or historically consequent to each other. The ecological approach criticizes the assumedly outdated Pasteurian approach that depicted microbes as enemies (Paxson 2008; Paxson and Helmreich 2014; Landecker 2016; see Latour 1993): if beneficial bacteria and other species have co-evolved with humans, and a collective human-microbe existence performs numerous micro-ecological functions which are essential to human development, immune system formation and function, digestion, metabolism, and cognition (Lynch and Pedersen 2016; Van Treuren and Dodd 2020), the hygiene-enthusiastic anti-germ theory of the Pasteurian tradition of the 20th century must be flawed. In a "post-Pasteurian" view this understanding of the microbial ecologies of the human body indicates a paradigm shift whereby the human body is only now understood as inseparable from nature, and now the millions of years of co-evolution between humans and microbes are acknowledged (e.g. Lorimer 2020; Lock 2018). The re-discovery of human bodies' and microbes' deep co-evolvement and inextricably interdependent entanglement is sometimes presented as a novelty and a historical progress (Lock 2018, 467). In our ethnographic study, however, scientists smoothly shifted between the registers without reference to linear chronological progression. Furthermore, futurity here also means that contemporary understandings of bacteria alter their future in the now: Hannah Landecker (2016, 37) suggests that "The effects of presuppositions are material, such that the very thing under study has the human history of explanation and intervention within it".

An underlying commitment to child survival both as a group of people and individuals may explain the limit to the ecological notion of the body here. Pathogens in vast numbers are dangerous even in much of the ecological holobiont thinking, as in some forms of vaccine denialism, if the idea of individual human survival is retained as a value (Nurmi 2021). The quantity and pathogenicity of bacteria, as well as the human-centeredness of the quest for personal and population survival, are, we

suggest here, also orientations in futurity. Immunity as border control and the all-encompassing ecological approach come together in their aspiration to look forward, to be geared towards a possible future, whether to survive as species or be embedded in continuous change.

Deadly mistakes and the vulnerable body

While the aim of the trial is to collect useful and credible data, we frequently witnessed attention and care to an individual's health concerns. In these moments, worry, pain and also grief were not downplayed. Yet, it was also emphasized that as a doctor, the professional must learn from mistakes and be ready to make new ones. For us these reminders were about the scholarly trial body being constantly diffracted into new patterns by medical practice (Barad 2007), and that the scientists are also practitioners of medicine. This practice reminds the scholar of individuality, fragility, vulnerability, and grief in the face of pain or fear of loss of lives, as well as the need to act and proceed into an uncertain, contingent future despite the many failures. When the bus transporting the very last group of trial participants to the airport left the trial site, the principal investigator, to her own surprise, had a strong emotional reaction. According to her, it was the relief that the trial participants had all survived and without any severe accidents; she had considered herself ultimately responsible for the health and safety of the participants. Thus, the body of numbers mentioned in the beginning of this article contains also the individual body, that does not disappear from the view of the scientists.

The topic of care for the individual patient emerged often when discussing particularly intriguing patients in doctors' work in general. Sometimes the comment was that some patients cannot be diagnosed correctly without a face-to-face encounter. Taking a hunch seriously requires the professional competence of an experienced doctor who can suspect an entire range of issues, not only the most obvious. One of the doctor-coordinators of the trial referred to a similar hunch when she had to make a major decision about procedures regarding one trial participant. Her decision to act turned out to be the correct one; in her explanation, a particular kind of feeling based on all her work experience, and her ability to pay careful attention to certain signals, led to her decision.

One interviewee, a doctor-coordinator, described the different logic of a trial compared to the clinical logic of care of the individual's health followingly: in the everyday work of medical practice the point is to "just take care of things" and get health problems fixed, rather than focus on recording everything carefully. As she put it, "I'm used to that - - it's

enough that the throat ache is gone. Then in this case [the trial] it's not at all the point that the sore throat is gone, but that it's properly recorded in all the places. So I kind of had it the wrong way in my head at first". This brings to the fore the "inconsistencies" between what we have called the body in numbers, and the vulnerable individual body that needs to be cared for. The advice for the doctor-coordinators was that the participants' health is the priority, and everything else comes after that, which meant that these different logics needed to be constantly balanced. In her study on the ontologies of a trial, Charlotte Brives suggests that the patient-participants acquire new skills and knowledge and take on new corporeal practices (Brives 2013, 411); in our study, those conducting the scientific work needed to negotiate the different versions of the body.

These stories are reminders to us sociologists that despite most of their time being spent in other duties, patient encounters and skills in conducting them root medical researchers in their roles as doctor-scientists. Similarly, the scientist-doctors in Ville spent a lot of their time consulting the individual participants on how they cope with diarrhea, calling them several times a day when needed. The attention to the individual does not stop them from seeking the mathematic probabilities. The vaccine trial and its various conductors manage the numerical body of the double-blind trial, and the holobiont body – the body that is ecologically open and at times fights to maintain a safe boundary – and the individual, unique body that needs to be seen and spoken with, and who may die in the hands of even a competent doctor.

Discussion

The ethnographic method whereby social scientists follow the same individuals through different situations enables the observation of the body multiple within a research team that is explicitly committed to one idea of the body: the ontology of the trial and its body dispersed and again condensed into numbers. In this article we identified a diverse set of other enactments of the body too: the ecological holobiont body of the vaccine, the nation-state defensive body of the personal everyday practices of the staff, and the individual, vulnerable body of the doctor-patient relationship. All these figured in the same trial, when followed ethnographically. They all are "true" at the time of the event and should be taken seriously. They have further consequences, and they send off novel diffractions in unexpected ways, yet following a pattern that can be detected. Often the pattern is governed by an agreed-upon methodology – albeit one that requires everyday tinkering. The method gives the diffraction its credibility

even if the method itself is a mere construct, a temporary achievement that coheres around a momentary consensus. In this trial, the consensus however alternated with seemingly paradoxical accounts, for example, given in the ten minutes between moving from test tubes to lunch salads, exhibiting parallel, inconsistently organized ideas and practices of corporeality rather than cumulative epistemic progress.

Such concerns seemed not to trouble the scientists of this trial. This, we argue, has to do with future orientations and indeterminacy. The corporeal, inflected, "less elegant" modest witness (Haraway 2007, 24) we encountered, has a convincing case, not despite the many emerging ideas of the body, but because of them. It is also important to consider that the researchers in focus here were not alone, and the trial science was made possible by an assemblage of a large number of people, critters and more-than-human actors, and their creative craft, as well as infrastructures, technologies, and material equipment.

This article discusses two aspects of temporality highlighted here: first, the paradoxes between the different imagined and enacted bodies are possible due to future orientation; second, the holding together of vastly different and conflicting images of the body usually assigned to different eras and historicized to belong to certain decades only, has also to do with non-linear space-time-mattering in everyday scholarly, and lived, corporeal, practice.

Here also lies our contribution to the discussions on queering medicine and the queer temporalities of the body in medicine (Dolezal et al. 2021, McCormack 2021): rather than working at the outset from a sense of a normative alliance between a presumed coherent body of medicine and the individual, independent, bounded neo-liberal, capitalist technology of a heroic patient, a look at the cracks and inconsistencies highlights the multiple diffractive potentialities in science and medical practices. The challenge remains, of course, to insist on the importance of a critical analysis of the ways in which normative power operates while new futurities emerge. Our analysis of the diarrhea vaccine trial honors the tradition of queer studies, where the double task of looking for life-affirming disruptions in diffractions and a critical analysis of the potential force of medicine as an institution of social control is not a binary either-or but a both-and (Clarke et al. 2010, Bennett 2004, Shildrick 2019).

References

Ahmed, S. (2004). Collective Feelings: Or the Impressions Left by Others. *Theory, Culture & Society*, 21(2), 25–42.

Barad, K. (2003). Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter. *Signs*, 28 (3), 801-831.

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

Barad, K. (2011). Erasers and Erasures: Pinch's Unfortunate 'Uncertainty Principle'. *Social Studies of Science*, 41(3), 443–454.

Bennett, J. (2010). *Vibrant Matter: A Political Ecology of Things*. Durham: Duke University Press.

Berg, M. & Mol, A. (Eds.). (1998). *Differences in Medicine: Unraveling Practices, Techniques, and Bodies*. Durham: Duke University Press.

Bhatt, A. (2010). Evolution of Clinical Research: A History Before and Beyond James Lind. *Perspectives in Clinical Research*, 1(1), 6-10.

Blume, S. (2005). Lock in, the state and vaccine development: Lessons from the history of the polio vaccines. *Research Policy*, 34(2), 159-173. https://doi.org/10.1016/j.respol.2004.12.001.

Brives, C. (2013). Identifying ontologies in a clinical trial. *Social Studies of Science*, *43*(3), 397–416.

Butler, J. (1993). *Bodies that Matter: On the Discursive Limits of "Sex"*. London: Routledge.

Cartwright, N. (2007). Are rcts the Gold Standard? *Biosocieties*, 2(1), 11–20.

Chigudu, S. (2020). *The Political Life of an Epidemic: Cholera, Crisis and Citizenship in Zimbabwe*. Cambridge University Press.

Clarke, A. E. J. Shim, L. Mamo, J. Fosket, & J. Fishman (Eds.). (2010). *Biomedicalization. Technoscience, Health, and Illness in the U.S.* Durham & London: Duke University Press.

Crane, J. T. (2010). Adverse Events and Placebo Effects: African Scientists, HIV, and Ethics in the 'Global Health Sciences'. *Social Studies of Science* 40(6), 843-70.

Crane, J. T. (2013). *Scrambling for Africa: AIDS, Expertise, and the Rise of American Global Health Science*. Cornell University Press.

Devanesan, A. (2020). Medical Nihilism: The Limits of a Decontextualised Critique of Medicine. *Studies in History and Philosophy of Science. Part C. Studies in History and Philosophy of Biological and Biomedical Sciences*, 79, 101189.

Dinshaw, C. et al. (2007). Theorizing Queer Temporalities: A Roundtable Discussion. *GLQ: A Journal of Lesbian and Gay Studies*, 13(2), 177-195.

Dolezal, L., Käll, L. F., McCormack, D., Oikkonen, V., & Shildrick, M. (2021). Introduction: Queering Health and Biomedicine. *Lambda Nordica*, 26(2-3), 7-18.

Edelman, L. (2004). *No Future: Queer Theory and the Death Drive* (Ser. Series q). Durham, NC: Duke University Press.

Epstein, S. (2007). *Inclusion: The Politics of Difference in Medical Research*. University of Chicago Press.

Fisher, J. (2020). Adverse Events: Race, Inequality, and the Testing of New Pharmaceuticals. NYU Press.

Foucault, M. (2003). *Birth of the Clinic*. London and New York: Routledge.

Frost, S. (2020). The Attentive Body: How the Indexicality of Epigenetic Processes Enriches our Understanding of Embodied Subjectivity. *Body and Society*, 26(4), 3–34.

Gilbert, S. F. (2020). Developmental Symbiosis Facilitates the Multiple Origins of Herbivory. *Evolution & Development*, 22(1-2), 154–164.

Gilbert, S. F., Sapp, J., & Tauber, A. I. (2012). A Symbiotic View of Life: We Have never Been Individuals. *The Quarterly Review of Biology*, 87(4), 325–41.

Gunkel, H., Hameed, A., & O'Sullivan, S. (2017). Futures and Fictions. A Conversation with Henriette Gunkel, Ayesha Hameed and Simon O´Sullivan. In *Futures & Fictions*. Gunkel, H. Hameed, A., & O´Sullivan, S., 1-20. London: Repeater.

Halberstam, J. (2020). *Wild Things. The Disorder of Desire*. Durham: Duke University Press.

Haraway, D. J. (1991). *Simians, Cyborgs, and Women. The Reinvention of Nature*. New York: Routledge.

Haraway, D. (1997). *Modest-Witness@Second-Millenium. FemaleMan (R)-Meets OncoMouse™: Feminism and Technoscience*. New York: Routledge.

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

Helmreich, S. (2009). *Alien Ocean: Anthropological Voyages in Microbial Seas*. University of California Press.

Helosvuori, E. (2021). *Procreative entanglements : embryos, clinical practices and experiences of childlessness in the age of assisted reproduction*. [Dissertation, University of Helsinki]. Helsingin yliopisto. http://hdl.handle.net/10138/333278

Hinchcliffe, S. et al. (2016). *Pathological Lives: Disease, Space and Biopolitics*. Malden and Oxford: Wiley Blackwell.

Hird, M. J. (2009). *The Origins of Sociable Life: Evolution after Science Studies*. London: Palgrave Macmillan.

Huttunen, K., Oinas, E., & Sariola, S. (2021). When cultures meet: Microbes, Permeable Bodies, and the Environment. In C. Brives, M. Rest, & S. Sariola (Eds.), *With Microbes* (pp. 121-142). Manchester: Mattering Press.

Huttunen, K. E. (2023). Relationality, Individuality and Entanglements of Helping in the Context of a Touristic Vaccine Trial: Nordic Research Subjects in West Africa, *Science & Technology Studies*, 36(1), 59–74. doi: 10.23987/sts.113032.

Irni, S. (2013). Sex, Power and Ontology: Exploring the Performativity of Hormones. *Nora - Nordic Journal of Feminist and Gender Research*, 21(1), 41–56.

Kirksey, E. (2019). Queer Love, Gender Bending Bacteria, and Life after the Anthropocene. *Theory, Culture and Society*, 36(6), 197–219.

Landecker, H. (2016). Antibiotic Resistance and the Biology of History. *Body and Society*, 22(4), 19–52.

Latour, B. (1993). *The Pasteurization of France*. Cambridge, Mass.: Harvard University Press.

Latour, B. (2005) Reassembling the social: an introduction to actor-network-theory. Oxford: Oxford University Press.

Lock, M. M. (2018). Mutable Environments and Permeable Human Bodies. *Journal of the Royal Anthropological Institute*, 24(3), 449–474.

Lock, M. M., & Nguyen, V. K. (2010). *An Anthropology of Biomedicine*. Oxford: Wiley-Blackwell.

Lorimer, J. (2020). *The Probiotic Planet: Using Life to Manage Life*. Minneapolis: University of Minnesota Press.

Lynch, S. V., & Pedersen, O. (2016). The Human Intestinal Microbiome in Health and Disease. *The New England Journal of Medicine*, 375(24), 2369–2379.

Margulis, L. (1991). Symbiogenesis and Symbionticism. In L. Margulis & R. Fester (Eds.), *Symbiosis as a source of evolutionary innovation: Speciation and morphogenesis* (pp. 1-14). Cambridge, MA: MIT Press.

Martin, E. (1987). The Woman in the body: a Cultural Analysis of Reproduction. Boston, Massachussets, Beacon Press.

Martin, E. (1990). Toward an Anthropology of Immunology: The Body as Nation State. *Medical Anthropology Quarterly*, 4(4), 410–426.

Martin, E. (1994). *Flexible Bodies: Tracking Immunity in American Culture From the Days of Polio to the Age of Aids.* Boston, MA: Beacon Press.

Martin, D., Pereira, P. P. G., & Spink, M. J. (2018). Multiple Bodies, Political Ontologies and the Logic of Care: an Interview with Annemarie Mol. *Interface - Comunicação, Saúde, Educação* [online]. 22(64): 295-305.

Maury, O (2023) Patterns of Coloniality Within the Innovation Economy: Talent Attraction and the Converging Racializing Processes of Migration Administration. In: Krivonos, D; Pascucci, E & Aparna, K. (eds.) *Souths and Easts as Method: Europeanization as Violence*. Manchester: Manchester University Press.

McCormack, D. (2021). The Haunting Temporalities of Transplantation. *Body & Society*, 27(2), 58–82.

Merz, S. (2021). Global Trials, Local Bodies: Negotiating Difference and Sameness in Indian For-profit Clinical Trials. *Science, Technology, & Human Values*, *46*(4), 882–905.

Meskus, M. (2018). *Craft in Biomedical Research: The iPS Cell Technology and the Future of Stem Cell Science.* New York: Palgrave Macmillan.

Mol, A. (2002). *The Body Multiple: Ontology in Medical Practice*. Durham, NC: Duke University Press.

Moreira, T., & Will, C. (ed.s) (2016). *Medical proofs, social experiments : clinical trials in shifting contexts.* Routledge. https://doi.org/10.4324/9781315594675.

Muñoz, J. E. (2009). *Cruising Utopia: The Then and There of Queer Futurity*. New York, NY: New York University Press.

Nurmi, J. (2021). Building 'Natural' Immunities: Cultivation of Human-Microbe Relations in Vaccine-Refusing Families. In Brives, C., Rest, M. & Sariola, S. (Eds.). *With Microbes*. (pp. 104–121). Manchester: Mattering Press.

Oikkonen, V. (2021). Post-Pandemic Futures and the Affective Appeal of Immunity. *Lambda Nordica*, 26(2-3), 21-46.

Oinas, E. (2019). HIV Politics and Structural Violence: Access to Treatment and Knowledge. In Vaittinen, T. & Confortini, C. C. (Eds). *Gender, Global Health and Violence: Feminist Perspectives on Peace and Disease.* (pp. 89-114). London: Rowman & Littlefield Publishers.

Paxson, H. (2008). Post-Pasteurian Cultures: The Microbiopolitics of Raw-Milk Cheese in the United States. *Cultural Anthropology*, 23(1), 15–47.

Paxson, H., and Helmreich, S. (2014). The Perils and Promises of Microbial Abundance: Novel Natures and Model Ecosystems, from Artisanal Cheese to Alien Seas. *Social Studies of Science*, 44(2), 165–193.

Petryna, A. (2009). *When Experiments Travel: Clinical Trials and the Global Search for Human Subjects*. Princeton: Princeton University Press.

Petryna, A. (2010). Paradigms of Expected Failure. *Dialectical Anthropology*, 34(1), 57–65.

Pradeu, T. (2012). *The Limits of the Self: Immunology and Biological Identity*. Oxford University Press.

Pradeu, T. (2019). *Philosophy of Immunology: Elements in the Philosophy of Biology*. Cambridge University Press.

Riska, E. (2010). Gender and Medicalization and Biomedicalization Theories. In A. E. Clarke, J. Shim, L. Mamo, J. Fosket, & J. Fishman (Eds.), *Biomedicalization: Technoscience, Health, and Illness in the US* (pp. 147-170). Duke University Press.

Rosemann, A. (2019). Alter-Standardizing Clinical Trials: The Gold Standard in the Crossfire. *Science as Culture*, 28(2), 125-148.

Roy, D. (2018). *Molecular feminisms: Biology, Becomings, and Life in the Lab*. Seattle: University of Washington Press.

Sariola, S. (2021). Intellectual property rights need to be subverted to ensure global vaccine access. *BMJ global health*, *6:*4, [005656]. https://doi.org/10.1136/bmjgh-2021-005656

Sariola, S., and Simpson, B. (2019). *Research as Development: Biomedical Research, Ethics, and Collaboration in Sri Lanka.* Ithaca: Cornell University Press.

Shildrick, M. (2019). (Micro)chimerism, Immunity and Temporality: Rethinking the Ecology of Life and Death. *Australian Feminist Studies*, 34:99, 10 24.

Tamari, T. (2021). Interview With Samantha Frost on 'the Attentive Body': Epigenetic Processes and Self-Formative Subjectivity. *Body and Society*, 27(3), 87–101.

Tarvainen, A. (2022). The modern/colonial hell of innovation economy: future as a return to colonial mythologies, *Globalizations*, doi: 10.1080/14747731.2022.2048460

Tupasela, A. (2021). *Populations as Brands: Marketing National Resources for Global Data Markets.* New York: Palgrave Macmillan.

Van Treuren, W., and Dodd, D. (2020). Microbial Contribution to the Human Metabolome: Implications for Health and Disease. *Annual Review of Pathology: Mechanisms of Disease*, 15(1), 345–369.

Wahlberg, A., and McGoey, L. (2007). An Elusive Evidence Base: The Construction and Governance of Randomized Controlled Trials. *BioSocieties* (2), 1–10.

Will, Catherine 2016. Addressing the Commercial Context: The Collective Critique of Clinical Trials, in Moreira, T., & Will, C. (eds.) *Medical proofs, social experiments: clinical trials in shifting contexts, pp.67-83,* Routledge. https://doi.org/10.4324/9781315594675

Wilson, E. (2015). *Gut Feminism*. Durham: Duke University Press.

Åsberg, C. (2021). Ecologies and Technologies of Feminist Posthumanities. *Women's Studies*, 50(8), 857–862.

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