Microbes and Sovereignty

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MICROBES AND SOVEREIGNTY

MASTER'S THESIS

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Abstract

The text looks at the concepts of microbes and sovereignty, not only to reveal that there are any number of links between them, but also to problematize their respective categorization as 'natural' and 'social'. By examining the historically contingent beginnings of contemporary notions of sovereignty, as well as the socio-historical context around the scientific 'discovery' of microbes, the thesis aims to show that the modern idea of sovereignty involves imposing two different frameworks of understanding onto the world: one for the social world (in which sovereignty applies), and the 'natural' world (beyond sovereignty). The 'rediscovery' of microbes in the second half of the 19th century was ostensibly the culmination of this dual framework of nature/society. However, more recent understandings of microbes have ended up disrupting this neat and familiar framework of nature/society. The disruption in turn requires the reconsideration not only of the strong division between the two, but a number of other concepts we have come to accept, such as individuality, positionality, sociality, agency, etc.

Key words

microbes, sovereignty, observation, Grotius, Pasteur, conceptual framework

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Introduction

In the introduction to his book *Kant and the Platypus*, Umberto Eco asks "what has Kant got to do with the platypus?" and answers, "Nothing. […] And this should suffice to justify the title…" (2000: 1). He then goes on to elaborate his 'nothing' across several hundred pages. Perhaps counterintuitively, it takes many more pages to elaborate such a 'nothing' than the present text has taken in (at least) sketching the answer to the question 'what have microbes got to do with sovereignty': something. Nevertheless, this should suffice to justify the title.

Further justification, however, if necessary, can be found in that the present text emerged from a program of Cultural Studies, which pride themselves on the premise of interdisciplinarity, and taking an askew look from the margins. I have endeavored here to take literally and seriously the basic instinct of those working in the field of Cultural Studies, that nothing is so small or unreal as not to deserve a closer look. Not just that, but all things – important things, banal things, material things, fictitious things – deserve to be placed next to one another and see how they look to each other. In that sense, the hope is that microbes and sovereignty can reflect back on one another such that they also shed light on themselves (and for us too).

What complicates matters somewhat here is that the two phenomena studied happen to be invisible to the naked eye, and invisible in different ways: microbes are simply too small for the human gaze, requiring technology to become apparent, while sovereignty belongs to the order of entities only visible in their effects. What they do have in common, however, is that they are both 'made visible', most present to the human spirit, when something goes wrong, i.e. in illness or government breakdown. (And as we shall see, those two go together often.)

I insist on this question of visibility (of what, to whom?) and invisibility (when?) because an important component in considering both microbes and sovereignty is that of observation. It turns out – to absolutely no one's surprise – that observation depends as much on the one looking and one's vantage point, as it does on what is being looked at. It is likely that microbes do not mean the same thing to an ill person as they do to one of sound health, for example, just as sovereignty means something different to a municipal clerk at their desk and a refugee at a border crossing. If there is one lesson of cultural studies, it is that the context that frames a particular issue is crucial.

More than anything, then, the present text seeks to elaborate the context surrounding the issues of sovereignty and microbes. In so doing it brings together some historical background and certain theoretical notions, it notes the transfers of concepts and language from one discipline into

another, and it traces the threads that already tie these two phenomena together. It also recognizes that the context did not just happen as if by magic, but that it was elaborated by a series of figures – scientists, thinkers, observers. Luckily for us, the complexity of these figures allows for second looks, multiple layers of meaning, moral ambivalences and the like. Take Louis Pasteur, for example, whose work I discuss in Chapter IV. A man of undeniable genius and endless energy, a century and a half after he began his most serious work, it is more and more obvious that he was driven by less than purely scientific motives. And it is clear that his celebrity and influence derived in equal measure from who he was and from what contemporary French society needed him and his figure to be.

Yet we must not see such complexity as simply contamination of scientific inquiry, as some impurity, which once removed, leaves only unadulterated science. On the contrary, we must try to see, that is to say, I will try to show, these complexities as constitutive of the scientific legacy of people like Antoni van Leeuwenhoek, Hugo Grotius, Thomas Robert Malthus, Pasteur… It is these complexities that form their positionality, going some way towards answering the aforementioned question: what was the vantage point from which they made their observations? All of which means that in order to reveal the context that frames these phenomena, it was important to (somewhat) reconstruct who it was that provided this framework and how they did it.

Hence, in Chapter I, I look at how the novelty of map-making led to a new way of seeing 'the world', a notion that might have itself only recently emerged at that point. Combined with the circumstances in which the newly-born Dutch Republic found itself at the beginning of the 17th century, this led a daring young Delft jurist to come up with a few small but decisive innovations in political theory that allowed for a whole new way of thinking about sovereignty. Chapter II explores the emerging scientific world of the 1600s: through two complex figures, Galileo and van Leeuwenhoek, it shows the growing importance of 'seeing' instruments, first the telescope and then the microscope. Not only what they observed, but the way the two men observed, and the importance they imparted to observation itself, would all remain important thereafter.

Chapter III deals with the rise and development of a new conceptual tool, mostly in the 18th century. Counting and statistics became an increasingly important matrix scientists and governments could apply to try to come to terms with Europe's rising population, migration, and colonization. This period also cemented some of the notions first proposed in the previous century. To take a central aspect of the work as an example, if the 17th century proposed seeing nature as a resource, it was in the 18th century that this take on the world would become the dominant way of thinking.

The following chapter discusses how notions developed in the 17th century and methods developed in the 18th came to bear on the enormous changes caused by Europe's industrialization in the 19th century. By the time we enter the golden age of microbiology, sometime after 1850, the context into which microbes emerge and their relation to the human world has already been heavily elaborated. Meaning that the role microbes would play when they first emerged into social consciousness was already largely delineated by what had come before.

Chapter V follows both the full flowering of the sovereign paradigm from the 17th century and the expansion of significance of microbes for our world. Crucially, however, it also points to how these two successful strategies both drew on previous conceptual solutions and how each actually fueled the development of the other. For example, microbes emerge as a social force with the rise in population of European cities; but they only emerge as a social (and not merely some destructive 'natural') force because of modes of governmentality already projected in the 18th century. And when they do take their place in the social world, the microbes are placed in the service of defending and developing the economies of sovereign countries as Grotius had understood them two hundred years prior.

The same chapter also introduces the conceptual changes that follow reaching the limits of the dominant paradigm. Hence Chapter V also shifts from speaking about human figures (as in the first four chapters) to non-human agents of milk and microbes. The aim, as mentioned, is to shade the context around these issues. But significantly, the shift in focus or agency is also followed by a shift in the number of contexts. Namely, the goal is to go from microbes and sovereignty belonging to disparate domains and place them into one field, a single register, where they can be considered together.

One further word on the structure of the text. I did not set out to write it in chronological order. I was fascinated with the Dutch 17th century, and specifically with Antoni van Leeuwenhoek, and sought to connect him with the figure of Louis Pasteur as it appears in the work of Bruno Latour. The rough temporal sequence of the chapters emerged from my efforts to write around this van Leeuwenhoek-Pasteur axis. For this purpose, however, and in particular in discussing the nature and pitfalls of Pasteur's project, I felt it necessary to reach a near full century before van Leeuwenhoek and also elaborate another Dutch 17th century legacy: sovereignty. For now, this should suffice to justify the title…

Chapter I: The Geographer and His Maps

Begin with Vermeer's *Geographer*. The stunning blue of the robe, the light streaming through the window onto the face of the subject and the unfolded paper before him, the richly woven fabric casually draped over the table, the nearly invisible yet exquisite white and blue tiles along the bottom of the wall—. Beyond mere scopophilic pleasure, what does the choice of objects represented tell us about what we are looking at? The tiles along the floor, the big window, the fabulously luxuriant cloth, all speak of opulence. Which extends to the subject in the painting: he is neither a clergyman, nor an aristocrat, nor even a captain of industry; he seems not much more than a humble technician of some kind. Yet even one of no particular status or distinction is clad in a lush blue robe. We have stumbled upon him at work, lost in thought, his instrument in hand.

The exquisite artefacts are of course Vermeer's way of showcasing the extraordinary industry and ingenuity of the Dutch 17th century. Nor should we ignore that the subject is represented as youthful and in rude health. But let your eye wander a bit, and it is likely to go from window, down across the fabric, to the wooden box, up by the chair to the map on the wall, following the armoire's shadow to the globe, slipping by the books to return to the window. The eye's journey, circumnavigating the subject, only makes one recall that when Vermeer painted the canvas, the Dutch ruled the high seas, running a trade empire the world had not seen before. Indeed, the riches of the room before us are really the riches of the world brought to the Low Countries. Where are the man's thoughts? The dividers in his hand tell us that he is not contemplating abstract philosophy, nor theological exegesis. No, his thoughts are much more practical, concerning the next shipment of textile, or new trade routes, or how to reach parts as yet unknown – something, in any case, that can be represented in quantity and on a map.

The world of mapping

Nine of Vermeer's paintings feature maps (Snyder 2015). There are any number of ways in which map-making and painting were intertwined in the 17th century: map-makers and painters belonged to the same artist guild; they are both two-dimensional representations of three-dimensional things; they could be mere interior decoration, but could also confer status on either or both the subject of the map or one displaying it. Painting maps into a painting would be a way for a painter to show off technique, but also an effective way of conveying information. Thus, the map in the right top corner in *The Geographer* is from the first half of the 17th century by Willem Blaeu and shows

western part of Europe, southern Greenland, northern Africa, and a good piece of the northern Atlantic. It is oriented with the western coast of Europe at the top, a practice standard for Dutch maps of the 16th and 17th centuries (Snyder 2015). It also shows the ocean with less distortion than the European land, meaning that it is a navigation map. In *The Art of Painting*, Vermeer inserted a map of all seventeen Dutch provinces, even though the provinces had been split up since 1581 and Spain recognized the independence of seven of them in 1684 (effectively making the split permanent, as it remains today) (Koeman and van Egmond 2007). Is there a way to read this element that does not include the artist's patriotism/nationalism?

It is perhaps worth noting today that maps as we know them were still a relative novelty at the time. Although the first maps of the Low Countries go back to the first half of the 16th century, map-making in the Dutch countries exploded in the 17th century (Koeman et al. 2007), becoming common decoration in middle class homes (Snyder 2015: 200). They were at once the latest technology, representing a far-away (even really far-away) part of the world, and intimate, personal items – maps were the World Wide Web of the 17th century.

And much like the Internet of today, maps were initially military technology. One of the reasons the craft of maps expanded and changed rapidly in the Low Countries in the second half of the 16th century is that it was a tool for both the Spanish and the revolting provinces: "The best preserved illustrations [of war events and technical military innovations], are found in Spanish and Italian collections" (Koeman and van Egmond 2007: 1282). And these authors are careful to point out how many Dutch engineers who designed fortifications but also drew maps worked for Spain (ibid.). Those skills would be vital in the struggle of the Seven United Provinces for independence from Spain. In fact, a dynamic interesting for our present purposes develops here. Here are Koeman and van Egmond:

> Due to the lack of any strong central authority, general cartography rarely exceeded the boundaries of a single province. Thanks to the Union of Utrecht in 1579, defense became one of the few areas in which there was some centralization. Military mapmakers were not limited by provincial boundaries and thus produced maps that went beyond them. Moreover, there were fewer civilian maps available of areas of interest to the military – the "frontiers" – than there were of the economic center of the republic. This kind of mapping thus occupied a special place in the development of the cartography of the Low Countries (2007: 1285-6).

Where maps were previously (during Spanish rule) primarily a map of locations of towns, necessity shifted their purpose to survey of 'frontiers'. I cannot but wonder whether in the process of militarily mapping the borders of the Seven United Provinces, the military engineers were not also

simultaneously and unwittingly describing a new domain of sovereignty? Patrick Joyce (whose book on the 19th century city will be more relevant for Chapter IV of the present text) writes that "…the modern map [from the beginning of the 17th century] is essential to power and to the practices of governance" (2003: 36).

My discussion here is nothing more than a reverse engineering of Koeman and van Egmond's argument. At the beginning of their article, they write that "an account [of a history of Dutch mapping] is difficult to understand, however, without knowing the complex historical-political development of the Low Countries after the Middle Ages" (2007: 1246). My claim is merely that developments in map-making also help us understand the "complex historical-political" events.

Mapping the world

We do not know about the maps on the floor, or even the one in front of the subject, but the recognizable map in Vermeer's *Geographer* is, as I mentioned, for seafaring (Snyder 2015: 202). That is, its primary focus is the sea, not land. And the globe atop the cabinet is turned to the Indian Ocean – the Dutch were known for (and proudest of) their maritime quests. Indeed, it was globes, not wall maps that were responsible for the shift in representing the world.

At this point it might be helpful to say a few words about the man most responsible for this shift, Gerardus Mercator, as there will be parallels with other figures in our narrative. If ever there were a transitional figure, Mercator is it. He studied in Leuven in the 1530s, genuinely interested in philosophy and theology, but which he had to put aside for the more commercial side of science (globe-making). He seems to have already been troubled by a tension between certain aspects of the Ptolemaic view of the world and Holy Scripture, and when he encountered Copernicus' *De revolutionibus*, he was convinced of its truth immediately (Koeman et al. 2007). He was already producing high-quality globes in the 1540s and '50s. On the one hand, he was deeply influenced by Ancient philosophy and Medieval theology (remaining a devout Catholic his whole life) (Zuber 2011); on the other, Koeman et al. tell us that

> The publication of Mercator's globe pair in Louvain represented the final step in the first phase of the history of globemaking in the Low Countries. During this phase, the globe metamorphosed from an expensive object, made by scholars to demonstrate the newly discovered areas and their ideas about the form of the world, into an object that was sold commercially and, with the inclusion of rhumb lines, suitable for ocean-going navigation (2007: 1360-1).

Mercator's personal interests may have laid in the old way of using the globes, i.e. "ideas about the form of the world;" but what made him a household name was the practical and commercial side of his work. Indeed, Koeman et al. continue, saying that "Mercator lay the foundation for the enormous flourishing of globe manufacturing that would follow in Amsterdam" (2007: 1361). It was when Flemish cartography moved to Amsterdam, after 1585, that Mercator's insights about globes, maps, representations of the world, seafaring straight lines across oceans would become truly weaponized.

Only after his globe-making would come atlas-making and the famous Mercator projection, with which he is still deeply with us today. Yet Mercator sought to get back from mere technical work to natural philosophy, incorporating his knowledge of geography. But this was resisted by both his publishers and the Church authorities: he had to publish his 1592 *Evangelicae historiae quadripartitas monas* himself, and *De mundi creatione ac fabrica* was placed on the *Index librorum prohibitorum* of 1619 (Zuber 2011).

In this aspect, Mercator's difficulties resemble that of Galileo (as we shall see in Chapter II). Mario Biagioli shows in *Galileo's Instruments of Credit* that the Italian attempted to "…turn a hierarchical relationship between theology and astronomy into a parallel one…" (2006: 232). And Mike Zuber tells us that "…Mercator's own natural philosophy was a transgression of disciplinary boundaries," (2011: 516) and that in his texts, he "…actively moulded the hierarchy of the disciplines" (2011: 532). The argument is similar to Latour's descriptions of Pasteur's interventionist moves. To make an academically inappropriate experiment, here is a sentence with the name of the scientist it deals with removed: "The social movement into which X inserted himself is a large part of the efficacy attributed to X's demonstrations." The statement stands true of Zuber's Mercator (or Biagioli's Galileo) as it does for Latour's Pasteur.[*] (And there will be more discussion of Pasteur in Chapter IV.)

There is a subtler contribution to mapping as well as to our world for which Mercator is responsible (albeit far from alone). The late 16th and early 17th century was the moment when the "epistemic foundations of maps" as we know them were laid down (Joyce 2003: 35).

> Visuality was central to how abstract space was conceived. […] The abstract, and gendered, gaze of the map was literally superior: the view from above was detached, part of a visual rhetoric of modernity which privileged the observer with a vantage point separate from the observed. […] The cartographic surveyor, one whose gaze is detached and looking always upon its object is a particularly important exemplification of this visual rhetoric (ibid.).

[*] As a matter of academic honesty, I am obligated to cite this reference. It is in fact Latour 1988: 28.

It is as if Joyce lifted these lines from a reading of Vermeer's *Geographer*.

Open sea/open theory

By the last decade of the 16th century, the Dutch were making regular sea voyages to the East Indies. More and more, navigators for these voyages were using maps with the Mercator projection, because although it required some learning, for open sea voyages, it was simply more precise (Schilder and van Egmond 2011). The advantages of the Portuguese and Spanish, who had been sailing longer, were beginning to erode before Dutch efficiency. This was true in general historically, and in map-making specifically by correcting previous maps, precisely using the Mercator projection: "…and that without any shortening or diminution of the countries, though on the Spanish, Portuguese, Italian, Sicilian and other sea-charts they are placed three, four and five degrees, and more, outside their true position and latitude" (Schilder and van Egmond 2011: 1409). Three or four degrees of imprecision might not mean much when traveling, say, from Genoa to Seville; sailing across the Indian Ocean with four degrees of imprecision, on the other hand, would be disastrous.

Sure enough, before the first decade of the 17th century was out, the seafaring baton was passed from the Iberian peninsula to the Dutch. We can point to three (related) events to further elaborate this point. The capture of a Portuguese ship, *Sta. Catarina*, off the coast of Singapore in 1603 by the Dutch; the chartering of the Dutch East India Company (the Verenigde Oostindische Compagnie, or VOC) later that same year (Zandvliet 2011); and finally, "the first embassy to a European country of diplomats from far-away Siam (now Thailand)" in 1608 (the same year Hans Lipperhey applied for a patent for the telescope, Chapter II) (Zoomers 2010: 301), an event that signals that the Dutch had a different approach in their colonial endeavors to the Portuguese and Spanish.

Richard Tuck points out that the seizure of the Portuguese ship was most likely just the impetus for unification of several smaller companies into the Dutch East India Company. In any case, the VOC would go on to dominate trade in this part of the world for the next two centuries (Tuck 2001: 79-80). The capture of the ship was instantly the stuff of legend: the ship was laden with copper, silk, porcelain, and bullion, the value of which was "not far off the total annual expenditure of the English government at the time…" (Tuck 2001: 80). If ever there were a metonymy of the changing of hands of power and wealth in the colonial theater, the seizure of the *Sta. Catarina* is it. In addition to being an event of enormous impact for European politics of the time, it was in response to this event that Hugo Grotius wrote first *De Indis* (in 1604/5) and then *Mare liberum* (in 1609), key texts of 17th century political philosophy.

Grotius was only twenty years old when his cousin (as it happens), Jacob van Heemskerk (Tuck 2001: 79), captained the Dutch ship that seized the *Sta. Catarina*; and only twenty-one (in October of 1604) when he was invited to write a legal justification for the plunder (Ittersum 2006: 95). By the time he was able to write anything, politics had moved on, so his text was never published. (The text would only be recovered in the 19th century and be given a different title by the publisher.) Grotius was once again invited to write a justification of the seizure in November 1608, during peace negotiations with Philip III of Spain (Tuck 2001: 81), and the result was *Mare liberum*, later incorporated into his much larger *De iure belli ac pacis*.

Naturally, Grotius could not write a text in which he explicitly defends the stealing of ships, and thus makes no mention of the *Sta. Catarina*, van Heemskerk, or money made from the sale. His task was to uncover, so to speak, a rock solid enough to ground the Dutch actions, all the while pretending that plundering of Portuguese ships is only one specific instance (not even worth noting) that is ostensibly justified by a robust theoretical framework. Indeed, even before he actually begins his tract, in the address to the princes and rulers of the world, he gives very general comments about right and wrong (Grotius 2004). And he goes on to list all the various ways in which the Portuguese do not have the right to dominate the Indian Ocean – ten of the thirteen chapters of *The Free Sea* refer to Portugal in title.

In so doing, Grotius – dare we say – stumbled upon a few innovations in political theory.† The Dutch were justified in their actions because the Portuguese had unfairly barred them from trading across the Indian Ocean. *The Free Sea* focuses so much on the Portuguese because he has to remove the justification for their dominance of this body of water, so that he could therefore show that their *de facto* dominance so far has been unjust. This, in turn, would mean that the Dutch were in fact the wronged party seeking justice/restitution. Now the reason the Portuguese are not justified, that is, unjust, is that their actions do not rest in natural law: they have no right by title of invention, no right by title of Pope's gift, no right by title of possession, no right by prescription or custom (Grotius 2004: 3-4). The Portuguese offended "against Dutch merchants *and their indigenous trading partners*" (van Ittersum 2006: 29, my emphasis), which were "gross transgressions of natural law, particularly the law of inoffensiveness and freedom of trade and navigation" (ibid.). Martine Julia van Ittersum goes on, "[t]his was a major innovation in legal theory and practice…" (ibid.).

† As a reader, I am not entirely convinced that Grotius is successful in justifying the ship's seizure; the lateral move onto theoretical terrain, however, allows the reader to entirely lose sight of how successful (or not) Grotius' justification of Heemskerk's actions really is.

In the second step, Heemskerk's action had to be brought into line with this Dutch just restitution, lest they be considered mere piracy. In other words, it was not enough to show that the Dutch deserved reparations of some kind, but that it was Heemskerk who is allowed to exact them. Grotius says, therefore, "…a good man judging it would adjudge liberty of merchandise unto the Hollanders and would forbid the Portugals and others who hinder that liberty to do any violence, and would command them to restore their losses" (2004: 59). That is to say, because Heemskerk was a good man, his act is not the act of a pirate, but of a representative of the injured Dutch. "A private individual," says van Ittersum, "could reclaim these powers [of sovereignty] and exercise them in person under certain circumstances…" (2006: 29). These circumstances are the absence of higher instantiations of sovereignty, such as judges, military officers, etc. (ibid.).

The innovation here lay in this flow of sovereignty between an individual and higher powers. In justifying the ship captain, Grotius reversed the question of justification: he did not ask who authorized Heemskerk to perform this act; rather he established that sovereignty "…derived from the Dutch commonwealth or *respublica* and, more specifically, from each and every Dutch citizen" (ibid.). The rhetorical sidestep worked all too well: at least as far as theory went, Grotius rendered the seizure of the *Sta. Catarina* a moot point, opening up a whole new way of thinking about law, sovereignty, and politics.

States/myths of nature

Yet, the framework of the argument required a couple of more new moments. The very nature of writing a text like *The Free Sea* meant distinguishing between things over which there can be sovereignty and over which not. Indeed, just as the Dutch were historically establishing their own sovereignty of the United Seven Provinces, Grotius would never deny the Portuguese their sovereignty over their own *land*. The open sea, however, was a different matter. One could possess that which one could catch in the sea; but not the sea itself. Therefore, it would also not be fair to deny anyone fishing in any location of the sea. One could fish wherever, and the caught fish were one's possession; but one could not bar others from fishing (even in the same portion of the sea) and claiming possession to their caught fish (Grotius 2004).

The same applies, says Grotius, to the air and wild lands: they cannot be possessed, but caught fowl or wild animals become possessions. What we are presented with here is an idea of nature as a bountiful resource. In several places, Grotius mentions that "God himself speaketh this in nature…whereof the life of man standeth in need, to be sufficiently ministered by nature…" (2004:10),

"[n]ature had given all things to all men…" (2004: 49), "…the common and harmless use of the sea is required, which by the law of nature is common unto all…" (2004:59). And in a reply to William Welwod's critique of *Mare liberum* (Welwod was worried about Dutch fishing off the coast of England), Grotius reiterates: "…moreover, because of the fact that it is no one's property, its fruits may be gathered by anyone, as can be shown from the example of herbs and other things growing in lands newly discovered" (2004:123). It does not take much to recognize the fiction in which nature is considered a resource to be a crucial aspect of the capitalist world, one that would remain with us to the present.

To this fiction, Grotius adds another, one that is also still with us under various guises. The story, according to Grotius, goes something like this: "[w]e are to know, therefore, in the first beginning of the life of man, dominion was another thing and communion differing from that which they are now" (2004: 2) – that is to say, things were different "in the first beginning." At that time, "[b]y the first law of nations, which sometimes also is called natural and which the poets elsewhere describe in the golden age…nothing was proper…" (2004: 21) – that is to say, in that first state of nature there was no property, everything was common. Indeed, "[i]n this signification, therefore, we affirm all things common at that time…" (ibid.). Then, "[p]roperty being found out, there was a law set down which should imitate nature." (2004: 22) Note that the departure from this state of nature was followed by establishment of laws, that is, by natural law. Then, "[t]he same time commonwealths began to be instituted and established" (2004: 24) – that is to say, countries, groupings of individuals, come into being. And, of course, trade: "[b]ut so soon as movable things (necessity which was even now declared pointing at it) passed into proper right, permutation was found out, whereby that which is wanting unto one should be supplied of that which is superfluous to another" (2004: 50). Just so.

The two "natural" fictions are intertwined. In the beginning, there was no property and everything was common; then, through their labor, men (always men) fished the seas and tilled the land, claiming possession of items caught, hunted, grown. All the while, nature's plenty, ensures both that everyone possesses something and that these possessions are rather diverse, which brings about trade. And again, the flow of sovereignty from individual to state (or vice versa) means that trading individuals are essentially no different to trading companies (groups of individuals) or states. Just as individuals are free to exchange possessions, so are states free to conduct trade. Thus, Grotius returns us to the (natural) right of the Dutch to trade in the East Indies, and why the Portuguese have no (natural) right to bar them from doing so.

It is perhaps worth spending a little more time on these notions of nature. If our contemporary sensibility finds the notion of 'nature as resource' distasteful, we should remember that four hundred years ago, humans' relation to the planet was remarkably different. The notion of 'overfishing', for example, as we know it, would have seemed ridiculous in the early 17th century. Therefore, Grotius's example of fish being part of the open sea until they are caught seems perfectly reasonable: one could no more exhaust the fish in the sea than one could, say, cart away sea water one bucket at a time. Seen thus, the idea of nature as a plentiful resource, waiting (willing?) to be transformed by the labor of men, is not at all far-fetched. Furthermore, an aspect of this understanding of nature as resource is still with us. Namely, if nature is 'open' to anyone until it is possessed by someone, it means nature is mere matter awaiting the distinction (in both senses of the word) of being possessed by a man; while man becomes sovereign conferring ontological status of possession through his labor. It would take humanity reaching the actual, physical limits of resources (i.e. overfishing) to question the underlying assumptions in this approach to the world. This was something that would not take place until the 20th century.

Grotius' invention of individual sovereignty would be further, and more famously, fleshed out by later political thinkers, such as Hobbes, Locke, Rousseau – but the seeds of the self-interested, sovereign individual were already there in 1609. Richard Tuck writes that Hobbes' "state of nature was peopled by agents preoccupied with their own protection, and willing to use any violence necessary in order to ensure their survival" (2001: 228). And while he does say that Hobbes' account goes further than Grotius', they are following the same line of thought. For Grotius – and political theorists for at least two centuries thereafter – self-interested entities always concerned with self-defense. Crucially, companies (like the VOC) were also self-interested entities obsessed with survival, as were individual human beings. And this was their natural state.

In the introduction to Grotius' three-volume *The Rights of War and Peace*, Richard Tuck writes:

> Whatever their different views about what he had done, Grotius's readers in the seventeenth and eighteenth centuries were united in their praise for his originality, for in *De Iure Belli ac Pacis* we have indeed found many of the central themes of modern political theory. Grotius's men are born free, under no authority but that which all men will recognize, the authority of a minimal kind of natural law. They are equal, for the essence of Grotius's natural justice (as distinct from the distributive justice characteristic of civil societies) is that it treats all men as equal and does not recognize distinctions of rank or even of merit; furthermore, in nature our property is extremely exiguous, and no one can claim property rights at the expense of the poor. And yet, on the other hand, his men are competitive and censorious, eager to conquer new territories if that will promote the rational use of the world's resources, and eager to intervene in the internal affairs of other nations if they see injuries being suffered by the

> innocent. The world Grotius depicted is indeed recognizably our world, for good or ill (Tuck 2005: xxxiii).

*

Mercator's maps and Grotian individuals are still very much with us. Vermeer's geographer is yet taking the measure of our world.

Chapter II: The Geographer and His Observational Instruments

Begin with Vermeer's *Geographer*. The stunning blue of the robe, the light streaming through the window onto the face of the subject and the unfolded paper before him, the richly woven fabric casually draped over the table, the nearly invisible yet exquisite white and blue tiles along the bottom of the wall—. Beyond mere scopophilic pleasure, the arrangement of the various objects in the painting draws the eye, with the light, past the draped cloth, down to the wooden box in the right lower corner, then up to the map hung on the wall, then back across towards the globe in middle, and back to the window pane. Vermeer is presenting the viewer with the technological marvels of the age: the cloth, tiles, maps, globes, and glass – all of it indirect veneration of the figure at the very center of the canvas. What, asks the painting, is at the center, the origin, of all this technological wonder? The new scientific mind, comes the response.

By the time Vermeer painted this picture in 1668, the Copernican and Galilean revolution was over. Copernicus had published his world-changing book over a hundred years prior, and at this point both Kepler and Galileo were already dead (to use them as reference points). And although Isaac Newton was yet to burst onto the scene (not for long), a new science had well and truly taken the stage. It was, therefore, no accident that Vermeer chose to represent it with a figure of a youngish man with no trace of anything religious about him.

Yet the objects represented in the painting are more than mere satellites of the human, and are even related to one another independently of him. On their own (without the young scientist) they sing of a novel world. Although it had been nearly two hundred years since Columbus' initial journey, there were regions of the world that were still completely new to 17th century Europeans, in particular to Dutch explorers. The Netherlands itself was new in two different ways: its independence from Spain was still a novelty and its survival was far from certain at this point. (Indeed, shortly after the birth of this painting, the Dutch had their disaster year – *Rampjaar* – in 1672, very nearly destroying the country.) But even more astonishingly, the Netherlands itself was new since the Dutch were reclaiming land from the sea: it was quite literally new land. All of this is well represented through the globe atop the armoire, the map on the wall, the unfolded paper in front of the scientist, and the dividers he holds in his hand. The cloth and window have their own relationship. Both cloth-making and glass production were booming in 17th century Delft, where Vermeer lived. Drapers used magnifying glasses in the course of their work to assess the quality of the weave, either imported or produced locally (Snyder 2015).

Unsurprisingly for a painter, Vermeer was looking for a new way to see and render the world on canvas. Cloth, maps, glass were all items that had a strong connection with painting at the time, because they had a strong connection with ways of seeing (Snyder 2015). According to Laura Snyder's book *Eye of the Beholder*, Dutch painting prior to the 17th century was done on wood, so canvas as a painting material was new (2015). Map-making and painting were a single profession, both sets of artists belonging to the same Guild of St. Luke.

It is, of course, glass-making that interests us most here. More than perhaps anything else, glass-making, that is, observation through glass magnification, which drove the new science of the 17th century. Starting with Galileo Galilei's 1610 publication of the *Sidereus Nuncius*, telescopes and then microscopes became the hallmark instrument of the new science. And more than anything else, *observation* became what the scientist did. In fact, in her book, Snyder tells us that the original title of Vermeer's painting was not *The Geographer*, but *The Surveyor* (2015: 149); it was only much later that it was given its present title. It is only fitting, since surveying, as a word and activity, includes seeing and looking (in a way that does not immediately leap to mind with geography).

Observing (in) the 17th century

Debate rages on about the exact origin or invention of the telescope. Magnifying glasses of sorts had been around for centuries even prior to the 1600s (Zuidervaart 2011). Nevertheless, scholars agree that the moment the telescope becomes a key scientific instrument comes in 1608 (Van Helden 2011, Willach 2011). Hans Lipperhey‡ applied for a patent with the States General of Dutch Republic for an instrument 'for seeing far'. (One of the ways which we know that Lipperhey is not the inventor of the telescope is that his patent was refused.) From this moment, the telescope undergoes "rapid dissemination" (Zuidervaaart 2011: 11) throughout Europe. A mere eighteen months separate that initial moment from the publication of Galileo's *Sidereus Nuncius* in March 1610. It would be difficult to overstate the importance of this instrument to the scientific revolution that took place in the first half of the 17th century.

In *Galileo's Instruments of Credit*, Mario Biagioli explains just how central the instrument was to Galileo's career. The telescope allowed him to go "from being a somewhat obscure mathematics professor…to becoming a courtly star in Florence…" (2006: 1). Galileo was able to subtly change the

‡ In his essay "The 'true inventor' of the telescope. A survey of 400 years of debate," Huib J. Zuidervaart claims that Prof. G. Moll added an 's' to Lipperhey's name, making it Lippershey, an error that remains in English publications to this day. I follow Zuidervaart's spelling (2011).

function of the instrument as a social tool in order to advance his career. First, in 1609, he presented it to the authorities of the Venetian Republic – to them, Galileo presented it as a military tool, a way to see ships on the horizon before they became visible to the naked eye. In return, the Venetians increased his professorial salary. Then, he used the telescope to make observations about celestial bodies, which he named after the Medici. These observations would become the *Sidereus Nuncius* and would lead to him being given a position of official mathematician to the Medici at the University of Pisa (Biagioli 2006).

However, Galileo knew that there are more discoveries to be made. Therefore, although he did describe his instrument in the book, "…the 1610 *Nuncius* did not provide information to build the instrument that was so central to the claims made in the book" (Biagioli 2006: 4). He had to walk a very fine line, however, acting as if

> …corroboration of his observations [was] easy, not difficult. Galileo's primary worry […] was not that some people might reject his claims, but rather that those able to replicate them could too easily proceed to make further discoveries on their own and deprive him of future credit. He tried to slow down potential replicators to prevent them from becoming competitors. He did so by not providing other practitioners access to high-power telescopes and by withholding detailed information about how to build them (Biagioli 2006: 79).

Once his position with the Medici was secured, however, his stance changed. It

> allowed him to assume an authoritative, if not arrogant, stance toward those who failed to replicate his discoveries. He began to act as if the difficulties some had encountered in seeing the satellites of Jupiter did not discredit his discoveries but only confirmed that his telescope was the best (Biagioli 2006: 42).

Thus, through subtle changes to the approach and function of the telescope, Galileo ensured his own (scientific) rise. The telescope was first a military instrument, then an instrument of discovery for the sake of ingratiation, and finally an instrument with which to maintain his scientific authority. Cunning, no doubt, on Galileo's behalf; but only possible because of the Galileo's social positioning of the telescope, that is, the (social, scientific) credit he was able to derive from the instrument (Biagioli 2006).

In his reading of Galileo's credit, Biagioli (tells us in footnote 76 that he) follows the work of Latour and Woolgar, specifically from *Laboratory Life*. Indeed, Biagioli's description of how Galileo inserts the telescope into scientific discourse is reminiscent of Latour's explanation of Pasteur's interventionist moves. To make an academically inappropriate experiment, here is a sentence with the name of the scientist it deals with removed: "The social movement into which X inserted himself is a

large part of the efficacy attributed to X's demonstrations." The statement stands true of Biagioli's Galileo as it does for Latour's Pasteur.[§] (And there will be more discussion of Pasteur in Part II.)

Where Latour and Woolgar use the expression "credit as credibility," Biagioli uses the word distance. He sees distance not as some mere (perhaps serendipitous) accident in scientific work, but as a crucial constitutive element. He illustrates this with another 17th century example, that of the Royal Society.

Although when founded, it was given a charter by Charles II and counted among its members such luminaries as Robert Boyle, Christopher Wren, Robert Hooke, and a little later Isaac Newton, Biagioli tells us that the Royal Society

> was a private, voluntary organization with very limited and poorly paid staff. […] The academy struggled to secure a significant endowment to support its activities, hire staff, find a building to call its corporate home, keep its members interested, maintain a good level of activity at its weekly meetings, and make sure that everyone paid his dues. Despite the enthusiasm that permeated the first few years of the academy's life, crisis was just below the surface, and the corporate survival of the Society never certain (Biagioli 2006: 46).

(Perhaps it is worth pointing out that a good deal of this precariousness of the Society Biagioli is trying to convey could also apply to the whole country of the Netherlands at the time.) Yet, it turns out, we owe a lot to this precariousness. Had the Society had stronger standing, it would have perhaps not solicited as much work from lesser-known researchers. Indeed, Antoni van Leeuwenhoek, a central figure for the present work, is Biagioli's further evidence. Van Leeuwenhoek was the son of a basket-weaver, a draper by trade, appointed to a civic position (fairly) early on in his life. It allowed him a handsome living, was a steady source of income even in the course of the *Rampjaar* of 1672 (the economic collapse that Vermeer, for example, was unable to weather, plunging into debt), but still left him free time to pursue his interests (Snyder 2015). Calling van Leeuwenhoek's interests hobbies would perhaps be unfair, given the zeal, dedication, discipline and sacrifice he gave to them (the word obsession is not far out of reach). Yet, he had no scientific training, had little or no grasp of languages other than Dutch, crucially being illiterate in Latin, in fact, nothing to recommend him to the scientific community of the time, no less the 'Republic of Letters' that the Royal Society was weaving across Europe. Nevertheless, van Leeuwenhoek became one of the Society's most prolific (if not *the* most prolific) correspondents.

[§] As a matter of academic honesty, I am obligated to cite this reference. It is in fact Latour 1988: 28.

That a society of ostensibly such high standing would deign to correspond with such a lowly figure as van Leeuwenhoek is certainly evidence that such high standing was (in the first part of the Society's existence) mere fiction. Albeit, one which they got away with. On the other hand, it is also a most happy circumstance, because while van Leeuwenhoek was not a scientist (perhaps even by today's standards), he was an exceptional observer; so exceptional that his observations were useful far beyond bolstering the reputation of a private society in London.

It is perhaps difficult for us today to conceive of Galileo as an outsider to science, given how deeply embedded in its foundations he is. But we should not ignore Biagioli's introduction to Galileo: before the publication of the *Sidereus Nuncius*, lest we forget, Galileo was "a somewhat obscure mathematics professor" (2006: 1). And Biagioli does not even call van Leeuwenhoek a scientist, calling him "a microscopist" (2006: 60). Which is not to say that I think Biagioli is wrong. On the contrary, it is to point out how novel telescopists and microscopists were in the 17th century. It is to point out that the telescope and microscope had to be drawn (dragged, inserted) *into* science. It is to point out that if today telescopes and microscopes seem like perfectly ordinary (which is to say embedded within) scientific instruments, that is only because of the work of people like Galileo and van Leeuwenhoek (often outsiders).

Microbserving

While Galileo's status as mega-star of the scientific world remains inviolate, van Leeuwenhoek cuts a more ambiguous figure. He was not quite a scientist, and yet has had an undeniable role in science. He was both too early and too late to the game of observing through a microscope. And he was too early *and* too late to the story of microbes.

As with the telescope, there are no exact origins of the microscope. Reports of a compound microscope go as far back as 1595 (by a Dutchman – always a Dutchman! – Hans Jansen) (Croft 2006). Malpighi, Descartes, Kircher – there is no shortage of great names of the 17th century who tinkered with and wrote about microscopes (Bradbury 1967), testifying to how widespread across Europe the instrument was, but also how much discovery it potentially promised. Perhaps our best reference in that sense is Robert Hooke, whose 1665 *Micrographia* is a central text in a few ways. The book emerged from Hooke's role as "curator of experiments" to the Royal Society, a position he held from 1662. It was popular beyond scientific circles, capturing the imagination of the general public (Snyder 2015). In it, Hooke reports his observations of the point of a needle, cloth, sparks, color, grains of sand, salt crystals, ice crystals, petrified wood, cork, leaves, mold, moss, sponges, seeds, hair,

skin, fish scales, bee stings, fly eyes, insect eggs, but also looking up at stars and the moon. (It was in his observation of cork that he first used the word 'cell', which would become the unit of life [Hooke 2005].) Which is to say that, whatever else he was doing, Hooke was showcasing the microscope's potential. Or what he thought was its potential: "by the help of *Microscopes*, there is nothing so small, as to escape our inquiry; hence there is a new visible World discovered to the understanding" (2005: 5).

Hooke's microscopes and his observation were top of the line; his optimism, however, was unfounded, because his microscopes were also, unbeknownst to him, the end of the line. Development of microscopical observation went on for another fifteen years or so, and then tapered off significantly after 1680. "…in the 1680s…the microscope began its alleged century-long "decline" within the scientific community, during which comparatively little was written on microscopical observation outside the world of fiction" (Needleman Armintor 2009: 195). "The microscope became a toy for English ladies and gentlemen. The toy would consist of a microscope and a box of mounted specimens from the plant and animal kingdom" (Hacking 1983: 192). Hooke's work is central to microscopy in the sense that it was the apex: before 1665 there was rapid development of observation through/with a microscope; after 1680, the microscope would go on scientific hiatus for a couple of centuries or so.

And yet, Antoni van Leeuwenhoek did not get in touch with the Royal Society until 1873. Indeed, although he had obsessively been making lenses and observations since the late 1650s (Snyder 2015), there would have been no reason for the Royal Society to be in touch with him, as he was a complete scientific outsider. Once the Society and van Leeuwenhoek were in touch though, it was – this is precisely Biagioli's point – a match made in heaven: for the next fifty years, until literally his deathbed, van Leeuwenhoek would write long letters on just about everything under the sun. It is hard not to admire van Leeuwenhoek for his indefatigable curiosity, work rate, and discipline. Where Hooke reported his eyes hurt using the kind of microscope van Leeuwenhoek designed and built, the Dutchman used it all day long. Where Malpighi looked at frog's blood under the lens, Antoni used his own blood, semen, hair, skin, tooth plaque, etc. He taught himself to polish beads of glass to make single-lens microscopes, and while we do not know how many he actually made (Snyder says possibly as many as 566 [2015: 105]), they were the best in the world for a long time.

It is fitting that although he wrote an enormous number of letters, van Leeuwenhoek never wrote a book of any kind. Snyder attributes this to him never pausing in his observations: "one gets the sense of a man in a hurry," who "did not wish to take time away from making observations" (2105:

214). Perhaps that is part of the story; but equally likely is Biagioli's intuition in calling him a 'microscopist' (and not a scientist). That is to say, van Leeuwenhoek was an excellent technician and brilliant observer, but perhaps lacking a theoretical mind that could synthesize what he had been seeing. Either way, when the scientific world lost its appetite for observing through a microscope (as I said, sometime after 1680), van Leeuwenhoek continued carrying out microscope experiments for over forty years. Hooke himself, who had given up observation through microscopes by the late 1670s (Snyder 2015), wrote in 1692 that the scientific world was "now reduced almost to a single Votary, which is Mr. Leeuwenhoek; besides whom, I hear of none that makes any other Use of that Instrument, but for Diversion and Pastime" (quoted in Bradbury 1967: 77).

To the extent that van Leeuwenhoek was the only person making observations with the microscope after scientists had already moved on, he was late to the game. There is a sense, however, in which he was also too early with his discoveries. In the fall of 1674, van Leeuwenhoek sent one of his letters to the Royal Society in which he mostly discussed the eyeball of a cow. Only towards the end does he mention that in a droplet of water, he has been able to observe "little animalcules, whereof some were roundish, while others, a bit bigger, consisted of an oval. On these last I saw two little legs near the head, and two little fins at the hindmost end of the body" (quoted in Dobell 1932: 110).

Snyder's explanation for why this passage was ignored by the fellows of the Society was that it was "buried under all the other detailed observation…some of whom may not, indeed, have read all the way to the end" (Snyder 2015: 230). This is giving way too much credit to the Royal Society members. More likely, they did not read the letter at all; and if they did, only a little of it might have been of interest to their own scientific research; and what was of interest to them, certainly did not include what must have sounded like – forgive the phrase – complete poppycock. Snyder goes on to say that van Leeuwenhoek was rattled and shocked, but offers no evidence of this (2015: 230). The reason I think there was no shock or stupefied response from England is that neither van Leeuwenhoek nor the fellows of the Society (who bothered to read till the end) really had any idea what was observed.

The point bears some expounding. Van Leeuwenhoek's discovery of bacteria was indeed somewhat different even to Galileo's discovery that the Moon's surface is not smooth or that Jupiter had moons of its own. In Galileo's case, although it was new that Jupiter had moons, people of the time understood and had seen celestial bodies enough to know what Galileo was describing. The moons of Jupiter are just like our own moon, but circling Jupiter, not the Earth (at least in principle).

Even if I am oversimplifying, it must be allowed that Galileo's discovery concerned objects that were on the whole familiar.

In the case of van Leeuwenhoek's observing bacteria (as we now call them), these were not things that were on the whole familiar to scientists. Scientists had peered through the microscope and seen parts of animals or organic matter (Hooke looked at bee stings, Malpighi at frog blood), but a whole, live, moving, tiny animal would have been utterly unimaginable. Van Leeuwenhoek's letter was from 1674, which is only a year into his correspondence with the Royal Society. The Dutch cloth merchant had nowhere near enough credit (to borrow a notion from Biagioli) to convince in a few lines members of the Royal Society that he had discovered something never before seen (if, that is, he himself understood at this point the magnitude of his observation). That not a single member was stirred by this news, nor in fact that van Leeuwenhoek did not mention these little animals again for over a year (sic!) – should be a surprise to no one (Dobell 1932).

It is in October of 1676 – at least two years after the first sighting – that Leeuwenhoek writes what Clifford Dobell calls "Letter 18" – "a truly amazing document" (1932: 112). By this point we can say, I think, that van Leeuwenhoek wrapped his mind around the significance of the phenomenon. The letter, although in Dutch and signed by him, is not in van Leeuwenhoek's hand (Dobell 1932: 113), meaning that he thought this epistle important enough to have it written out by someone with a more calligraphic hand. Further evidence that van Leeuwenhoek understood the importance of the issue is that in November of 1676, he sent a shortened version of "Letter 18," in Dutch to Constantijn Huygens (Dobell 1932). This was unusual for van Leeuwenhoek, since throughout his career he almost exclusively corresponded with the Royal Society (Biagioli 2006).

If the little animals were yet to impress the Society fellows, they did, however, impress Oldenburg (to whom the letter was addressed) enough to translate it into English (Dobell 1932). It might be worth noting that Oldenburg only translated a portion of the letter. When Clifford Dobell wrote *Antony van Leeuwenhoek and his "Little Animals"* in the 1930s, the entirety of the letter had not yet been published in English, and had only been published in Dutch in 1925 (Dobell 1932). When I say that van Leeuwenhoek was too early with work, it is in the sense that in the 20th century, science was still in part catching up with him.

The fellows of the Society would only hear the letter (or Oldenburg's translation) read in February of 1677, and it would be published in the Society's journal *Philosophical Transactions* in March 1677. Here the story becomes reminiscent of our previous Galilean episode. The members of the Royal Society asked Leeuwenhoek for information on how to make a microscope with which they

could see these little animals – in effect, asking for replication of observation. And much like Galileo who divulged little information about his telescope, van Leeuwenhoek simply refused to tell the RS how he made his microscopes: "My method for seeing the very smallest animalcule I do not impart to others" (quoted in Snyder 2015: 238).

In response, the RS called up its own great microscopists, Nehemiah Grew and Robert Hooke, both of whom, Snyder points out, had begun to lose interest in the microscope by 1677 (2015: 240). Nevertheless, mid-November, Hooke was able to replicate the observation and to show it to members of the RS: "[there were] great numbers of exceedingly small animals swimming to and fro.… [T]hey were near an hundred thousand times less than a mite…They were seen by Mr Henshaw, Sir Christopher Wren, Sir John Hoskyns, Sir Jonas Moore, Dr Mapletoft, Mr Hill, Dr Croune, Dr Grew, Mr Aubrey, and divers others so that there was no longer any doubt of Mr Leewenhoeck's discovery" (Birch, quoted in Dobell 1932: 185-186).

Of course, the RS also had an interest in van Leeuwenhoek being right. After all, they had accepted (if only through correspondence at that point) into their ranks a person who was now claiming to be able to see through a microscope (that no one could reproduce) beings so small that "if 100 of them lay stretched out one by another, they would not equal the length of a grain of course Sand; and according to this estimate, ten hundred thousand of them could not equal the dimensions of a grain of such course Sand" (van Leeuwenhoek, quoted in Snyder 2015: 234). These claims were so outrageous that if they had turned out to be wrong, the Royal Society would be subject to major embarrassment. As luck would have it, the Delft civil servant really was as good an observer as these claims suggested.

Now, a comparison between Galileo's and van Leeuwenhoek's discoveries might be useful. Why was Galileo (eventually) placed under house arrest for his scientific claims, while van Leeuwenhoek was celebrated? Well, it could be a matter of somewhat different time and place: Italy vs. Holland, and first half vs. second half of the 1600s – by the time van Leeuwenhoek is performing his observations, the Copernican system had won the day. It could be perhaps that Galileo wrote and published in Catholic Italy, whereas van Leeuwenhoek lived in more tolerant, (largely) Protestant Delft. But I would like to submit that there is also something else. Galileo was a man of his time: the order of the day was disproving Ptolemaic and proving Copernican cosmology. After writing the observational *Sidereus Nuncius* in 1610, Galileo went on to publish more philosophical texts (like the *Assayer*), because he could see (and was forced to deal with) the theoretical consequences of what he had 'merely observed' earlier.

For better or worse, van Leeuwenhoek was never in a position to, as it were, interrogate his own theoretical assumptions. After the initial observation came the second, and third, and so on until his death. But even more so, beyond pure curiosity, what was the point in looking so closely at a droplet of water? Even when van Leeuwenhoek discovered that the animalcules could be found everywhere (and it would be really difficult to find something in 17th century Holland that he had not looked at through his device), what did that change about scientists' understanding of the world? Put differently, Galileo was timely because he was providing answers to the Copernican challenge at a time when they were necessary. In a way, Van Leeuwenhoek is more the Copernicus (not Galileo) figure, in that his discovery would revolutionize the world, but the corresponding Galileo figure in this story would only come onto the scene in two hundred years (or later).

Does van Leeuwenhoek count?

Nowhere, perhaps, is the ambivalence of the figure of van Leeuwenhoek more visible than in his research on human sperm. He was endlessly curious about the world, including sperm (of sundry species); but he was also willing to ignore it out of prudery, finding it unseemly (Snyder 2015). He was able to show that sperm came from testicles, and that the human male produced much more sperm than was necessary for the generation of a single human – a contemporary point of contention in the scientific and theological world; on the other hand, to his dying day he clung to the notion that each spermatozoon contained a homunculus, and that this is what created a new human. He wished to study human sperm, using himself as subject; but he also wished to remain a pious Christian, writing that "[w]hat I investigate is only what, without sinfully defiling myself, remains as a residue of conjugal coitus" (quoted in Snyder 2015: 252) – studying human sperm was pure science, but masturbating to obtain said sperm was impure morals.

There is another similarity to Galileo that I would like to point out here. After a series of important discoveries in the 1670s, and certainly after he was elected into the RS in 1680, van Leeuwenhoek's reputation and authority grew immensely. He added the 'van' to his name (Snyder 2015) and addressed the members of the RS as his equals (whereas before he was deferential to the point of obsequiousness [Biagioli 2006]). Snyder tells us that when in 1699 a French researcher claimed to have actually seen the homunculus in human sperm, van Leeuwenhoek wrote to the RS saying that in all his observations of human sperm he had never seen anything like the description offered by the Frenchman, concluding that it was entirely invented (Snyder 2015: 255). All the while, he still believed

in the homunculus theory of generation, he just did not think that anyone would be able to see it, i.e. use a microscope to observe better than him.

His arrogance aside, van Leeuwenhoek's observations of sperm did allow him to think about it in innovative ways. It was his relentlessness of observation that allowed him to notice that all kinds of animals had sperm, not only humans: rabbits, dogs, cockroaches, fish, etc. Further, he noticed that to a greater or lesser degree, all these produce much more spermatozoa than they do actual animal individuals. Reading his letters gives the impression that the various counting and calculation he performs of the spermatozoa in different animals was in part a way to express just how small were the phenomena he was seeing. In the process, however, he hits upon an interesting notion. Here is a passage containing a calculation done towards the end of the letter of 25 April 1679:

> Let us assume that Holland and Westfriesland are 22 miles long and on average 7 miles broad, which makes 154 square miles for the area of Holland. The inhabited earth is 13.385 times larger than Holland. According to N.N. who has speculated the number of inhabitants of Holland, it is inhabited by 1.000.000 human beings, and if we assume that the inhabited part of the earth is as densely populated as Holland, though it cannot well be so inhabited, the inhabited earth being 13.385 times larger than Holland yields 13.385.000.000 human beings on earth (van Leeuwenhoek, 1948).

The phrase "though it cannot well be so inhabited" tells us that he knew that the number at the end is *not* the actual population of the Earth. He is high-balling the number. He says: "I will now calculate (but very roughly) the number of human being on the earth" (van Leeuwenhoek, 1948) But this calculation follows the one in which he informs us that (by his calculation), there are "150.000.000.000 little animals in the milt of cod" (van Leeuwenhoek, 1948). And when he finishes his calculation of the number of humans, he finishes the letter by referring once again to cod sperm: "The little animals in the milt number 150.000.000.000, which means more than ten animals in the milt of a cod as against one human being on the earth's surface" (van Leeuwenhoek, 1948).

In the essay "How Many People Can the Earth Support?," based on his eponymous 1995 book, Joel E. Cohen says that van Leeuwenhoek "wrote down what may be the first estimate of the maximum number of people the earth can support" (1999: 330). This, I would like to argue is both true and untrue. I think that van Leeuwenhoek's main goal with the calculation of the number of humans was rhetorical: he was trying to emphasize how many of these little animals there were in cod milt. As if to say to his reader: imagine if all the lands were as densely populated as Holland; that would still be only a tenth of how many animals in fish semen. In that sense, he is not even providing a

realistic estimate (hence "but very roughly") of how many humans *there are*, no less one of how many *there could be*. In that sense, Cohen's use of van Leeuwenhoek is tendentious.

However, van Leeuwenhoek's choice of comparison, seems to me, to beg for a second look. First, there are surely any number of comparisons he could have made that would have been just as effective and perhaps even less laborious. Second, it was not clear to scientists at the time what the relation was between sperm and reproduction, that is, between spermatozoa and actual human individuals. By comparing cod milt with human numbers, van Leeuwenhoek placed sperm (the familiar substance), spermatozoa (the little animals he observed), and actual individuals into the same theoretical framework, as if to say, these are related. Once we set aside the causality between sperm and individuals (of which they were not entirely aware), this relation can go both ways: just as a rough calculation of the number of humans could illustrate the number and size of spermatozoa, the spermatozoa are a variable in counting humans.

In that sense, Cohen's statement is true. Van Leeuwenhoek really was thinking about this problem *demographically* (and was probably the first to do so). The way he calculates the number involves an aspect of reproduction (sperm) and available resources (land). Are these not, *mutatis mutandis*, the variables employed in demographics: number of humans born/dying, and resources necessary to sustain them? Van Leeuwenhoek's variables are perhaps rudimentary and his result is obviously incorrect, but the theoretical framework seems to me spot on. A little further in his essay, Cohen says "[f]or several years I have been trying to understand the question, 'How many people can the earth support?' and answers to it." Is it too far-fetched to say that he is playing three hundred year catch-up with Antoni van Leeuwenhoek?

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Galileo's telescope and van Leeuwenhoek's microscope are still very much with us. Vermeer's geographer is yet taking the measure of our world.

Chapter III: Populations

Let us stay for just another moment with van Leeuwenhoek's intuition and estimate of the number of people in the world, which he based on extrapolation of the size and population of the Netherlands. In using this method of calculation, he brought into the framework of thinking one other crucial aspect for political thinkers from the late 17th century onwards: land. Where Grotius was primarily concerned with the open sea – little wonder given the style of Dutch colonialism – John Locke would elaborate issues relating to land use. This too should not be surprising, given that Locke is writing at a time of rapid expansion of English colonies, mostly in America. Indeed, Locke was intimately involved in these endeavors, helping to write the charter of Carolina (Tuck 2001).

Grotius' sovereign individual was rather useful to Locke, in that if an individual was sovereign he could colonize, defend his colony, and punish those who would transgress against it. Just as Grotius had Heemskerk's actions in mind, so was Locke concerned with what the colonizers of America could and could not do against the Native American population. Unsurprisingly, in this relationship, the Europeans had Lockian natural law on their side. There were other ways in which Locke adopted Grotius to his own ends. He took Grotius' account of possessing caught fish to tease out a logic of possession (and ownership). One possessed or owned something if one invested one's labor into it. The sea and the fish in their 'natural state' were indeed no one's and anyone's; and fish indeed became the possession of one who caught the fish; what made the fish his who caught it was the labor of fishing. This seemingly banal point, when applied to questions of land, had massive ramifications.

As far as the English colonists were concerned, the vast spaces of wilderness they encountered in North America were vacant. That the Native Americans had or could have a different understanding of space and place did not enter their way of thinking. To them, these were open lands, waiting to be worked. And he who worked a piece of land came to possess and then own it. Locke was merely taking the next step in Grotian thinking. Without wishing to diminish the catastrophe this approach wrought upon the Native Americans, Tuck does point out that there had been a famine in England in 1623, that the colonists could not have known that this was to be the last famine in England, and that they were coming over to North America poor, hungry, and desperate. From their perspective, it really would have seemed unjust to deprive them of the fruits of the labor they had put in cultivating the land (Tuck 2001).

If van Leeuwenhoek provided the notion of thinking in terms of population, and Grotius provided the notion of plentiful nature and the sovereign individual, Locke would add himself to the

picture by adding labor. Various thinkers combined these elements in various ways (and to various ends), but they remain constant in their writings. There was, I think, another connection between these notions. Namely, once Grotius (and Hobbes, and Locke, and…) made the individual sovereign, the individual mattered in a way he had not before. It therefore mattered *how many* individuals there were. This meant counting and thinking of humans in terms of numbers – but there was a twist.

(In)human populations

There is an irony to this endeavor of counting of humans. Reading 18th and 19th century demographic writings one is struck just how little humans count. Locke opens "An Essay on the Poor Law" from 1697 with the observation (and ostensible consternation) that "the multiplying of the poor…is so general an observation and complaint it cannot be doubted of" (1997: 183). On the next page, he offers prompt diagnosis: the "growth of the poor must therefore have some other cause, and it can be nothing else but the relaxation of discipline and corruption of manners…" (1997: 184). The poor and idle are themselves guilty for their condition and the burden they are to society. He goes on to say:

> Supposing, then, there be 100,000 poor in England, that live upon the parish, that is, who are maintained by other people's labour (for so is everyone who lives upon alms without working), if care were taken that every one of those, by some labour in the woolen or other manufacture, should earn but 1d per diem (which, one with another, they might well do, and more), this would gain to England £130,000 per annum, which, in eight years, would make England above a million of pounds richer (1997: 189).

We have here the full force of Locke's population thinking: there is the population estimate, the analysis of their poverty (that is, living on other people's labor), and quick economic calculation of potential revenue lost. It is worth lingering over the passage to point out the importance of labor for Locke the economist. Labor is the solution to those idle, that much is explicit. But he also places the notion of labor into the realm of social and economic nature. That is to say, labor is simply present: if one is not performing labor, they are "maintained by other people's" labor. And crucially, framed thus, labor reduces human beings themselves to a resource. If labor is merely present, performed by all or by some on behalf of all, then it becomes something that the country's government ought to figure out how to make use of. In a move mirroring the colonist famer, (human) labor becomes the plentiful natural resource that the government will through its own labor (coercion?) turn into something useful. The more they were counted, in other words, the less humans actually counted.

I would like to briefly offer a counter-example, only to prove my point about the general tendencies of 18th century thinking on this issue. Jonathan Swift's 1729 essay, *A Modest Proposal* is read above all as supreme satire, and only secondly as a political pamphlet, one answering only a current political topic at that. Namely, the text is seen as a remarkable example of a writer's power to galvanize resistance against a specific political event, i.e. William Woods' proposed halfpence scheme for Ireland (Damrosch 2013: 366). But I think that George Wittkowsky's essay "Biography of an Early Georgian Pamphlet" was right to look past the excellent literary qualities and the daily politics, to consider Swift tackling the same issue as Locke's essay on the poor law (Wittkowsky 1943).

Swift opens in a similar tone to Locke: "I think it is agreed by all parties, that this prodigious number of [destitute] children in the arms, or on the backs, or at the heels of their mothers, and frequently of their fathers, is in the present deplorable state of the kingdom, a very great additional grievance" (1973: 502-3). And continues in the same scientific yet concerned tone:

> As to my own part, having turned my thoughts for many years, upon this important subject, and maturely weighed the several schemes of our projectors, I have always found them grossly mistaken in their computation. …I propose to provide for [the children] in such a manner, as, instead of being a charge upon their parents, or the parish, or wanting food and raiment for the rest of their lives, they shall, on the contrary, contribute to the feeding, and partly to the cloathing of many thousands" (1973: 503)

Famously, the "feeding, and partly to the cloathing" that the children will contribute is in fact their own flesh and skin. The children in Swift's essay are turned into a mere resource that can potentially be turned into something useful (such as "admirable gloves for ladies, and summer boots for fine gentlemen" [1973: 505]). Gruesome detail aside, Swift is following Locke's blueprint, estimating the number of souls in Ireland (at one million); calculating the cost of maintaining the 'commodity' (at ten shillings a piece per year); and calculating its market value (at eight shillings sterling)…

Twice in his essay Swift refers to an American acquaintance, assuring the reader that such treatment of babies was perfectly common the other side of the ocean. A clever ploy to add a modicum of believability and help along a credulous Irish readership, no doubt. On the other hand, there is no reason not to think that Swift chose his exotic example carefully, perhaps cognizant of the pervasiveness of equating every aspect of America with the notion of resource. After all, what was America to the Europeans at the time? And what the colonists for Locke, other than labor/resource?

Doubling populations

Only about twenty years after Swift wrote his satirical essay, a very important American did indeed write a short piece that dealt with these issues. Entitled "Observations Concerning the Increase of Mankind, Peopling of Countries, etc.," it was written in 1751, when America was still part of the British Empire. Although American, the author, Benjamin Franklin (who sometimes signed his letters as "Americanus), at this point still referred to Britain as the "mother country" (Franklin 1936). The text contains no slaughter of babies in the way Swift's essay envisaged, but it features a horror all its own and typically American. Namely, it is permeated by what the modern reader cannot help but perceive as blatant racism, lamenting the "darkening of superior beings" (Franklin 1936: 402), as well as that there are so few "purely white people in the world" (1936: 401). (While he does not elaborate, it is still disturbing to read the words he uses for skin complexion: "black," "tawny," "swarthy" [Franklin 1936].) When discussing slavery, Franklin talks only about the cost of slave labor compared to wage labor (and perhaps surprisingly claiming that holding slaves is more expensive) – with no hint of recognition of ethical difference between the two.

Nevertheless, racism aside, Franklin's essay, I think, shifts the debate in a couple of important ways. Just like Locke and Swift, Franklin begins his essay with births and deaths, that is, with numbers of humans, moving on to land, money, labor. But both Locke and Swift estimate given populations: "supposing, then, there be 100,000 poor in England…" (Locke 1997: 189) and "there being a round million of creatures in humane figure throughout this kingdom…" (Swift 1973: 509). Franklin introduces the *process* of populating: "[t]hus there are suppos'd to be now upwards of One Million *English* Souls in North America, (tho' 'tis thought scarce 80,000 have been brought over sea)" (Franklin 1936: 401 emphasis in the original). However, as opposed to merely counting, Franklin's number reflects the result of growth. And he goes on triumphantly:

> This million doubling, suppose but once in twenty-five years, will in another century be more than the people of *England*, and the greatest Number of *Englishmen* will be on this side the water. What an accession of Power to the *British* Empire by the Sea as well as Land! What increase of trade and navigation! What numbers of ships and seamen! We have been here but little more than one hundred years, and yet the force of our Privateers in the late war, united, was greater, both in men and guns, than that of the whole *British* Navy in Queen *Elizabeth's* time (ibid.).

Leaving aside the triumphalist tone and whether he is in fact correct in his estimates, and even the amusing fact that one of the founding fathers of American independence was so rabidly pro-British twenty-five years (one cycle of a *million* people!) before the revolution – the novelty here is Franklin's *projection*.

Franklin's projection seems unimpeded by any resource constraint. Whether he was deliberately limiting himself to "another century," or whether he took seriously the idea that "…so vast is the Territory of North America, that it will require many ages to settle it fully…" (1936: 396), or even perhaps simply a reflection of his general optimism, the essay does not envisage any obstacles to this growth of doubling every twenty-five years. Be that as it may, what is important for us here is the notion of projection of population.

Franklin's other departure from Locke and Swift is perhaps a little more subtle. Franklin wrote about the country in which he lived in organic, natural terms. Britain was the mother country, and he reminds (presumably the politicians in Britain) that "…weakening the children [the colonies] weakens the whole family" (ibid.). A little later, his racism acquires a naturalistic metaphor (sounding depressingly contemporary): "why should the *Palatine Boors* [Germans] be suffered to swarm into our settlements, and by herding together establish their languages and manners to the exclusion of ours?" (1936: 401). Perhaps anachronistic, but it is difficult for the modern reader not to be appalled by such words as "swarm" and phrases as "herd together."

The passage in which his notion of a country assumes the most organic from is worth quoting in full:

> A Nation well regulated is like a Polypus; take away a Limb, its Place is soon supply'd; cut it in two, and each deficient Part shall speedily grow out of the Part remaining. Thus if you have Room and Subsistence enough, as you may by dividing, make ten Polypes out of one, you may of one make ten Nations, equally populous and powerful; or rather, increase a Nation ten fold in Numbers and Strength (Franklin 1936: 401).

Would it be going too far to suggest that perhaps this passage shows a glimpse of an idea bubbling up from the back of Franklin's mind: that an America independent from its 'mother country' would be just as strong? Certainly, it shows Franklin's optimism, at which it is difficult to be surprised, given American land expansion and development in the 18th century.

What is interesting for us here are the words 'powerful' and 'strength'. The way they are used here is synonymous with wealth and health. Franklin would not have been the first to associate the terms wealth and health in regards to measuring the quality or power of a nation, but an organic analogy, such as the one he uses, only tightens the connection.

By the century's end, however, these elements would once again recombine. Nearly fifty years and three (different) revolutions separate Franklin's essay from that of Thomas Robert Malthus' *An Essay on the Principle of Population* (Malthus 1998). The first was the American Revolution, in which the colonies successfully rebelled against – to throw Franklin's words back at him – the mother country;

the second was the French Revolution, which understandably terrified the upper echelons of English society, and to which Malthus explicitly refers at the beginning of his essay (1998: 1); and third, the industrial revolution.

Population trouble

It is abundantly clear from Malthus' essay that he is quite concerned about the poor; it is also clear that his concern comes from a very different place to that of John Locke. Locke wrote of the multiplying poor in (literally) the same sentence as the increased tax necessary to maintain them, i.e. as an economic burden. He had no compunction when referring to this problem as the "evil…upon us" (1997: 183). Indeed, Swift's satire is in part possible precisely because of the disdain Locke (and others at the time) showed towards the poor. The American and in particular the French revolution taught the English intellectuals that there was a whole other, much less passive and pleasant side to the poor. If Malthus' essay feels like it is delivering an urgent message, it is because he is aware that he is writing on the cusp of a population explosion – the second word dangerously approaching its literal meaning.

However, although the urgency and trepidation before the populace has a distinct post-terror flavor and thus testifies to the moment of writing, the novelty in Malthus' thinking lies elsewhere. From when Grotius formulated the principle of the free sea at the beginning of the 17th century, a constant in the writings of political philosophers had been the abundance of resources. These were the fish that according to Grotius anyone could catch; these were the lands that Franklin thought have yet to be tilled in America; and Malthus himself quotes William Godwin in saying that the Earth will be able to sustain an increase in population for centuries to come.

If Godwin's utopian views sound fanciful to our contemporary ears, it is certainly in part because, whatever else is said of him, Malthus and his way of thinking have become so deeply embedded in our own. Malthus' break with two centuries of tradition can be described in one phrase: resources are finite. Malthus makes his famous claim at the beginning of his essay: "…the power of population is indefinitely greater than the power in the earth to produce subsistence for man. Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio" (1998: 4).

With Malthus' erasure of the notion of abundance of nature, gone also are Godwin's and Franklin's boundless optimism. But more importantly, Malthus thus explicitly formulated a framework in which people and populations are locked in a struggle for resources, meaning for survival. He even

goes so far as to say that it has nothing to do with greed or the riches in the hands of the few. The battle for resources is such that some must always lose out:

> A collection from the rich of eighteen shillings in the pound, even if distributed in the most judicious manner, would have a little the same effect as that resulting from the supposition I have just made, and no possible contributions or sacrifices of the rich, particularly in money, could for any time prevent the recurrence of distress among the lower members of society, whoever they were. Great changes might, indeed, be made. The rich might become poor, and some of the poor rich, but a part of the society must necessarily feel a difficulty of living, and this difficulty will naturally fall on the least fortunate members (Malthus 1998: 25).

And although he does soften his pessimism by discussing possible checks on population growth (negative ones, like war and pestilence, and positive ones, such as having fewer children through abstinence), he ultimately remains rather negative in his projections: resources are limited and therefore some will always be poor.

Malthus draws from Locke that maintaining the idle poor is an expensive problem, labor being a solution (in Malthus' case partial). He draws from Franklin the notion of population projection (he refers several times in his essay to the doubling of the population every twenty-five years in America and contrasts it with English growth), albeit with completely different results.

Perhaps it is worth emphasizing here that these were Malthus' projections, that is to say, his scenarios are no more imaginary than those of William Godwin. In the above quote, he seems to depart from empirical data ("eighteen shillings to the pound"), but quickly devolves into guess work (however thought through) when he says that this "would have a little the same effect" and "will naturally fall on the least fortunate." Nevertheless, Malthusian 'fancy' has remained with us ever since in a number of ways.

In 1800, the British government conducted its first census. A hundred and twenty years after van Leeuwenhoek estimated the population of the Earth, the world was finally ready to start thinking *demographically*. Populations (were) counted. Two aspects were significant in the counting: fertility and resources. For van Leeuwenhoek, the first could be derived from the number of spermatozoa he could see under his microscope; for Malthus, it was "the passion between the sexes" (1998: 4). Resources for van Leeuwenhoek was the land of Holland (which he estimated at 1/13,385th of Earth's total land mass); for Malthus, it was "that food was necessary to the existence of man" (ibid.)

Malthusian shadows

Malthusian thinking is still with us in discussing environmental problems we face. When Robert Kunzig, senior environment editor of the National Geographic, asks in the subheading of his article "[b]y 2045 global population is projected to reach nine billion. Can the planet take the strain?" (Kunzig 2011), he is asking Malthus' question. More important still, however, is how Malthus' thinking has transferred into our thinking about the natural world.

If the phrase "locked in a struggle for resources and survival" sounded familiar, it is because this notion was adopted by Charles Darwin. Darwin was convinced of (as he called it) the 'transmutation' of species from at least the time The Beagle returned to England in 1838. Being the consummate scientist, he refused to go public with his idea until he had a mechanism for this transmutation. That mechanism is what he called 'natural selection'. Lest we forget, the full title of Darwin's great book is *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (1859). Here is Darwin at the beginning of his book:

> In the next chapter the struggle for existence among all organic beings throughout the world, which inevitably follows from the high geometrical ratio of their increase, will be considered. This is the doctrine of Malthus, applied to the whole animal and vegetable kingdoms. As many more individuals of each species are born than can possibly survive; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be NATURALLY SELECTED (1859: 4, emphasis in the original).

Darwin's son, Francis, put together two volumes of 'life and letters', in which Charles Darwin confirms the inspiration received from Malthus:

> In October 1838, that is, fifteen months after I had begun my systematic enquiry, I happened to read for amusement 'Malthus on Population,' and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here then I had at last got a theory by which to work… (2008: 55).

In other words, as theory, Malthus' principles were successfully applied beyond their author's wildest dreams; just not in the field for which he designed them.

A few words of commentary are in order. We should, first of all, not underestimate the order of Darwin's 'discoveries'. Darwin 'happened to read [Malthus] for amusement' at a time when he was a) already convinced of evolution, and b) when he was deep into his 'systematic enquiry'. That is to

say that this mechanism of natural selection did not enter an unbiased mind, rather one that had been groping around for an explanatory procedure for something it already considered true. Second, the success of evolutionary theory by natural selection lent itself to their equation, that is to say, reduction of one to the other, theory to its mechanism, which is what happened when Herbert Spencer coined the phrase 'survival of the fittest'.

Moreover, in what must rank as one of the most stunning examples of indiscriminate field jumping, Malthusian theory of population was given a new lease on life. What was a fanciful idea in 1798 (two years before the first census, that is, when Britain started keeping official data on population!) became iron clad natural law when it was transposed into biology some sixty years later. For his part, Malthus was mining a tradition of political theory that went back (at least) to Grotius: a self-interested, sovereign individual was locked in a battle with other self-interested, sovereign individuals. If for Grotius this did not mean outright war, that was not because these sovereign individuals were not by nature bellicose, but because nature provided enough for everyone such that war was unnecessary. As soon as Malthus applied his own maxim, 'resources are finite', that same individual now became inextricably mired in an endless state of war. Whatever the case regarding resources, the sovereign individual survived over two hundred years of political theory and was rewarded for it by emerging into the science of biology.

If subsequent theorists – from the aforementioned Herbert Spencer and Darwin's cousin Francis Galton, through Julian Huxley all the way to E. O. Wilson and Richard Dawkins – found it easy to shift between evolutionary theory and social theory, ostensibly applying the principles of the former to understand the latter, is it not precisely because the founding theory of biology had so heavily imbibed from a very social theory?

Chapter IV: Purity

Let us return briefly not to the figure of Malthus that infiltrated biology, but to Malthus the political scientist. His idea of finite resources ultimately derives from the very strong link between land and resources. In this respect, Malthus was in good company. Franklin, Godwin, Smith, and later David Ricardo would all present strong connections between wealth/resources and land. (Again, if their ultimate results varied, it was because they were not in agreement about the ultimate amount of available land.) The historian E. A. Wrigley calls these economies "organic" (2004: 246). He points out that

> Land was a necessary factor in all forms of material production to a degree not easily recognised in a post-industrial revolution setting. Almost all raw materials were either vegetable or animal: even where mineral raw materials were employed, they were capable of conversion into a useful form only by burning a vegetable fuel (Wrigley 2004: 244).

However, by the 1830s, massive changes were afoot. Again, Wrigley, with a critique of Malthus and others:

> Malthus, in common with the other classical economists, failed to foresee the extravagant possibilities for growth represented by a world in which *the fact that land was in fixed supply would cease to have any serious relevance to the possibilities of expanding output* […] But, though with the benefit of hindsight we can detect evidence of the slow conversion of the English economy to a new mode of operation in the later eighteenth and nineteenth centuries, later christened the industrial revolution, Malthus remained unaware of the sea change in progress about him, even at the end of his life in the early 1830s (2004: 246, my emphasis)

The economic onus was rapidly shifting from land/agriculture to towns/industry (Hopkins 2000, Wrigley 2004).

The diseased city

Yet, even though land was losing its economic importance, it retained (even strengthened) its ideological significance as that which stood in contrast to urban filth. City squalor would be a common refrain throughout the 19th century (as we shall see), but it was well grounded in previous theories. Even in his 1798 essay Malthus thought that "[t]he unwholesomeness of towns, to which some persons are necessarily driven from the nature of their trades, must be considered as a species of misery…" (1998: 34). This was even before the great expansion of British cities that took place in the 19th century. Eric Hopkins tells us that already around the time of Malthus' death in 1834, towns around the country "were faced with great problems of housing, water supply, sanitation and drainage,

as multitudes of newcomers poured in from the countryside. […] the standard of life in them was causing increasing concern ('a mean and groveling mode of existence', one observer called it)" (Hopkins 2000: 7).

It is important to point out that there are two sides to this urban story: one is indeed the urban filth and horrible living conditions of the burgeoning British working class; the other is how the intellectual elite framed these issues as both the fault of those who suffered in these circumstances, i.e. the poor, and also explicitly as their moral failings. The first is a consequence of the growth of cities beyond what anyone had ever seen before. The second mined a long theoretical tradition that went back at least a quarter of a millennium, to Locke and William Petty, of disdain and disgust with the poor. Frank Mort tells both sides of this story wonderfully in *Dangerous Sexualities. Medico-moral politics in England since 1830* (2000).

Following Mort, our story of populations shifts right around the time of Malthus' death to cities and to a slightly different agent: cholera. There were instances of the disease in the 1820s, but it takes center stage when the first epidemic hits England in 1831 (Mort 2000). It would remain a constant presence on the social scene for the duration of the 19th century (with big epidemics in 1848-9, 1853-4 and 1866 [ibid.]).

That the disease is sometimes known (still to this day) as *Asiatic cholera* is a hint about the significance of the disease in the story of (English) colonialism and its reverberations back home; that the first epidemic coincides with the expansion of industry and urban population is crucial for thinking about the nature of disease (that is to say, that it is above all a social ill); that it would primarily strike the poor but be instrumentalized by the elites in their stronghold of power is fascinating. The case of cholera was also perhaps the first modern example of a tension between the (ostensibly) guaranteed freedom of the individual to live one's life how one chooses, and the sovereign right of a country/community to protect itself. (In other words, the contemporary debate regarding vaccines and whether governments should have the right to coerce parents to vaccinate their children can already be read in the issue of cholera in 19th century Britain.)

What can doctors do?

Immediately upon the first epidemic, the medical community (for lack of a better word) issued its response. In 1832, James Kay published a pamphlet entitled "The Moral and Physical Condition of the Working Classes Employed in the Cotton Manufacture in Manchester" (Mort 2000). It is important to note a couple of things about the figure of James Kay. He was a doctor who came from

a family whose money was in cotton, printing, blacking (ibid.) – that is to say, not in land, but rather industries on the rise. His perspective on the issue of the poor suffering from cholera was not a matter of pure altruism; rather, Kay and other industrialists were afraid that the disease would decimate their workers. "Mine owners in the north east petitioned for increased state intervention, not on humanitarian grounds but to alleviate losses to capital" (Mort 2000: 14). Further, Kay's ideas about being a doctor belonged very much to his own time in that this profession conferred a duty of social involvement, i.e. being politically active. "…[L]ike Wakley he [Kay] saw no division between medical inquiry and politics" (ibid.: 15). That is, it was not just that Kay was a doctor *and* a politician (or social reformer), the two roles were really one: he was a politician whose politicking was conducted through medicine, and he was a doctor whose specialty was public health. Medicine, thus, far from being some neutral and altruistic science, was a tool in the hands of a specific political group.

That group is worth one more comment. Mort points out that at the time when Kay is writing his pamphlet, doctors and medicine are not yet part of the elite circle of professions. Here is Mort:

> The exact position of the local doctor, in terms of class and professional status, remained economically and culturally ambiguous until well into the mid-nineteenth century. He was caught between the trade origins of the barber-surgeons and the superior ranking of lawyers and barristers. Many came from relatively humble origins, like Wakley, the son of a west country farmer and William Farr, a central figure at the General Register Office, who was from a family of agricultural labourers (2000: 21-2).

(We can also include here John Snow, whose father was a lowly laborer and farmer.) This adds another dimension to the high school textbook story of doctors and hygienists working to stamp out cholera: the work of these activists is perhaps better described (to borrow a phrase from Latour) as "politics by other means" (1988: 142).

Actually, there were two sets of 'politics' through medicine taking place. One was the kind of politics just described, dealing with the poor, and (broadly) the subject of Mort's book. For this politics, cholera was used to discipline workers. It was necessary, therefore, to establish a strong connection between illness and morality, that is, that the disease is the result of improper living. By extension, squalor of living quarters and poor physical development (Malthus' "species of misery") was seen as the moral failing of the urban working class.

The second politics was jostling among the elites for belonging, control, status. Cholera in this case was an instrument to force one's way among the political elites. Twice Mort tells us of doctors' furious reactions to solutions that excluded them. In 1832, Thomas Wakely was outraged since the "new board…was yet another illustration of the way the profession was being led by drones,

sycophants and titled imbecility, most of whom had no personal experience of treating disease, nor any understanding of how infection was transmitted" (ibid.: 14). Never mind that doctors themselves had little experience treating the disease (given that it was new), and nearly no idea (it turns out) how infection was transmitted. And then again in 1848, when a committee was set up: "Almost immediately there were familiar cries of outrage from medics over what they saw as their wilful exclusion from the new board. It was deeply insulting, they complained, to set up a 'medical board of two noblemen who are perfectly innocent of medical information and a lawyer'" (ibid.: 27). But the doctors too were "perfectly innocent of medical information," since "as late as 1853 the Lancet comically listed the range of competing explanations: 'Is it a fungus, an insect, a miasma, an electrical disturbance, a deficiency of ozone, a morbid off-scouring from the intestinal canal? We know nothing; we are at sea in a whirlpool of conjecture'" (ibid.: 22).

The English doctors did not like the germ theory of disease because that would mean that the cleanliness and moral standing of an ill person had nothing to do with the disease; that the agent of disease lay elsewhere. "It was," says Mort, "the 'atmospheric' or 'miasmatic' approach which was favoured" (ibid.). If Mort is right in his analysis, though, something rather remarkable follows: at least part of the reason medics favored a specific scientific theory is that this theory allowed them to retain power. These doctors were not interested in the truth as such; they were interested in the truth *insofar* as it allowed them to hold a powerful position in society. For it was also true that better living conditions, sanitation, nutrition, etc. lowered the incidents of disease and death, and yet in the course of an entire century, British doctors would not find the true cause of the illness. The "truth" of the "'miasmatic' approach," allowed them exercise of power, that is, move forward with hygiene and sanitation projects (which they were angry to be left out from); it also allowed them to continue to blame the values and behavior of poor people for the conditions they lived in and diseases they contracted. It is, I think, no coincidence that germ theory would be rejected in England and would have to be developed on the continent: the miasma theory was more convenient.

This 'high wire' act stood true even of those doctors who sought the cause of cholera not in miasma, but in water. Consider John Snow: well-known (even to English school children) as the man who disabled a water pump (which is now a tourist attraction in London). Yet Snow did not discover or theorize the cause of cholera, rather, its modes of communication. Like Kay, Snow offered an approach that did not explain the disease, but allowed the doctor to have power by inserting himself. Power here refers to the right to remove the pump handle, but also the right to tell people what not

to drink, where not to dump their waste (in the Thames) or tell the water company not to draw water from a certain portion of the river.

Snow is further illustrative for our story, because he was at the forefront of thinking about the problem spatially. In addition to statistics and demographics, as the new disciplines used to 'understand' this burgeoning new world, the English doctors/hygienists/reforms pioneered the use of maps. The banal, but not uninteresting, reason for the proliferation of maps was that cities were growing and changing so quickly in the 19th century that maps became an obvious tool (Joyce 2003). The reason maps were interesting to people like Snow, Kay, and Edwin Chadwick was that the diseases they were facing had an inevitable spatial component: they were not to be found on a single body, but on entire groups of people, in neighborhoods, that is, on the body of the city.

I have already quoted Patrick Joyce in Chapter I saying that maps were essential to power and governance. His book, *The Rule of Freedom. Liberalism and the Modern City* is an elaboration of this point. "The cognitive nature of both [maps and statistics] turned on a particular version of space, 'abstract space', which had first been elaborated at least as early as the seventeenth century. This now lent itself to the social sciences as once it had been integral to the foundation of the natural ones" (Joyce 2003: 35). 19th century maps, thus, drew on the notion of abstract space (recall Mercator, Chapter I) and on demographics (which we discussed in Chapter III). Note, also, the point he makes in the second sentence, about the transfer of knowledge between the natural and social sciences, which we have also seen take place in the theory of evolution.

What can engineers do?

Nevertheless, we should be in no doubt regarding the extraordinary effort that was made to deal with cholera, even without (the search for) a definitive theory of causation. On the contrary, that the Victorians had no understanding of the true cause of the illness makes their efforts all the more impressive. Famously, the city of London to this day looks in large part how it does thanks to the chief engineer of the sewer system, Joseph Bazalgette. The sewer system was a direct response to the new, Victorian, that is, social illnesses. Let me be clear: of course sporadic instances of various illnesses, such as cholera, typhus and typhoid existed prior to the massive urbanization in western Europe in the 19th century; however, they only grew to the level of epidemics with the population growth – this is what I mean in labeling them 'social illnesses'.

One way of looking at Bazalgette's achievement is that he produced the blueprint for how urban areas would develop thereafter. However else cities the world over would grow from then on,

they had to make room, to *incorporate*, the agents of these illnesses. Bazalgette did not know what that agent was – although the world would soon find out – but he knew to, as it were, pull up a chair to the negotiating table for it.

Allow me to elaborate this point just a little. The immensity of this shift that accommodates this new agent goes beyond a response to the new social illnesses of the 19th century, impressive as that was. In his groundbreaking book *Plagues and Peoples*, William H. McNeill points out that "[u]ntil the nineteenth century, cities had everywhere been population sumps, incapable of maintaining themselves without constant replenishment from a healthier countryside" (1978: 242). (Little wonder then that economists and demographers placed so much value on land and considered the true economy of a country to lie in agriculture.) It was not merely the population surge in the cities, but sanitation projects that allowed cities demographic autonomy from rural areas. McNeill is explicit: "[b]y 1900, therefore, for the first time since cities had come into existence almost five thousand years previously, the world's urban populations became capable of maintaining themselves and even increasing in numbers without depending on in-migration from the countryside" (1978: 243).

Only by accommodating these 'new agents' could human communities grow and maintain themselves on their own. And these agents are still with us. When sanitation systems function well, we allow ourselves the illusion that there is no longer any issue. But the truth is that we are still very much forced to acknowledge the presence and action of this agent, even if it only becomes evident in situations when the system designed to incorporate them in the human community breaks down. Examples abound: an outbreak of cholera was reported in Algeria in August of 2018 (Al Jazeera); a year prior, Yemen suffered as many as 1,500 deaths in an epidemic that counted a suspected 300,000 people (Kamali Dehghan 2017). We only notice the necessity of Bazalgette's chair at the negotiating table when it breaks or is removed; but one way or another, the agent it is meant for is present.

Pasteur: facts & figures

Be that as it may, at this point in our story – in the mid 19th century – medicine had little use for such agents. In a move reminiscent of Galileo and van Leeuwenhoek, the decisive step would come from an outsider whose training was in chemistry. Recall that Biagioli's Galileo is a figure as brilliant at leveraging social credit and debt as he was at observation and science. For different reasons and in a somewhat different context, we saw van Leeuwenhoek also entangled in social networks that spilled over into and were influenced by his observations. We now encounter a comparably complex figure in Louis Pasteur. By the time he was fifty years old, Pasteur was awarded an annual state pension

by the French National Assembly. Before he was sixty, a plaque honoring him was placed on the house of his birth. And before he turned sixty-six, in 1888, the French state opened the Institut Pasteur, of which he was head until his death in 1895 – effectively turning a human being into an institution (Geison 1995).

Before all that, however, Pasteur was a chemist crystallographer, first in Strasbourg, then in Lille. In *The private science of Louis Pasteur*, Gerald Geison takes a scrutinizing look at the great French scientist by analyzing his private notebooks and diaries, which had only become available to the public nearly a hundred years after Pasteur's death. Perhaps even more interesting than how Louis Pasteur became Institut Pasteur, that is, the human became – as Geison calls him – a legend, is the smaller question at the root of the larger one: how did a crystallographer become biologist, become immunologist, become science paragon?

In *The Pasteurization of France*, Bruno Latour calls Pasteur's steps a series of "sideways" moves (1988: 68), but Geison goes into more detail about the increments of the scientist's transition. First, prior to 1857, Pasteur was a run-of-the-mill chemist who had made discoveries of optical isomers in tartrates in 1848. Geison rejects the 'just-so' stories in which Pasteur takes an interest in wine fermentation at the request of a student who happens to be the son of an industrialist. Instead, Geison posits that Pasteur's crystallization experiments, as well as certain underlying beliefs he held pushed him to shift his subject (1995: 92). Pasteur's work was in right-handedness and left-handedness of crystals. His conviction, which he tried to prove through tireless experimentation, was that only one of the two kinds belongs to the living world and is associated with life. These ideas were simply the scientific subject of the day in the field of chemistry (Geison 1995).

When he hit a wall in his experimentation, Pasteur shifted his focus slightly, but decisively. Between the months of August and December of 1857, Pasteur would publish two articles, one right after the other, and also move from the northern town of Lille to the capital Paris. The first article was on lactic fermentation, and it caused a bit of a stir among biochemists with its bold claims. With the move to Paris and publishing notes on alcoholic fermentation – which was the bigger subject at the time, not least because of the industrial development of beer- and wine-making – Pasteur was wading into a raging battle.

The debate among chemists was whether alcoholic fermentation was a purely chemical process, that is, an interaction between inert substances, or whether something biological was involved. Pasteur's audacity was to claim that his experimental methods – scholars agree that he was a brilliant and indefatigable experimenter – could resolve the issue in favor of the biological side. This

also, it should be said, was largely 'the French' side, as opposed to German, in the debate: Geison writes that the scientific debate "clearly drew some of its heat from nationalism" (1995: 108).

Latour and Geison agree that we have here the elements of Pasteur's success. Placing himself at the very heart of an already raging debate, bringing with him his laboratory skills, but also his skills of rhetorician and demonstrator. The debate is on a subject that has larger implications than merely scientific truth (such as more efficient wine-making) and Pasteur is masterful at igniting the broader public's imagination with the possibilities offered by his side of the debate. Whether or not he was right in his scientific work, and whether or not the rest of the scientific community considered him right in his scientific work (and the two are not the same), Pasteur was able to present himself as right to audiences at large. That is, he told the non-scientific public that he was able to resolve the debate with his experimental methods, making his scientific star shine ever brighter.

The same underlying belief that living organisms were involved in the fermentation of alcohol led him, in the mid 1860s, to once again shift his focus, this time to an even 'bigger' question: whether disease was the result of germs or 'spontaneous generation'. Geison paints quite a lively picture for an evening at the Sorbonne in 1864 when Pasteur – in the presence of "*tout Paris*" (1995: 110) – first outlines the (incredibly wide) scope of the question, before declaring that

> Neither religion, nor philosophy, nor atheism, nor materialism, nor spiritualism has any place here. I may even add as a scientist, I don't much care. It is a question of fact. I have approached it without preconceived idea, equally ready to declare – if experiment had imposed the view on me – that spontaneous generations exist… (quoted in Geison 1995: 111).

This is rhetoric at its finest! 'I do not care', 'it is merely fact', 'no preconceived ideas', 'equally ready to declare one or the other truth', and my favorite, 'the experiment imposes a view'. It is not me speaking, it is the experiment, fact, truth, objective science…!

Observation as weapon/observers as warriors

The word 'experiment' is crucial here. When Pasteur waded into these debates, he was not alone. He came armed with his lab equipment. Pasteur "…did not abandon the laboratory methods acquired in crystallography," (Latour 1988: 68) and "…again he brought onto the laboratory terrain problems that had not previously been there and capitalized on the attention of an educated public that was already much larger than the industrialist public…" (ibid.: 69). It was a century and a half later, but here was another tireless observer, this time able to weaponize both van Leeuwenhoek's instrument and his insights.

Three words, I think, bear some elaborating here: instrument, insights, and weaponize. Upon his death, van Leeuwenhoek donated his microscopes to the Royal Society. Brian J. Ford tells us that for the next hundred years, they were acknowledged as still having the best lenses in the world (2015: 132). However, Ford goes on to recount that a certain Sir James South wrote a letter in 1855, asking "the Society's secretary to find out where *the missing microscopes might be*…" (ibid., my emphasis). Somewhere between 1820 and 1855 then, the collection of microscopes was lost. Yet despite the microscope's loss of status within science (which, as I mentioned, occurred already in van Leeuwenhoek's time), advances of the instrument continued. Van Leeuwenhoek's lenses were still the best, but there were any number of other improvements that technicians made in the interim: fixed concave or plane mirrors, pillar stands, diaphragms, water immersed lenses… – all allowed the observer to see better (Bradbury 1967). It is perhaps fitting that van Leeuwenhoek's microscopes should be lost, for their purpose of seeing was not exactly the same as those that would come to be used in the 19th century. Namely, as I mentioned, the Dutchman was well-nigh obsessed with merely seeing things as small as he could. To him, in general, his animalcules were wonderful curiosities. When the 19th century finally caught up with the ability to see so small, it was seeing with a purpose. For example, both sides in the mentioned chemistry debate about whether a living organism was involved in the making of wine used the microscope – *purposefully* – to advance their theories (Barnett and Barnett 2011). In that sense, Pasteur was no different: the microscope was to him only one of a number of tools in his belt, and much more of an instrument (while for van Leeuwenhoek it was much more an end in itself).

In similar fashion that Pasteur and the 19th century *used* the microscope slightly differently, they had a different approach to van Leeuwenhoek's ideas of population. Perhaps because he wished to see entities as small as he could, although he saw many, many of them, van Leeuwenhoek kept focusing on individual creatures. For Pasteur, what was important was a culture, that is, a collection, a mass of germs or 'yeast' cells. It was important they be of a single species (a pure culture), but not that they be single. (Pasteur was not the first to produce a method for growing/isolating pure cultures; that distinction – much to Pasteur's chagrin – would go to the German Robert Koch [Barnett and Barnett 2011].)

Furthermore, in the intervening two centuries or so between van Leeuwenhoek and Pasteur, there were 'more populations' in Europe, by which I do not only mean that there were more human beings, but also that there were many distinct and dense 'populations' in cities that provided quasi-lab conditions. While van Leeuwenhoek's insights into the human population on Earth was brilliant for

its time, the 18th century, as we have seen, saw a lot more thinking conducted on this topic. Pasteur was able to apply much of this thinking in his own work, which is part of the reason he could be interested in (populations of) chickens, cows, sheep, silk worms, humans, etc. By raising them to the level of population, Pasteur was able to reduce the distance between humans and animals and animalcules. If Pasteur did not wish to see the single animalcule in the way van Leeuwenhoek desired to, it was because cities/labs taught him that only a whole culture of germs was effective (at whatever it did), and it was only relevant for entire populations of animals or humans. Pasteur was not a doctor treating an individual human patient; he was a scientist whose subject was the entire (animal and human) population of France.

Just like English doctors and social reformers, Pasteur's goal was never only scientific (in the narrow sense of the word). France, the country, was always the aim. Although we think of him today as one of the central figures of the golden age of microbiology, his work could just as easily be presented in the domain of nation-building, that is, as politics. (In this sense I refer to Pasteur *weaponizing* van Leeuwenhoek's observations.)

After the move from crystallography to fermentation came the move from fermentation to microbes; followed by the move to study disease-causing pathogens; followed by a move to fight the disease; followed by a move towards animal vaccines; followed by a move "to work on all of society" (Latour 1988: 70). Each time, just like the first, Pasteur brought his crystallography laboratory equipment with him, bringing it to bear on an ever-increasing field. Even at its founding, the Institut Pasteur was clearly meant to be involved in all aspects of French society. (All the way down to its colonies: in the mentioned example of the 2018 cholera outbreak, the news outlet Al Jazeera mentions the role of the Institut Pasteur of Algeria [Al Jazeera 2018].)

Indeed, Latour details the way Pasteur and Pasteurians took the lab out into the field with them (traveling to French farms as well as the colonies), and brought the world into the lab (Latour 1988). In developing the importance of the lab for society, though, the Pasteurians also developed the importance of the living organisms they studied – microbes. Although they would have perhaps abhorred the comparison (for a number of reasons), Pasteur was performing a similar task to Joseph Bazalgette and the English doctors: he was constructing a social space for the microbes (to repeat my metaphor from earlier, building them a chair at the negotiating table).

But before the 19th century scientists could construct a social space for microbes, they had to provide a purely microbial one. Scientists offered them "…an environment entirely adapted to *their* wishes…" (Latour 1988: 82, emphasis in the original). After Koch demonstrated his ability to grow

pure cultures at the International Medical Congress in 1881 (Barnett and Barnett 2011: 28), he formulated "a specific set of [four] guidelines for determining the cause of infectious diseases, now known as Koch's postulates" (Lerner and Lerner 2003: 247). The second of these postulates reads: "The organism must be isolated from a host with the corresponding disease and grown in pure culture" (ibid.). That is to say, an integral and necessary step in constructing a social space for microbes was to first remove them from farm animals and human bodies and give them their own environment.

However inadvertent, the phrase 'pure culture' is both misleading and more revealing than at first glance. Of course scientists referring to pure culture mean certain living beings isolated from their original environment, and thus are still natural beings (and not cultural ones). On the other hand, what could be more human than bringing the entire force of a scientific lab to isolate a single species of bacteria. What could be more artificial, that is, less natural than ripping these few cells out of their native environment and placing them in space cleared of everything but their own food (the medium). Latour illustrates this scene thus: "imagine an anthrax bacillus which has lived or millions of years hidden in the crowd of its cousins. One day it finds itself alone with its children under the blinding light of a microscope that is dominated by Pasteur's enormous beard" (1998: 224). Bacteria isolated in the way Koch described and demanded could scarcely be a more purely cultural product.

At this point, I need to circle back to my discussion of Grotius from Part I. In discussing his book *Free Sea*, I mentioned how the new framework Grotius set up required the elaboration of certain fictions of nature. In attempting to "free" the sea for the Dutch, Grotius had to posit certain parts of the world over which no one had, nor could have, sovereignty (such as the oceans). His principle of what could properly fall under (someone's) sovereignty was that it was not (somehow) natural. In addition to the seas, wild lands, fish, fowl, animals did not fall under anyone's sovereignty. Grotius' underlying ontology (although by no means only his) was a rather clear-cut distinction between the social and natural realms.

It is difficult to overstate just how deeply embedded this distinction is in (what we call) Western civilization. The modern idea (also to be found in Grotius, as mentioned) of nature as mere resource is of a piece with this ontological division. On the other side is human society as intelligent, holding agency, and – crucially for us – sovereign. And this sovereignty lies not only in that of a government over a territory or a people, but sovereignty over an ontological division between nature and culture.

When the followers of Koch 'purify a culture' in isolating a bacterium, they are equally purifying the social. Because if the purification of a culture requires such strict regulations and

conditions to be called 'pure', it sets clear and strict criteria for the distinction nature/culture. As Richie Nimmo writes in his book *Milk, Modernity and the Making of the Human: Purifying the Social*, the "…effect was to purify the boundary between the human and the animal, crucially by rendering the animal body – and particularly liquid milk – 'safe' for human consumption" (2010: 92). Nimmo is specifically writing about cows, milk, and the dairy industry in a period that largely coincides with the one we are dealing with, between 1865 and the mid 20th century (Nimmo 2010). He adds that "the struggle to control cattle disease was far more than an economic issue, for at the same time it was an attempt to maintain a given ontology, which crystallized a specific form of socio-natural order" (2010: 77). Remove the word cattle from that sentence, and my point stands.

Yet, if this nature/culture distinction "is not given in the nature of human practice, but is a historical and material accomplishment brought into being by networks of practice" (Nimmo 2010: 77), there is another important aspect to this story. The distinction does not get established once and for all; indeed, Swift depended on it for the grotesque effect he wished to produce with his satirical essay, Malthus re-asserted it in his discourse on populations, and it was reiterated by those who wished to control epidemics among humans and animals. That is to say, the distinction is being continuously re-affirmed. In one of his later moves, Pasteur the immunologist shifted from inoculating sheep and cattle to vaccinating humans (famously with the case of Joseph Meister). This breakthrough was also followed by an ideological stance. Latour quotes a Pasteurian, Landouzy, who says that "the day will come when, thanks to militant, scientific hygiene, diseases will disappear" (quoted in Latour 1988: 27-8). It is the word 'militant' with which I would like to justify saying that Pasteur and Pasteurians *weaponized* van Leeuwenhoek. The unbridled optimism in Landouzy's statement is not surprising, and none of the words, except for militant, seem out of place. The Pasteurians did not just insert (a word that Latour uses numerous times to describe their conduct) themselves into chains of power, they positioned themselves as the defenders of humanity. Defenders from what? From, microbes, of course. "The state defends its frontiers with soldiers against large-scale enemies and with doctors against small-scale ones" (1988: 95), writes Latour.

Significantly, militaristic ideology is not at all out of place here. Latour opens his book with an account of Tolstoy's reading of the Battle of Borodino. Later he points out that the scientists' struggle against microbes was relevant because (at least until the 20th century) "in wartime, as is well known, there are more deaths from microbes than from the enemy" (1988: 115). But most obviously, the frontier defense against microbes took place at the actual frontiers of European empires – in the colonies.

> As McNeill suggests when discussing the millennium-long struggle between the microparasites and the macroparasites, a struggle that seem to him to be the motive force of history, [in the 19th century] the scale is turned in favor of the macroparasites. The rich and the empires will at last be able to spread. Hitherto, especially in the tropics, they could never go very far. Their most faithful factotums soon died. Now, wherever the Pasteurians and hygienists gained ground, the microparasites lost ground (Latour 1988: 41).

Or to quote McNeill directly (without Latour's flourishes): "In fact, the penetration of the interior of Africa that became a prominent feature of Europe's expansion in the second half of the nineteenth century would have been impossible without quinine from the Dutch plantations" (1978: 247).

The story of modern sovereignty, therefore, circles back to the Dutch 17th century and its colonial expansion into Asia. It is not coincidental that Grotius' understanding of sovereignty required several 'natural myths'. Nor is it an accident that European scientists in the late 19th century saw themselves as standing guard over the frontiers of sovereign civilized territory, defending it.

Chapter V: Changing Perspectives

Begin with Vermeer's *Milkmaid*. The stunning blue of the apron, the light streaking through the window, the freshly-baked bread, the milk being poured slowly, carefully, its stream twisting— In this case, let us stay for a moment with the scopophilia of painting: painters know a thing or two about the pleasure of looking, especially at a subject that cannot look back. There is a hierarchy developing here, structured by the gaze. That the subject being looked at is a lone young woman, only reinforces the hierarchical and dominating aspect of observation. Vermeer did not help matters by placing the body so centrally, unavoidably to the eyes, nor by lending it corpulence and heft: look, look at the body.

Yet, I think Vermeer is cleverer than to remain with a pretty picture. There is a turn here. Perhaps it begins by noticing that this woman is lost in thought and the viewer cannot help but wonder what is she thinking about; or by being drawn to the milk, the viewer's attention thus being taken away from the female body and possible salaciousness towards the mundane task, the near ritual of the scene. The observer might then become conscious of one's own viewing, that one has stared a little too long for comfort, that it is a little unseemly to gaze so intently at something that cannot even glance back.

Painters know a thing or two about the pleasure of staring/gazing/observing but, unsurprisingly, are also painfully aware of its inherent ambivalence. What one brings to the painting when looking at it is just as important as what is on it. And yet what one brings to the painting remains invisible, much like the person who has stumbled onto the milkmaid. Staring at a painting is what Haraway referred to as the "god trick," 'disembodied vision from nowhere' (1988: 581). She goes on to note that when this disembodied vision from nowhere is "endlessly enhanced" it becomes "unregulated gluttony" (ibid.).

I would like to follow Vermeer's turn and ask questions not of the canvas, but of the viewer. Who is looking? what does it mean to look/gaze/stare/observe? what does it mean to take pleasure in catching a glimpse/watching/observing? what is the relation between the one who sees and the subject? who, after all, is the subject and who or what the object? In making the young woman pour out some milk, Vermeer is forcing us to notice that even a banal, quotidian, domestic scene can be *seen* differently, depending on who is looking, what they wish to see, what their disposition is. Take the milk, for example: we might look at the painting and wonder at the difference in relationship to the milk between the farmer who sold it, the woman in the kitchen transferring it from one vessel to

another, and the owner of the house consuming it. We could also marvel, as Richie Nimmo does, at the completely different relation to milk we have today in comparison to 17th century Holland, wondering if it is even the same substance.

Milk/*milk*

As Nimmo carefully describes in his book: this substance stands at the nexus of the human, the animal, disease, materiality, ideology. He shows how in the period in question, from the mid 19th to the mid 20th century, liquid milk underwent a profound change. From a substance that varied in taste, texture, fat content, and could only be consumed shortly upon being obtained from the animal, that is, *locally*, and thus bearing all the hallmarks of the local environment, to a substance of consistent, standardized texture, fat content, prepared (Pasteurized) and purified, transportable at distance, mass produced, and mass consumed (Nimmo 2010). The materiality of milk had to change (had to become social) in response to the danger microbes posed to a larger, denser human population. Along with the animal itself, the wild, unpredictable substance had to be stabilized before it could be allowed entry into the human/social domain. Nimmo writes: "milk was thereby not merely standardized but at the same time *humanized* […] cows being merely the organic machines […] utilized for this production" (2010: 131, emphasis in the original). This seems to me to be a continuation of Grotius' sovereign natural fiction(s): nature as resource belonging to one who is able to transfer it across the imposed nature/society line.

It needs to be said that on the quotidian level, the drawing of this strong line between nature/society, is only a consequence of the more basic power-seeking politics. Just as Grotius' natural fictions issued from, but then also grounded his real motivation, i.e. a Holland on par with Portugal, so too the 'humanizing' of milk (to use Nimmo's terms) was only a consequence of the more basic race to wealth and power among the great empires of Europe. It is no secret that Pasteur explicitly saw his discoveries and his rivalry with Koch as openly nationalist endeavors (Latour 1988, Geison 1995, Barnett and Barnett 2011). And Nimmo writes:

> It is unsurprising then that the [British] Board of Agriculture became preoccupied with extensive comparisons between British and German milk production, as the primary axis of economic competition tilted away from financial rivalries between private companies and towards military-industrial rivalries between nation-states (2010: 57).

It may appear that we are here speaking of two types or levels of sovereignty: national sovereignty (of, say, England or France) and 'ontological' sovereignty (of culture over nature). But I

would like to claim that we are not. How so? What is the relation between these seemingly two types of sovereignty? One issues from and also grounds the other. To reiterate my argument from Part I, Grotius' free sea was a ploy to declare the Low Countries legally equal to Portugal. For Dutch sovereignty to exist, that is, for the Dutch to be legally equal to the Portuguese (and Spanish, and English…), there had to be a *free sea*. Free here meant simply under no particular (national or royal) sovereignty, but it was also equivalent to natural (wild), outside the social.

The strong distinction between nature and society, or to give it a punctuation sign, between nature/society, was indeed a consequence of a more prosaic struggle. (That is to say, Nimmo's ontological role of milk as *humanized* is a byproduct of the British rivalry with Germany.) But the nature/society distinction was also the condition of possibility of national sovereignty: without the free sea or liquid milk or (nature as) resources in general – the notion of a sovereign nation would make no sense. Therefore, the 'two sovereignties' are really expressions of one and the same sovereignty.

World war flu

Nimmo notes that the crucial historical event in the change from milk to *milk* (if I may indicate the shift thus) is "…the impact of the First World War, which meant that the national economy suddenly became viewed not merely in terms of wealth creation but also, very substantially, in terms of the security of the nation-state" (2010: 57). I would like to elaborate and expand this idea somewhat. The national economy, first of all, was always also a matter of security. We have seen this in Malthusian population thinking, as well as Pasteur's inoculation efforts. (I do not think I am not correcting Nimmo here: his use of the 'viewed' makes me think that what was already true now became obvious.)

More importantly, however, it seems useful at this point to think about the First World War (beyond Nimmo's focus on milk, but including it) as both the complete development of the kind of sovereignty Grotius introduced three hundred years prior, and (the beginning of) its end. Not least because the European powers had largely finished their colonial carving up of the world. By 1914, as both McNeill and Latour noted, the last portions of the interior of Africa had fallen to the Europeans/Pasteurians. In support of this idea of (a) sovereignty's end, Richard Tuck cites no greater authority than Max Weber in saying "The historical origin of modern freedom [sic!] has had certain unique preconditions which will never repeat themselves. […] there is no new continent at our disposal" (quoted in Tuck 2001: 15). Indeed, in the conclusion of his book, Tuck goes on to claim that:

> A view of the international arena in which states had an array of thickly described obligations to one another…would not have produced the vision of autonomous agents which actually gripped European writers four hundred years ago. That vision grew out of a sense of the world as populated by autarchic and sovereign states warily constructing temporary alliances of convenience between themselves (2001: 226).

By the end of the 19th century, European nations indeed had "an array of thickly described obligations to one another." For our purposes, it is sufficient to point to one aspect of society in which this occurred. The first International Sanitary Conference was held in Paris in 1851. David P. Fidler details the number, variety and scope of international treaties on public health between 1851 and 1951. "Not only is the number of treaties impressive but so also is their range of subject matter – human, plant and animal diseases are all subjects of treaty law" (Fidler 2001: 265).

There is an irony here. Pasteurians were indeed, as Latour says, willing defenders of the state from microbial enemies; at the same time, however, they were unwittingly undermining the rationale (the sovereignty) of that state. And World War I is the best illustration of this. One of the very basic conditions of total war was the economic and biological efficiency with which the European nations entered it:

> In the decade before World War I another important medical discovery altered the epidemiology of European armies profoundly, for it was between 1909 and 1912 that the role of the louse in spreading typhus fever was figured out. This, together with systematic immunization against other common infections, was what made *the unexampled concentration of millions of men* in the trenches of northern France, 1914-18, medically possible (McNeill 1978: 252, my emphasis).

Nor should we forget that the development of cities that provided the military industry (and as we have seen with Nimmo, the food) for the war would not have been possible without the hygiene, sanitation, medical advancements of the previous seventy years.

The Pasteurians, it seems, overplayed their hand. As I mentioned, Pasteur and other scientists sought methods that would develop the wealth and health of the humans, animals and industry of each their own country. They believed that by finding ways to control microbes, they would be able to do this. In reality, however, in times of peace, 'controlling microbes' meant cooperation with those competing sovereign states, such that they were "*undermining the ability of the sovereign state* to control public health in its territories" (Fidler 2001: 263, my emphasis). It was in the mid-nineteenth century that "European states realized that they could no longer control diseases, such as cholera, through national measures alone but had to engage in international cooperation to achieve that objective"

(ibid.: 263-4). In times of war it was even worse, for the scientists had only provided the conditions for an even greater slaughter than had been previously possible.

And that is when it looked like they *had* command of the microbes. The final year of World War I provided a brutal demonstration of the limits of control doctors and scientists held over microbes: the influenza pandemic. No mere illness breakout, not only did it claim many times over the number of lives of the war, it was so tightly bound up with the war, that I would like to propose they be considered not as an epidemic exacerbated or even caused by the war, but as a single event (which I would like to call World War Flu). We have already seen how the (scale of the) war was caused by (the handling of) pathogens. But the specific form the influenza took points to an even stronger connection between the pan-war and the pandemic. "The environmental conditions associated with the trench warfare of World War I could hardly have been more favorable for the evolution of increased virulence of airborne pathogens like influenza" (Ewald 1994: 110). Paul Ewald's use of the word 'evolution' there suggests that the war may have created its own specific pathogen – at once bespoke and mass consumed. Equally remarkably, "the 1918 epidemic displayed an unusual penchant for the destruction of healthy and productive individuals in the prime of their lives" (Price-Smith 2009: 60). Ordinarily, the flu takes the lives of the very young, the old, the weak. The 1918 pandemic destroyed the same population (young men) that usually perishes in battle. Hence, one event.

My point is merely that World War Flu marks the full expression and also the conceptual end of our approach to microbes and sovereignty. If the extraordinary achievements of the second half of the 19th century were grounds for Landouzy's (and not only his) boundless optimism (Chapter IV), then it is clear that the first half of the 20th century swiftly put those fantasies to rest. Much more prophetic, it turns out, was the use of the word 'militaristic' (which I am sure Landouzy only meant as a figure of speech) (quoted in Latour 1988: 27-28). If I may return to my own figure of speech from before, the invisible agent at the negotiating table countered Landouzy's offer with a vengeance. Above all, this was an agent that demanded to be seen as just that, an agent.

Changing perspectives, the microbe(')s turn

If the doctors, scientists, immunologists were supposed to be our (or our state's) defense against microparasites, at best it has been a stalemate, and a temporary one at that. The truth of the matter is, however, that, irrespective of the outcome of the battle against microbes, the very paradigm of war is really out of place. The stalemate only makes sense if we consider the disease-causing

microbes: yes, typhus, polio, etc. have been eliminated to a large extent, while on the other hand cholera is still present and malaria and tuberculosis continue to be a problem worldwide. But this is only a fraction of all the microbes and microbial species. World War Flu was a lesson in the impossibility of containment, but at the same time, perhaps there was no need to attempt to contain them in the first place. We could say then, that the 'other' lesson of World War Flu was to look more closely at microbes and their role on Earth.

The first time microbes were 'discovered', their presence was so astonishing that even their discoverer(s) had little to no idea at what they were looking. The second time they would assume relevance for human society, let us say after 1850, it was in the midst of the industrial world's arms race against nature. For the capitalistically-oriented mind, nature had always been a resource to be drawn, exploited, transformed into commodity and transmuted into currency. In Donna Haraway's words, "[n]ature [was] only the raw material of culture, appropriated, preserved, enslaved, exalted, or otherwise made flexible for disposal by culture in the logic of capitalist colonialism" (1988: 592). Our examples of Locke, Franklin, Malthus attest to that approach towards people as well as land. With the industrial revolution, the efforts to seize and subjugate nature acquired unheard of proportions. Malthus' idea of the finiteness of resources was perhaps an intuition of this. (Again, a great example of this are Grotius' fish, which the industrial revolution allowed to be caught on an unprecedented scale.)

In this context, microbes walk onto the stage just at the moment when we (humans) think we have been able to completely conquer nature, and they are spoiling the fun. Little surprise then that in the dominant paradigm of the so-called golden age of microbiology, its first seventy years or so, microbes were seen as nothing other than pathogens. Perhaps we can read Landouzy's statement less as prophecy and more as a call to arms or even propaganda. And perhaps also understand a little better just how Pasteur came to be a national hero in his own life time, considering this is an honor given to military commanders much more often than scientists: because he was indeed sort of a general in a (not so sort of a) war.

As we saw, the paradigm imploded onto itself. In truth, the golden boys of microbiology knew so very little about microbes. I do not mean this as a slight, nor do I think that their war paradigm was even remotely the only thing that prevented them from properly comprehending the scale of the issue. In part, they knew so little because, barring van Leeuwenhoek, they were the first to take microbes (in one way or another) seriously, and did so to the best of their abilities. In fact, even to this day, if ever there were something that strains human understanding in so many ways, it is microbes. Everything

from their minuteness, their numbers, diversity of form, living conditions, longevity, durability, communication, behavior – staggers the mind. Pick up any book on bacteria, the likelihood is the first chapter will overflow with numerical representations, scale comparisons, illustrative analogies, all guaranteed to leave your head spinning (Bakalar 2003, Hird 2009, Maczulak 2011, Morris 2007). One idea that all the authors seem to agree upon (and after just that first chapter!) is that it is a microbial world and we are just living in it.

What is clear, though, is that the metaphor of war as our *main* relation to microbes simply will not do. There are certainly times, just as there were before the postulation of germ theory of disease, when a person or a population stands in direct opposition to a species or species of microbes; but from even the little we do know about them, microbes simply do too much in our world to be reduced to occasionally killing a few members of a large primate species.

This is not only for the sake of some scientific honesty or cosmic humility. The geographer Elizabeth Dunn writes on this intersection of bacteria and governmentality. In her essay "*Escherichia coli*, Corporate Discipline and the Failure of the Sewer State," she discusses the (failures of the) American food system (Dunn 2007). The conception of the state that emerges from her research on food safety is not flattering: "[t]his was just one instance of one of the most important bases of state power: the state's ability to act as sewer" (2007: 41). In support of her view, she quotes the French psychoanalyst Dominique Laporte, who is even more direct and succinct: "Surely, the State is the Sewer" (quoted in Dunn 2007: 42). I have nothing against Dunn's invective against the greedy and harmful actions of the US food industry and irresponsibility of its government – sewer might be the right word. However, the premise is that the state (as such, necessarily) attempts to purify culture, to excrete toxins, all *in defense* against a given species of microbe, *E. coli*. The paradigm in which we reduce microbes to enemies who make us soil our pants is also the paradigm in which we reduce the state to a sewer.

Indeed, I am in general suspicious of the paradigm of *defense*. More than anything else, perhaps, the claim to defense – of the open sea, national borders, resources, one's body – has been used as the centerpiece around which to construct problematic ideas. As we have seen, Grotius used it to justify the seizure of the Portuguese galley, Hobbes to defend his selfish individual (Tuck 2001), Pasteur to force an entire nation to follow his medical protocols, etc. Consider how different the relationship to the world is when defense is no longer the framing device:

> I love the fact that human genomes can be found in only about 10 percent of all the cells that occupy the mundane space I call my body; the other 90 percent of the cells are filled with the genomes of bacteria, fungi, protists, and such, some of which play in a symphony necessary

> to my being alive at all, and some of which are hitching a ride and doing the rest of me, of us, no harm (Haraway 2008: 3-4).

Haraway is referencing one of those facts to be found in every first chapter of books on bacteria. Scientific estimates are that there are ten times as many bacterial cells in and around us than there are human; and there are a hundred times more bacterial than human genes. Further, Haraway notes the role ('the symphony') of microbes in one's being alive in the first place.[**] (Paul G. Falkowski titled his book on microbes "Life's Engines" – this is no metaphor [2015].)

The section of Haraway's book from which I have taken the above quote is called "We Have Never Been Human," a nod to Latour's book *We Have Never Been Modern*. Referencing the same book in "A Symbiotic View of Life: We Have Never Been Individuals,"[††] Gilbert, Sapp, and Tauber write:

> The "immune self" model of individuality, first proposed by Sir McFarlane Burnet [in 1949], portrays the immune system as a defensive network against a hostile exterior world. The immune individual rejects anything that is not "self." Indeed, the discipline of immunology has been called "the science of self/non-self discrimination" (Klein 1982). In this view, the immune system is a defensive "weaponry," evolved to protect the body against threats from pathogenic agents: worms, protists, fungi, bacteria, and viruses. […] In a fascinating inversion of this view of life, however, recent studies have shown that an individual's immune system is in part created by the resident microbiome (2012: 330).

"For example," Myra Hird builds on this, "the expression of the enzyme matrilysin used to digest proteins and kill harmful bacteria is induced by the bacteria themselves" (2009: 83). Indeed, in the same passage, Hird says that "…it turns out that immunity is co-extensive with microbes…" (ibid.).

Let me abuse Hird's point by underscoring the phrase 'turns out'. Because this turn in perspective allows us to say that the microbial lesson is that the fiction of the Grotian sovereign individual crumbles upon closer scrutiny. As soon as the light is shone back onto him (always him!), the oh so important demarcation line between him and the world, between nature/society, dissolves. "From this point of view, the natural and the social are not exclusive domains" writes Nimmo, and continues, "…sociality is a function of our natural form of life […] it is a configuration of nature, not

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[**] Haraway's more recent book, *Staying with the Trouble: Making Kin in the Chthulucene* (2016), includes some discussion of human population control. It seems to me that far from staying with anything, Haraway has committed an about-face and lapsed into a neo-Malthusianism, a paradigm of which she was highly critical in her earlier work (which I reference). For a more detailed critique, see Sophie Lewis' article in Viewpoint Magazine (2017).

[††] I cannot help but think that Richie Nimmo would find these permutations of Latour's title wonderfully illustrative as they all play on the same theme: modern = human = individual (Nimmo 2010).

a departure from it" (2010: 153). With this I would like to not so much close the discussion on microbes and sovereignty as properly bring them into a single frame.

Conclusion

At its heart, this text has been about framing, or rather, re-framing. I would like to therefore briefly look at why framing is important and what impact re-framing a question might have. A legacy essential to the modern world, as I hope to have shown, is the notion of distinct and discrete conceptual frames to distinguish between nature/society. Although it has become so deeply embedded in (at least the Western) cultural world that it appears as a law of nature, the notion of separate frames for nature/society is historically contingent. As such, this idea has cultural roots, a beginning – which I have placed in the Dutch 17th century – but also an end – which I have placed around the flu pandemic and military events at the beginning of the 20th century.

I have placed the end of this historical idea around World War I for two reasons. The first one is that far from being just one or two more historical occurrences, the world war and flu pandemic were in great part *the result* of this dual framing, of sovereignty and resource. The second reason is that the very fact that the world war and the pandemic are considered *two* events (albeit connected) reveals an understanding of the world that applies two frames. Instead, I have argued that this was one event – a brutal demonstration that the line between nature/society, if it had ever existed, is no longer conceptually viable.

That is not to say that this conceptual framework has not survived the intervening century; it has and is still the dominant conceptual apparatus for humanity's relationship to the world. Nevertheless, *conceptually* speaking, this notion of strict division of nature/society has badly outgrown its utility. Take for example a recent event in the news, when French fishermen allegedly threw smoke bombs onto British fishing boats off the coast of Normandy in a "scallops row" (Senkul and Heffer 2018). I mentioned in Chapter I that when Grotius and Welwod were arguing about fishing off the English coast in the early 17th century (Grotius 2004), they could not have dreamed of the notion of 'overfishing'. Like a grim joke, Grotius' theory comes back to haunt us. There is such a thing as overfishing (of scallops), and the logic in which the fruits of the sea are simply there for anyone to catch, take possession, and claim ownership has resulted in the depletion of the seas and deterioration of human relations.

As trite as the example of the English Channel fishermen is, Grotian sovereignty can do very little to solve such a problem. Although this would be a subject for a different paper, sovereignty, as we have known it for the last four hundred years or so, is a major obstacle in resolving our global

environmental issues. In other words, our leaders are not stupid and governments lazy; but their work is conditioned on a framework that prevents them from being able to resolve the problems we face.

Nor has the Grotian individual fared historically better than his sovereignty. Consider what has happened to the human body under the reign of the dual framework. Namely, if society was to be circumscribed as distinct and above nature, then the beings that comprise the domain of the social had to be separated and placed above nature. At the same time, however, it was quite obvious that in body, humans were animals, much (if not exactly) like any other. The human being had to be placed on the fault line between the two domains, and split. In other words, Cartesian mind/body dualism makes perfect sense in the context of elaboration of these two distinct and clearly demarcated frameworks. The mind, the soul, the spiritual fell to the domain of the social, while the body would have to satisfy itself by mingling with the other entities of the natural world. The Grotian individual, it follows, may be sovereign, but has had to pay for his sovereignty by becoming disembodied.

In contrast to this fictional, incorporeal human, I propose, once again, Vermeer's *Milkmaid*. On the one hand, the body is undeniably present, as I have already mentioned. On the other, the painting shows her so deeply lost in thought – indeed, perhaps the reason she has taken so long to notice us – the painting is begging to be asked 'what is she thinking about'? There is not the least attempt to separate the thoughts and remove them from the body.

Nor do I think it is an accident that Vermeer chose a woman for subject of a painting in which he shows how mind and body come together so effortlessly. Like perhaps Vermeer's gazing, surveying *Geographer*, the Cartesian subject and the Grotian individual have played out their historical role as *male* characters. Donna Haraway's essay "Situated Knowledges" (to take but one example), from which I have already quoted regarding nature as resource at capitalist disposal, deals precisely with this intersection of masculinity, observation, exploitation (Haraway 1988). And Patrick Joyce has alluded to the gendered nature of the abstract gaze that oversees modern map-making (Joyce 2003). The milkmaid embodies a contrast to much of this thinking. And 20th century feminist thought has perhaps done the most to rid us of the notion of this fault line running across our beings.

As I mentioned in the last chapter, a further major problem with Grotius' self-interested, defensive, and sovereign individual becomes apparent when we take into account microbes. Considering them as the enemy (and nothing more) is reductive to the point of falsity. Nor is the recent vogue of probiotically engineering one's gut microbiome far from this same reductive logic (consider a recent article in *The Guardian* by Anthea Lacchia 2018). Both views suffer from setting microbes into one of two boxes, good or bad, that is, resource or trash. A consequence of either is

Elizabeth Dunn's "sewer state," or the other side of that coin, the "vaccination state." Because another area of potential further research could be the question of how microbes, and specifically microbes that thrive in large and dense human populations, complicate the relationship between the state and the individual.

Indeed, once considered, microbes call into question sovereignty as we have thought about it all these centuries. If sovereignty in general is about control of territory, of rights, of goods, and specifically *who* is in control, it is difficult to come away from even a cursory glance at microbes escaping the impression that they are in control, that microbes are sovereign. Even if this is going too far, microbes certainly complicate the notion of sovereignty. First, they force otherwise seemingly independent agents to interact, such as governments to become signatories to health treaties. Second, they display a remarkable tendency to punish countries in which governments renege on duties to their citizens, such as in times of war (like the mentioned 2017 cholera outbreak in Yemen) or neglect of infrastructure (like the one in Algeria in 2018). Third, they have allowed human beings to multiply and live in dense communities, but only on condition that the microbes be taken into account, that is, treated as agents in their own right. Fourth, microbes have been part of the drive to think differently about lines of demarcation, that is, things such as defense and immunity.

What Haraway, Latour, and others have emphasized emerges in this new framework is that we are not so much in relation with the world, as we *are* the relation within a world. With microbes, with animals big like us, with entire countries. From the macropolitical, to the individual, to the cellular level, it is relation all the way down.

References

Al Jazeera (2108). *Algeria says second person dies in cholera outbreak*, 25 August, 2018. Online <https://www.aljazeera.com/news/2018/08/algeria-person-dies-cholera-outbreak-180825173701802.html> [26 August, 2018].

Bakalar, N. (2003). *Where the Germs Are. A Scientific Safari*. Hoboken: John Wiley & Sons.

Barnett, J. A. and Barnett, L. (2011). *Yeast Research. A Historical Overview*. Washington: ASM Press.

Biagioli, M. (2006). *Galileo's Instruments of Credit. Telescopes, Images, Secrecy*. Chicago: The University of Chicago Press.

Bradbury, S. (1967). *The Evolution of the Microscope*. London: Pergamon Press.

Cohen, J. E. (1999). "How Many People Can the Earth Support?" In: D.E. Beauchamp and B. Steinbock, eds., *New Ethics for the Public's Health*. New York: Oxford University Press, p. 330-338.

Damrosch, L. (2013). *Jonathan Swift. His Life and His World*. New Haven: Yale University Press.

Darwin, C. (1859). *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. London: John Murray, Albemarle Street.

Darwin, C. (2008). *The Life and Letters of Charles Darwin*, Vol. I. ed. F. Darwin. Gloucester: Dodo Press.

Dobell, C. (1932). *Antony van Leeuwenhoek and his "Little Animals."* New York: Harcourt.

Dunn, E. (2007). "*Escherichia coli*, Corporate Discipline and the Failure of the Sewer State." In *Space and Polity*, Vol. 11, No. 1 (April), p. 35-53.

Eco, U. (2000). *Kant and the Platypus. Essays on Language and Cognition*. Trans. A. McEwen. Orlando: Harcourt.

Ewald, P. W. (1994). *Evolution of Infectious Disease*. Oxford: Oxford University Press.

Falkowski, P. G. (2015) *Life's Engines. How Microbes Made the Earth Habitable*. Princeton: Princeton University Press.

Fidler, D. P. (2001). "Public Health and International Law: the Impact of Infectious Diseases on the Formation of International Legal Regimes, 1800-2000." In *Plagues and Politics. Infectious Disease and International Policy*. ed. A. T. Price-Smith. New York: Palgrave, p. 262-284.

Ford, B. J. (2015). "Leeuwenhoek Microscopes: Mystery and Mischief." In *The Microscope*, 63:3, p.131-142.

Franklin, B. (1936). "Observations Concerning the Increase of Mankind, Peopling of Countries, etc." In *Benjamin Franklin. Representative Selections with Introduction, Bibliography, and Notes*. eds. F. L. Mott and C. E. Jorgenson. New York: American Book Company.

Geison, G. L. (1995). *The private science of Louis Pasteur*. Princeton: Princeton University Press.

Gilbert, S. F., Sapp J., Tauber, A. I. (2012). "A Symbiotic View of Life: We Have Never Been Individuals." In *The Quarterly Review of Biology*, Vol. 87, No. 4 (December), p. 325-341.

Grotius, H. (2004). *The Free Sea*. trans. R. Hakluyt. Indianapolis: Liberty Fund.

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

Hacking, I. (1983). *Representing and Intervening. Introductory Topics in the Philosophy of Science*. New York: Cambridge University Press.

Haraway, D. (1988). "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." In *Feminist Studies*, Vol. 14, No. 3. (Autumn, 1988), P. 575-599.

Haraway, D. (2008). *When Species Meet*. Minneapolis: University of Minnesota Press.

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

Van Helden, A. (2010). Introduction. In A. van Helden et. al., eds., *The origins of the telescope*, 1st ed. Amsterdam: KNAW Press, p. 1-8.

Hooke, R. (2005). *Micrographia*. Online: Project Gutenberg. Available from <http://www.gutenberg.org/ebooks/15491> [7 August 2018].

Hopkins, E. (2000). *Industrialisation and Society. A Social History 1830-1951*. London: Routledge.

Van Ittersum, M.J. (2006). *Profit and Principle. Hugo Grotius, Natural Rights Theories and the Rise of Dutch Power in the East Indies 1595-1615*. Boston: Brill.

Joyce, P. (2003) *The Rule of Freedom. Liberalism and the Modern City*. London: Verso.

Kamali Dehghan, S. (2018). "'Cholera is everywhere': Yemen epidemic spiraling out of control," *The Guardian* [online], 13 July 2017.<https://www.theguardian.com/world/2017/jul/13/cholera-is-everywhere-yemen-epidemic-spiralling-out-of-control> [26 August 2018].

Koeman, C. and van Egmond, D. (2007). "Surveying and Official Mapping in the Low Countries, 1500 – ca. 1670." In *The History of Cartography, Volume 3. Cartography in the European Renaissance*. ed. by Woodward, D. Chicago: The University of Chicago Press, 1246-1295.

Koeman, C., Schilder, G., van Egmond, M. and van der Krogt, P. (2007). "Commercial Cartography and Map Production in the Low Countries, 1500 – ca. 1672." In *The History of Cartography,*

Volume 3. Cartography in the European Renaissance. ed. by Woodward, D. Chicago: The University of Chicago Press, 1296-1383.

Kunzig, R. (2011). "Population 7 Billion." *National Geographic*, January 2011. Online, available from <https://www.nationalgeographic.com/magazine/2011/01/7-billion-population/> [22 August 2018]

Lacchia, A. (2018). "Probiotics 'not as beneficial for gut health as previously thought'." *The Guardian* [online] 6 September 2018. <https://www.theguardian.com/science/2018/sep/06/probiotics-not-as-beneficial-for-gut-health-as-previously-thought > [10 September 2018].

Latour, B. (1988). *The Pasteurization of France*. Trans. A. Sheridan and J. Law. Cambridge: Harvard University Press.

Van Leeuwenhoek, A. (1948). *Alle de brieven van Antoni van Leeuwenhoek. Deel 3: 1679-1683*. Trans. anon. Online: digitale bibliotheek voor de Nederlandse letteren. Available from <https://www.dbnl.org/tekst/leeu027alle03_01/leeu027alle03_01_0002.php#b0043> [7 August 2018].

Lerner, K. L. and Lerner, B. W. (2003). *World of Microbiology and Immunology Vol. 1*. Farmington Hills: Gale.

Lewis, S. (2017). "Cthulu plays no role for me." *Viewpoint Magazine* (8 May 2017). Online, at <https://www.viewpointmag.com/2017/05/08/cthulhu-plays-no-role-for-me/> [5 September 2018].

Locke, J. (1997). *Locke: Political Essays*. ed. Mark Goldie. Cambridge: Cambridge University Press.

Maczulak, A. (2011). *Allies and Enemies. How the World Depends on Bacteria*. Upper Saddle River: FT Press.

Malthus, T. R. (1998). *An Essay on the Principle of Population*. Online: Electronic Scholarly Publishing Project.

McNeill, W. H. (1978). *Plagues and Peoples*, New York: Doubleday.

Morris, R. D. (2007). *The Blue Death. Disease, Disaster, and the Water We Drink*. Oxford: Oneworld.

Mort, F. (2000). *Dangerous Sexualities. Medico-moral politics in England since 1830*. 2nd ed. London: Routledge.

Needleman Armintor, D. (2009). "The Sexual Politics of Microscopy in Brobdingnag." In H. Bloom, ed., *Bloom's Modern Critical Interpretations. Jonathan Swift's Gulliver's Travels*, 1st ed. New York: Infobase Publishing, p. 193-210.

Nimmo, R. (2010). *Milk, Modernity and the Making of the Human: Purifying the Social*. London: Routledge.

Price-Smith, A. T. (2009). *Contagion and Chaos. Disease, Ecology, and National Security in the Era of Globalization*. Cambridge: MIT Press.

Schilder, G. and van Egmond, M. (2011). "Maritime Cartography in the Low Countries during the Renaissance." In *The History of Cartography, Volume 3. Cartography in the European Renaissance*. ed. by Woodward, D. Chicago: The University of Chicago Press, 1384-1432.

Senkul, C. and Heffer, G. (2018). "French fishermen attack British boats 'with smoke bombs' in scallops row." *Sky News* [online], 29 August 2018 <https://news.sky.com/story/uk-and-france-in-fresh-scallop-war-as-angry-french-fisherman-attack-british-boats-11484706> [10 September 2018].

Snyder, L. (2015). *Eye of the Beholder. Johannes Vermeer, Antoni van Leeuwenhoek, and the Reinvention of Seeing*. New York: W.W. Norton.

Swift, J. (1973). "A Modest Proposal." In *The Writings of Jonathan Swift*. eds. R. A. Greenberg and W. B. Piper. New York: W. W. Norton.

Tuck, R. (2001). *The Rights of War and Peace. Political Thought and the International Order from Grotius to Kant*. Oxford: Oxford University Press.

Tuck, R. (2005). Introduction. In H. Grotius, *The Rights of War and Peace*. Indianapolis: Liberty Fund.

Willach, R. (2010). "The 'true inventor' of the telescope. A survey of 400 years of debate." In *The origins of the telescope*. ed. by van Helden, A. et al. Amsterdam: KNAW Press, 93-114.

Wittkowsky, G. (1943). "Swift's Modest Proposal: The Biography of an Early Georgian Pamphlet." Journal of the History of Ideas 4, 1943, 75-104.

Wrigley, E. A. (2004). *Poverty, Progress, and Population*. Cambridge: Cambridge University Press.

Zandvliet, K. (2011). "Mapping the Dutch World Overseas in the Seventeenth Century." In *The History of Cartography, Volume 3. Cartography in the European Renaissance*. ed. by Woodward, D. Chicago: The University of Chicago Press, 1433-1462.

Zoomers, H. (2010). "The Netherlands, Siam and the telescope. The first Asian encounter with a Dutch invention." In *The origins of the telescope*. ed. by van Helden, A. et al. Amsterdam: KNAW Press, 301-320.

Zuber, M.A. (2011). "The Armchair Discovery of the Unknown Southern Continent: Gerardus Mercator, Philosophical Pretensions and a Competitive Trade." *Early Science and Medicine* 16 (2011), 505-541.

Zuidervaart, H. J. (2010). "The 'true inventor' of the telescope. A survey of 400 years of debate." In *The origins of the telescope*. ed. by van Helden, A. et al. Amsterdam: KNAW Press, 9-44.