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Realms of Exposure:
A Speculative Design Perspective of Material Agency and Political Ecology

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A scorpion in the shower

A nine year-old child is taken to hospital and is kept breathing through artificial respiration in the Argentinean city of Córdoba.[2] A scorpion that had crept in through the grating of the shower has stung him. This and other human-scorpion encounters during the month of January has led to massive informational and preventive campaigns on how best to behave in case of being stung by a scorpion. We are aware of the state of the boy, who is fortunately stable and out of mortal threat, but despite the article and the campaigns we know little about the scorpion and how it ended up in the shower; an event that has become common over the last 10 years in some neighborhoods of the city. In this chapter we will pay attention to scorpions. We will try to understand their behavior and their effects on the city and its human population, how they challenge how we think and act as part of 'urban nature', and how they seem to provoke changes in the (more-than-human) political assembly of Córdoba.

The encounter outlined above is partly a result of historical processes of infrastructure investments. Following environmental historians and political ecologists, it is quite straightforward to narrate how large-scale, centralized infrastructure projects grew from the early 1900s to become part of the city, shaping everyday rhythms of water and sewage flows.[3] Besides these material dimensions, infrastructure also served to stake out in cultural and spatial terms what was ordered and domesticated versus filthy and discarded in the city.

The definitional power of infrastructure, moving from the material to the discursive, drives down stakes to mark territory, both spatially and in language. Importantly, this not only exposes the material flows and processes that structure everyday human life, but also

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[2] See: http://www.diaadia.com.ar/cordoba/en-el-hospital-un-nuevo-ingreso-por-picadura-de-alacran, accessed 3 March 2016.

[3] E.g. Cronon 1996, Gandy 2002, Karvonen 2011.

demonstrates how showering, washing and toilet-flushing by humans have created a fruitful, energy-rich habitat for the scorpion, alongside other animals and organisms. These organisms have adapted to life in the city; indeed they have proliferated in these urban ecosystems under the city. It is here, at this intersection between the sanitized, modernist and everyday home (for humans), and the underworld habitat of the scorpion (and other organisms) that we encounter fruitful turf to explore political histories, futures and present-days of urban ecologies.

In this essay we elaborate an approach to urban political ecology and environmental studies that shifts from the descriptive and analytical toward the propositional and speculative. This is intended to create new handles to (re)understand and (re)enact the political in a thoroughly more-than-human, cyborgian and artificial world. Before elaborating on this approach however, it is important to recognize the situatedness of our proposal and how it was informed by site-specific accounts from professionals in different fields, interviews we conducted, and our observation of the city's material arrangements. This delineated a coherent version of the ecological reality of the city and made us focus on designing an alternative shower grating, the object that separates and unites the home and the sewage system.

Emphasizing this site-specific character, our more general framework has been stimulated by two French philosophers who seldom are in communication: Michel Serres and Jacques Rancière. Together they provide a way for us to understand how design intervenes politically in constituting and re-constituting (more-than-human) political assemblies.

In *Malfeasance,* Serres offers the idea of a 'natural contract', where "appropriation [among living species] takes place through dirt".[4] Through flushing away our bodily excretions: blood, feces, semen, we as humans have historically marked and appropriated territory, in a practice common to all living beings. With modernist and centralized network infrastructure, the way we co-create urban ecologies has shifted through disseminating these substances by the way of sewage systems which no longer mark a territory or habitat in a concrete form, but in abstraction. The network operates to remove us from direct contact with the waste, the excretions and their results. Along this line, we appropriate local and regional ecosystems by the dissemination of toxins that our household effluent contains, not to mention all the other biophysical processes and materials that have been extracted to build and maintain the infrastructure that leads water from afar into the city to create and re-create our sanitized ordered home (what some term our 'ecological footprint').

Serres helps us to stay with the fear and potential harm of the scorpion-child encounter. But he also helps to sketch out the wider but seldom visible ontological dimensions

[4] Serres 2010, p. 3. See also the book *The Natural Contract*, (Serres 1995).

of urban ecologies, here viewed as those relations where species meet and interact, and how their modes of being are rubbed against each other. Here, a political dimension inextricably entangled in and with our modes of being becomes explicit. To this, Jacques Rancière offers us a particular definition of politics that pivots on what can be sensed and felt. Rancière defines the political assembly as a 'partition of the sensible' (*le partage de sensible*), which he views as a particular order that operates in the background to distinguish between speaking-beings, i.e. those with speech and voice, and those perceived as simply producing noise.[5] He insists that while there might be a lot of discussion about policies and politics, that a '*proper political moment*' is one that turns around events when those who have no part in the assembly claim their part. When the non-counted are forcing themselves into our community to be recognized, heard and counted as equals; when the partition of the sensible is disturbed, or disrupted; only then do we have a proper political moment, which necessarily requires a re-configuration of the political assembly.

By combining the two philosophies of Serres and Rancière—the territorial claim by species and the constitution of political assemblies—we hope to contribute to the debate and speculation around what Booth and Williams have called "more-than-human political moments"[6] and the role of human artifacts in this mediation.[7]

It is not enough however, to trace the city's infrastructure and the making of the human habitat alone. We must also understand the non-human; the scorpion, and its long history of evolution to better make sense of the (terrifying) political encounter between a scorpion and a child. Inspired by von Uexküll, we will try to take "a walk into unknown worlds" in order to make sense of Córdoba from the viewpoint (or sensing-point) of the scorpion.[8] This foray into the hills surrounding the city as well as kilometers of sewage pipes, scorpions' evolutionary history and the encounter between two species—the scorpion and the human—sets up *the political situation* into which we wish to enquire, i.e. what is it that defines and organizes what is in common in a more-than-human world? To do this we have used

[5] Ranciére 2010, 2014.
[6] Booth and Williams 2014, p. 182.
[7] We should clearly state that when discussing politics and power in this chapter, we are not going to be able to pay dutiful attention to the hierarchies of class, gender, age, ability and race among humans. This is not to say that our posthumanist approach here cannot be combined with the study of those structures of oppression. As a result of the focus we are giving to this chapter, the effect is that humans are rendered in our text a quite homogenous collective. For a critique of posthumanist and object-oriented ontological frameworks for political analysis and action, see Swyngedouw and Ernstson (forthcoming) and Henao Castro and Ernstson (forthcoming).
[8] The quote is from biologist Jacob von Uexküll's *A Foray into the Worlds of Animals and Humans* who already in the 1930s pushed an approach to learn about non-humans through understanding how they perceive the world, and as a consequence how differently they construct their worlds. As Dorion Sagan states in the foreword to the book, "nonhuman perceptions must be accounted for in any biology worthy of the name" (p. 3).

speculative design, focusing on the shower grating, the interface or *border* between the 'sanitized' home and the 'underworld' of sewage. The grating, as we explain in the next section, has become our tool to consider and reconsider everyday situations, as well as re-thinking and perhaps even re-arranging, political relations between humans and scorpions in Córdoba.

Pondering co-habitation: speculative design as a mode of enquiry

Design plays a role in creating registers to acknowledge and change how the world 'is' and how it 'works', and therefore, what it may become. Design can therefore participate in creating *affective ecologies* whereby we (and here "we" refers to humans and non-humans together) can establish contact with one another, directly or indirectly. We humans, but also non-humans, can be rendered sensible to other living forms in concrete ways through design.[9] Design then, and speculative design in particular, can support an explorative practice to articulate ecological and political aspects of our delegation of agency to non-human artifacts. We can explore how we become part of the worlds of others, and how they become part of our world; while keeping in mind that these worlds are ontologically not identical.

In such a situation—what Isabelle Stengers has called 'relational ontologies'—it is speculation rather than description that becomes necessary. "For Stengers [2010]," and we quote from Booth and Williams, "description […] relies upon the naturalistic assumption that there are things generalisable/universal and, hence, transferable and imposable. Rather than focusing on what is (as description does), speculation places the emphasis upon what may become within different suites of relations (or contexts) and from different standpoints."[10] A descriptive mode tends to assume a 'script' and becomes overly dependent on anthropocentric, language-dependent metaphors, analogies and narrative.[11] Design, while not independent from languaging and symbolizing, can in contrast be seen as a practice of in-scription, that is, a practice that inscribes material and immaterial arrangements that form 'partitions', which, as we will develop, should be seen in explicitly political terms as 'partitions of the sensible' expanding thus the textual and grammatical mode of description.

[9] Considering our human body as a set of organs that work as a collective (and enacted by myriad beings), then our eyes, hands, nose and so on, are such 'designs' that render us sensible to (some) other beings. These have co-evolved with technological developments as extensions of our capacities, which in turn can 'render' us more or less attuned, sensible and sensitive to specific interactions with other humans and nonhumans.

[10] Booth and Williams (2014, p. 183).

[11] See Maran and Kull (2014) who explain that narrative description is inadequate for the description of ecological semiosis and communication between species: "There are no general purposes that non-human organisms follow, their intentions are local and they do not have the tools for temporal integration or meta-description. […] A narrative description of ecological events is [thus] always metaphoric" (p. 46).

Our application of a speculative design mode then—in contrast to descriptive and analytical approaches most commonly used in urban political ecology—can help to explore new dimensions of politics and conceive alternative directions. Speculative design enacts thought through materializing and engaging physical constraints of specific everyday situations with the aim to understand ontological dimensions of urban ecologies, and to clarify our political ecological commitments in a radically more-than-human world.

In this account, we will assume that design plays an important role in shaping products, services and systems in everyday life. Particular designs, or artifacts created by humans, are responses to particular (mostly human) concerns, but they affect a wide variety of non-human actors that directly or indirectly participate and transform these designs. Their participation in turn creates new possibilities of interaction between humans and non-humans. The sewage systems of Córdoba are one such case. Córdoba is a major city in central Argentina which in the early 1900s began constructing large-scale infrastructure such as sewage and water systems, as did many other cities across the world. This type of infrastructure was part of a centralized design; a *strategy* rolled out by engineers over decades and maintained ever since. However, due to the continuous growth of the networks and the lack of resources to keep up with maintenance over the last decade (especially in the older parts of the city), sewage and water networks have started to attract species such as mice, cockroaches and scorpions. This has lead to a rise in violent encounters between scorpions and humans, particularly *Tityus trivittatus*, one of the most common scorpions and, in Argentina, the most dangerous to humans. For instance, during one day in November 2012, medical doctors attended 38 cases of scorpion stings in Córdoba, although the average number is much lower.[12] In 2010, two young children tragically died after having been stung by scorpions inside their homes.[13] As a response to this threat, people pour toxic chemicals down their shower gratings and toilets, trying to kill the scorpions and destroy their habitat.

If we study this quite nightmarish situation a bit more closely we observe that scorpions not only find shelter in the sewage system, but hunting opportunities; the sewers not only perform 'as planned', by transporting effluent from buildings, roads, homes and so on (all those things that disturb our city-life and that we don't want in our ordered home environments), but they also perform as alternative ecological niches for multiple beings, scorpions included.

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[12] Varying from year to year, the average number of persons getting stung by scorpions, may be around two or three cases per day during the summer, with less during the winter months. The source for this type of site-specific information comes from interviews, but can also be found in newspapers and public reports. Here the source is: http://www.cadena3.com/contenido/2012/11/10/105904.asp. This and other webpages mentioned in the essay were accessed 3 March 2016.

[13] See: http://www.forotarantulas.com/foro/index.php?topic=9659134.0.

Cockroaches and mice, to name two of the most common sewer inhabitants, find nutrients accumulated on sewer walls such as sediments of discarded food, blood, semen, and feces, among many other organic and inorganic substances which might be harmful *or* beneficial to the wide variety of organisms that come into contact with these systems. Thus, under the city, and created by the city, we have a thriving habitat for animals that we usually fear and would rather not cohabit with. The scale of their habitat is so vast and these beings so resilient and pervasive, however, that we need to contemplate what cohabitation could mean. Denying these ecosystems and continuously discharging pesticides, which kill indiscriminately, while also poisoning downstream ecosystems, are acts that are not sustainable in the long run. And design plays its part.

One might call design activities (regardless of whether they are performed by professional designers or not) *practices of inscription*, where a form of knowledge is applied to deal with an identified situation at a given moment. What design inscribes are 'partitions', and a way to understand these partitions is through the notion of *device*[14]. *Devices* designate artifacts in general—that is, human-made products—whether these are three- or two-dimensional material artifacts, services or systems. Etymologically, a *device* is something that *divides* and arranges. Following this reasoning, the notion of *device* points out the inclusions and exclusions organized and arranged by the systems devised and by the partitions inscribed.

Using the sewage system as our example, we can consider how the pipelines arrange an inside-outside of their membranes and how these optimize channeling flows from the home (or other human-made buildings) to an uncertain location where the effluents are expelled and eventually 'treated'. The entry and exit points (of waste water, air, etc.) of the pipeline become opportunities for the entry and exit of many other beings and substances. Indeed, all *devices* have an 'accidental' dimension made possible by their own configuration; when we created the car, we not only created a way to transport something from A to B, but also the car crash, or at a more global scale, peak-oil and increased CO_2 in the atmosphere.

In some cities, by building our sewers we have created not only the possibility to discard unwanted effluents, but also habitats for other life forms, many of them unwanted and unconsidered in the original plan.[15] One of the accidents of the sewage systems is the death by scorpion sting of vulnerable humans: children, the aged and those with immunodeficiency. The processes by which these *devices* are materialized, used and discarded, create arrangements and

[14] As developed in Avila (2012).

[15] In a similar way, Hinchliffe and Whatmore (2006) means that "cities are inhabited with and against the grain of expert designs" (p. 124).

inscriptions that codify—in and through the systems and environments affected—potential for inclusion and exclusion at different scales. Current material arrangements not only allow for scorpions to multiply, but also, because the installed household gratings (often made of metal alloys) have a fixity or permanence to them, they seem to direct or encourage humans to discharge toxic effluents into them in order to kill the scorpions and, with them, a variety of other beings. Are there alternative devices or designs that can alter this destructive tendency? And can they do so while simultaneously opening towards a different perception of 'who is there' in the city? Towards an alternative affective ecology?

In this chapter we use this somewhat bizarre situation to reflect on our relations with other beings. How do we cohabit with animals (scorpions in this case) that we instinctively fear? This question forms part of a wider project,[16] which aims to think and design artifacts that help us to cohabit with beings that we dislike or that pose serious risks to our lives without taking away the tensions.[17] This brings to mind Donna Haraway's expression "living with the trouble," not resolving the 'problems', nor neutralizing the repellence, but making those situations explicit in order to acknowledge them as part of our biome.[18]

Using speculative design we can expose, sometimes directly, sometimes indirectly, how 'undesirable' beings relate to us. However, we can also use speculative design to engage with these beings and understand how they form part of food chains and relationships that sustain intricate and wider ecosystems. While the encounter between the scorpion and the child is of central concern for our alternative design, there is also a wider metabolic reality that we take into account. This metabolic reality views each individual household of the city as a productive component of an urban metabolism. In other words, as places where things and processes flow through the system and enact ecological possibilities in terms of energy, shelter, nutrition, toxicity, etc. for all actors (a range of humans and non-humans) that participate in these environments. It is simply not enough to protect the child/human (or the scorpion), but there needs to be a two-way relationship where our actions as human and scorpion contribute towards our *co*-habitation, a recognition of being of the same city. This is the design brief in a nutshell. Now, before arriving at the design for our alternative grating, which is based on a

[16] The wider project is called "Symbiotic Tactics" and its designs is a result from collaborations with many professionals and are based on research developed at the Multidisciplinary Institute of Vegetal Biology and other research groups within the Argentinean Research Council (CONICET). Martin Avila's design proposals, of which some are part of this chapter, have been elaborated together with Leonardo López.

[17] What the first author has called "doomestics," see http://www.martinavila.com/projects/doomestics/. Doomestics is one of four projects within the wider research project "Symbiotic Tactics" mentioned in a previous footnote.

[18] Haraway 2008.

two-way idea of "degradable urbanism," we will need get to know the scorpion and its 'underworld' better.

Foray into the underworld: Waste for some, food for others

Some of the oldest neighborhoods of Córdoba are the most affected by the presence of *alacranes* as scorpions are locally known. The sewers in these areas were built with concrete pipes during the first four decades of the twentieth century. Although some private properties and households in these areas have made upgrades using more modern PVC pipes, the public infrastructure connecting to these remains outdated. Over time these older parts of the system have accumulated sediment. The transition between private (and new) and public (and old) systems are easily visible in online videos produced by sanitation companies, who have filmed inside the sewers using remote-controlled cameras.[19,20]

The food web in these sewers indicates important facts. Decomposers and detritivores such as bacteria, fungi, cockroaches and other organisms feed on the sediments. The decomposers are thus not always undesirable because they break down accumulated materials on the walls. They find fatty deposits which they metabolize and convert into the components that make up their own bodies, as proteins and fats. They also make available inorganic chemicals, which can be recycled as mineral nutrients for plants at the subsequent trophic level, further increasing the consumption of sediments. Apparently then, there are positive effects for humans in this accidental relationship with decomposers and detritivores, since what is waste for us could become food for them. On the negative side, some detritivores, for instance cockroaches, could become vectors for human disease. Additionally, as cockroaches feed and multiply they attract one of the top predators in this food chain: the scorpion.

Studying the areas of the city most affected by scorpion stinging, we can identify key issues that contribute to their proliferation.[21] Factors include hygienic conditions in the areas, mainly through the disposal of waste; sewage exposure in public spaces; degree of vegetation cover and other animals/insects, and other less relevant factors. Through interviews with specialists, and through hospital statistics, we have gathered evidence that most accidents with

[19] Although the following video recording is not situated at the neighborhoods being discussed, it clearly shows the state of the pipelines in the city and, specially, the difference between the private-public connections. See: https://www.youtube.com/watch?v=59a0lm4TGuU.

[20] Also take note here of an-oft entertained entry point for urban political ecological analysis, that between public and private consumption, which here could produce an environmental injustice in terms of what households scorpions are most likely to enter and cause harm. We have found no statistics to clarify this class-based analysis.

[21] For editorial reasons we cannot provide the reader with all visual information we have available. For a map available online of the areas most affected by scorpions in households see: http://www.diaadia.com.ar/cordoba/alacranes-mas-picaduras-en-el-centro-y-sudeste-de-cordoba

scorpions (more than 80%) happen *in the bathrooms of private households*. As a response to the awareness that household gratings are the prime 'mediator' of accidental encounters, people have been advised by the government to place smaller, denser meshes below the gratings that obstruct the entry of scorpions and cockroaches into the rooms (Figure 1).[22] Media coverage addresses the phenomenon each year during the critical months between spring and autumn[23], and it is clear that although there are several animals (spiders, snakes, and scorpions) in Córdoba that might threaten human lives with their poison, scorpion stings are the most common cause of hospital treatment.[24]

Figure 1 – A typical modern standard grating. Note the smaller plastic mesh underneath to avoid the passage of scorpions.

Even though our technologies allow us to explore and even inhabit extreme conditions of darkness and moisture (which could increase our understanding of scorpions' preferences), most humans do not engage with the sites where these conditions are found in an average city: the sewers. Laws reinforce these natural tendencies and private and public delimitations close off sewers from the average citizen, for the very good reason of protecting them from the

[22] See for example: http://puntosanitario.blogspot.com.ar/2014/12/temporada-de-alacranes-consejos-para.html
[23] Government information on scorpions and how to capture them: http://prensa.cba.gov.ar/salud/alacranes-como-capturarlos-en-forma-segura/
[24] See: http://www.cordobatimes.com/sociales/2013/11/13/especies-venenosas-en-cordoba-no-tema-pero-tome-precauciones/

physical and immunological risks that a human will encounter there. However, our lack of understanding of the behavior of scorpions and their role in these ecosystems (of this natural-artificial continuum) is partly due to the human attitude of fear and aversion to these places. Unfortunately, precautions such as the meshes that some households have mounted under their metal gratings do not help in decreasing the presence of scorpion populations in these habitats, nor do they diminish the discharge of noxious chemicals to safeguard the home. In our attempt to ideate alternative ways of engaging with scorpions and actively participate in their (and our) urban ecosystems we need to study their constitution and behavior.

Getting closer to the other: What is a scorpion?

Asking *what* another living being is, what it does and how, are instrumental questions that confront us with behavioral analogies. They bring us nearer to the beings we are trying to understand by revealing differences and similarities. The description that follows is by no means an attempt at a complete answer to the question "what is…". It cannot fully explain the plurality, overlap, and nuances of feelings that humans experience when encountering scorpions. But the description is still crucial in getting closer to the scorpion.

Scorpions are arthropods, invertebrates with segmented bodies and jointed limbs that form an exoskeleton mostly made of chitin. They are efficient predators of insects and other small animals; their sting possesses venom, which is usually neurotoxic. To a human being, the sting from most of the existing species of scorpion (about 1,500) would hurt no more than a honeybee. However, 25 species of scorpion can be deadly to a human, in some cases capable of killing within seven hours. While the evolutionary history of hominids (our history) dates back 28 million years (and that of primates about 75 million years), scorpions' evolutionary history dates back 425-450 million years.[25] From an evolutionary perspective, they have been quite conservative morphologically and their form has remained similar for millions of years. They are adaptable in their behavior, physiology, and ecology however, which explains their success at adapting to extreme physical conditions. Biologist Gary Polis writes of their extreme adaptability:

> [S]ome species can be supercooled below the freezing point for several weeks and yet return to normal levels of activity within a few hours. Other species can survive total immersion under water for as long as one to two days. Desert species can withstand

[25] Polis 1990, p. 2

> temperatures several degrees higher than most other desert arthropods are able to tolerate.[26]

That scorpions have adapted to living in cities demonstrates such adaptive capabilities, but also highlights our advance into their ecological niches. From the end of the 16th Century the city of Córdoba grew into the Suquía River and the natural habitat of scorpions (and other species).[27]

When it comes to feeding, scorpions use their sting to capture prey and defend themselves. They hunt at night and, although they have vision, the vibrations created by their prey also guide their hunting activities. They orient and sense with their whole body. Scorpions do not sting unless provoked or if they feel threatened. Interestingly, our very condition as diurnal human animals has made it difficult to study scorpion ecology. It was not until 1954 when the use of ultra-violet light became common in field research that their nocturnal habits could be documented and studied.[28] (Figure 2).

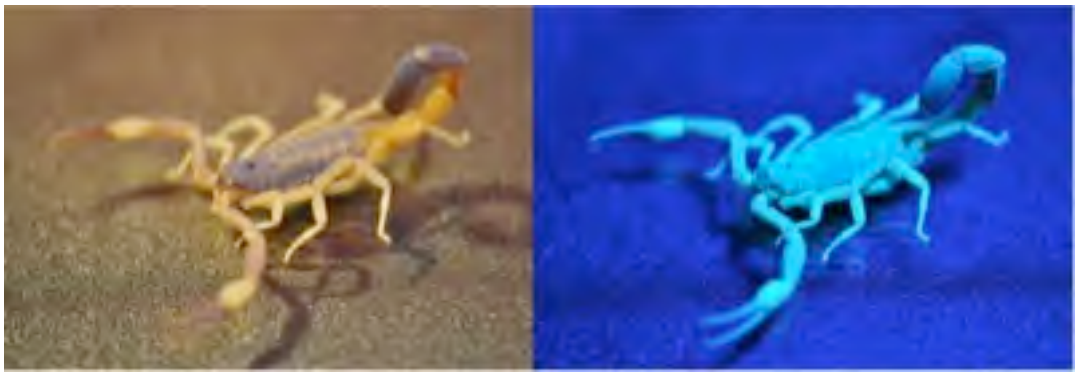

Figure 2 – *Tityus trivittatus* without and with UV light.

Since *Tityus trivittatus* is potentially deadly for humans, precautions for human safety must be maximized. The idea of cohabiting with them might be discarded automatically, but have they not already adapted to our cities? Are we not constantly expanding our habitats and displacing them and pushing them to adapt to a wide variety of artificial systems? Their adaptability and evolutionary history indicates that they are likely to further adapt to extremes. Combating them with noxious pesticides might be effective in the short term but ecologically devastating in the long term. Taking this as an extreme example of the tensions of cohabitation

[26] Polis 1990, p. 3.
[27] The city grew with colonization following a known pattern of Spanish conquistadores killing or forcing away indigenous peoples, including Comechingones, Sanavirones and other groups. In 2016 the city's population was approximately 1,500,000 people.
[28] Polis 1990, p. 128.

with non-humans, we will now turn to our design, which attempts to acknowledge human and scorpion needs at several trophic levels.[29]

Degradable urbanism: An alternative design for a shower grating

The following describes a design proposal for a *grating*, designed to biodegrade as well as to function as a trap to capture scorpions. Scorpions hunt, which means that they do not eat dead insects or animals. They not only see, but also recognize their prey by the vibrations that these emit. Keeping this in mind, the grating is covered on the exterior surfaces of the lower part with organic material such as bone meal to attract cockroaches. If a cockroach is lured into the interior of the device, it gets stuck as it steps on the adhesive covering the upper and lower surfaces beneath the grating (Figure 6). The device works to trap cockroaches. They do not die immediately but struggle to be released from the sticky adhesive, which causes vibrations through their movements and attracts scorpions that in turn will try to kill the cockroach, but get stuck on the same adhesive. In storage, and before using the grating, the food and glue on the inside are protected and preserved with a sealed strip (Figure 4). To install the grating, the strip must first be removed (Figure 5). The grating is then placed on the outlet pipe and it is immediately functional. The use of the shower will create a water flow that slowly degrades a white mineral layer on the grating's upper and visible side. Successive showers gradually reveal a darker layer underneath, which is made of a clayish mineral compound and will become increasingly more visible (compare Figures 3 and 4). The incremental darkening is a way for the grating to signal decay and transformation, and to warn us humans that we are becoming more and more 'exposed' as we come into closer connection with the sewer.

In contrast to the fixed (metal) grating between the 'underworld' and us, our device operates to expose the sewer. It makes apparent the need to maintain the system with the intent to transform our relationship to the 'underworld' of sewage. In practice, there is thus a need to maintain the gratings by replacing them once they darken and visually signal a 'connection' to the sewer. If the shower is used frequently, the device is designed to degrade in approximately three to four months.

Once degraded, the user replaces the grating and discards it. It might be composted; it might be directly mixed with soil or just thrown in the garbage bin. The nutrients that have been accumulated by catching insects and arthropods on the sticky surface are all part of the

[29] The design experiments where carried out by handling and testing situations with living scorpions of several species (*Urophonyus braquicentus, Tityus trivittatus, Bothriurus bonariensis*), but focusing on the most dangerous for a human being, *Tityus trivittatus*. The exposure to the risks involved cohabiting with them affected our sensibilities to the tensions involved in cohabitation, as well as informed, on an emotional level, our design proposals.

device and can be re-inserted into biophysical cycles. Since the grating's materials continue to degrade, it is up to the person to let the artifact contribute to some visible living cycle nearby or not. By scanning a QR code with a mobile device, the user would also get information on how to use, install, maintain and recycle the grating (Figure 4).[30] During its lifetime, and when operating as a grating, the device would complement natural processes by releasing non-toxic organic and inorganic materials.

Figure 3 – Grating while showering.

[30] The QR code (Quick Response Code) in the current image directs to the project site of "doomestics" (http://www.martinavila.com/projects/doomestics). There a general description is given, but this could be replaced with a fully detailed 'instruction manual.'

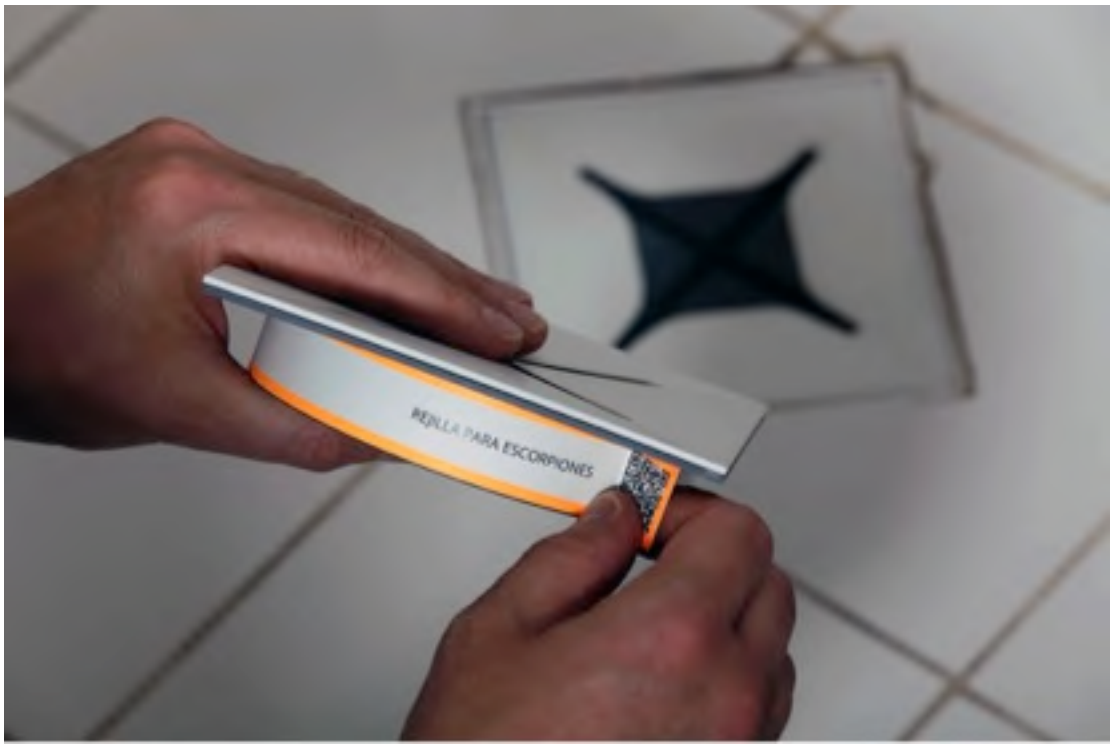

Figure 4 – Opening the protective strip to install a fresh grating and replace the degraded grating.

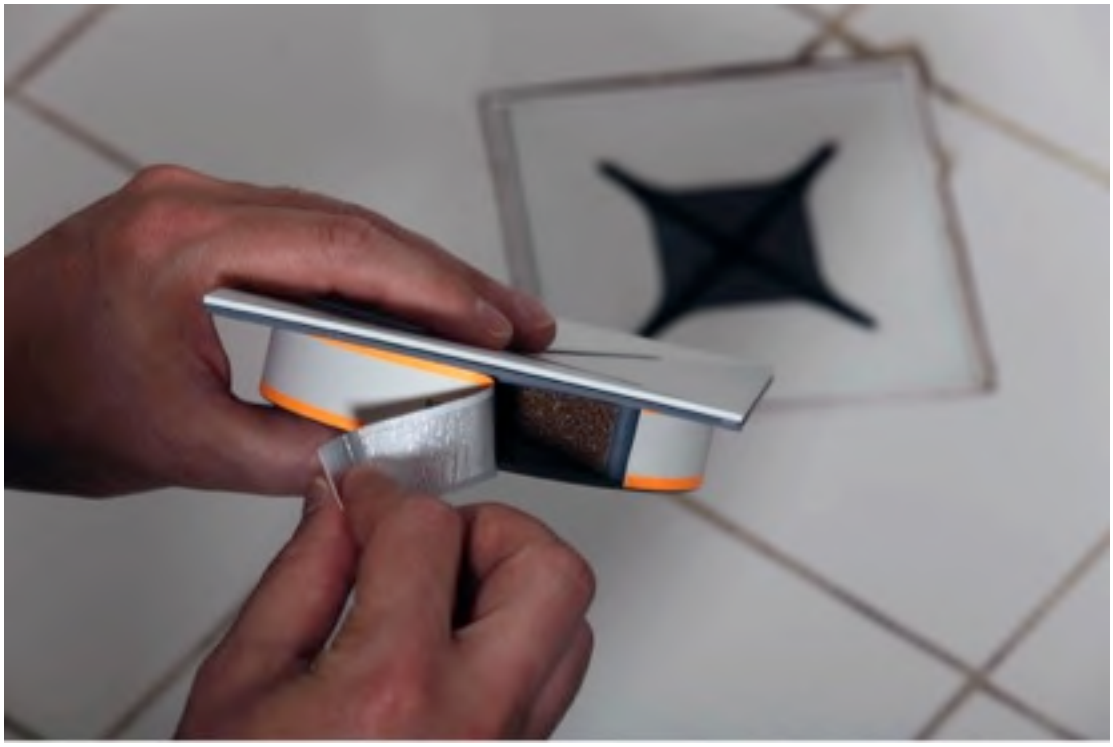

Figure 5 – Opening the protective strip to install a fresh grating and replace the degraded grating.

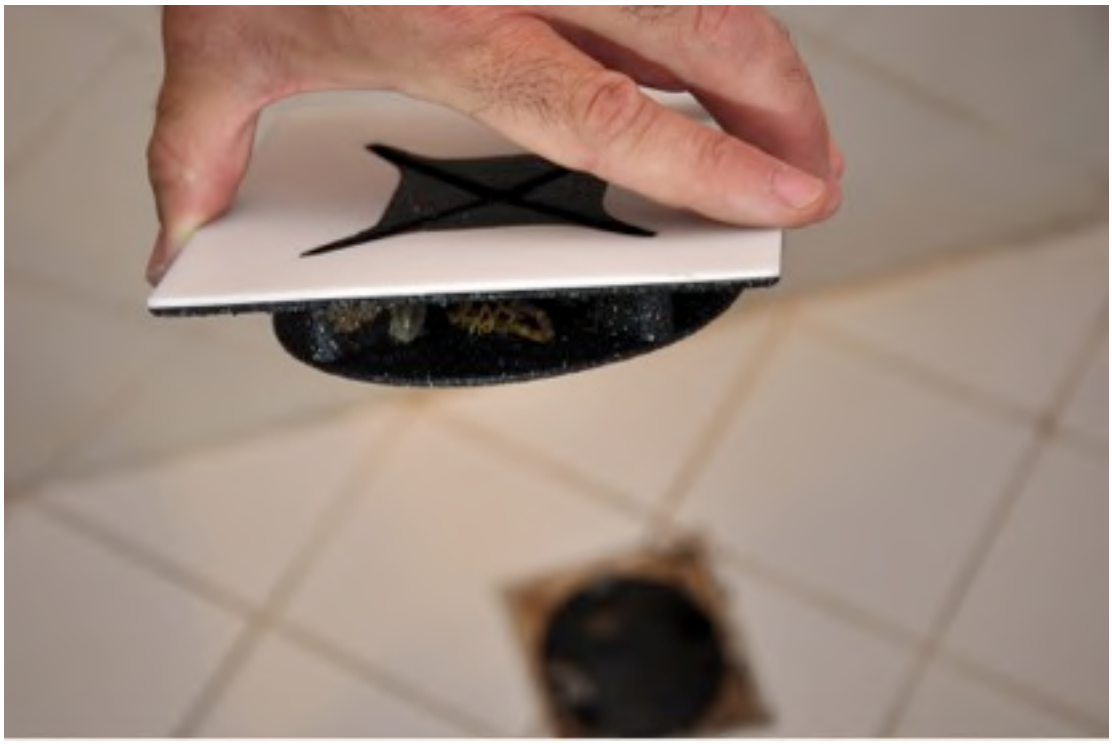

Figure 6 – Taking away the degraded grating.

Comparing current models of 'fixed gratings' with our proposed degradable grating, we note certain differences. The fixed grating in common use currently is part of the modernist vision based on an ideology of strict separation between the sanitized home and the underworld that is to be kept at bay. Through it goes water and other waste never to be thought about again. To be forgotten. Our alternative grating is less a separator than a link, a mediator in Latour's sense of the word as it transforms, translates, distorts, and modifies meaning, and, we might add, material relations.[31] It connects the human home and the habitat of others, and translates them both into a new (co)habitat, and a shared and wider ecosystem. The grating's changing appearance signals that it is in a constant state of change and disintegration, reminding us humans that we take part and relate to other worlds that we might know little about, but which still at times intersect with our world. Our grating thus differs from current conventional gratings in terms of performance at different scales and in terms of metabolism. This is important since the proposal is normative in the sense that it makes people act differently. It engages the user in a new constellation of relationships and demands more than the previous grating. Users need to make a greater effort for their own benefit, and the benefit of others. It implies a shift in lifestyle and provokes a change in perception of 'who we are living with'.

[31] Latour 2005, p. 38.

Since we have been designing *for*, rather than *with,* beings and that these beings are not consciously involved in the design processes (as in cases of 'participatory design'), we are proposing materializations that attempt to make explicit *some* aspect of the relationships that they are capable of enacting. What distinguishes these design attempts from standard anthropocentric praxes, is that even though the designs aim to benefit humans, their departure point is the conditions and potential of local ecosystems and the way humans interact with them. More importantly, the artifacts are designed to affect the way we engage (consciously or not) with beings that we do not normally consider to be part of our everyday life. We can also understand the proposition of the project in metabolic terms. The way that this device degrades and becomes eroded by the agency of domestic water flow, especially if it finds hundreds and thousands of users, makes it part of a wider metabolic flow by disseminating their material components into the biosphere.[32] At the same time, this 'metabolism' is conformed by many acts and materialities that have *not* been designed to perform in 'metabolic' ways (some detergents and chemicals, cleaning devices, flooring and fixtures, etc.) although they are certainly participating, by harming or benefiting some living systems at some eco-systemic level.

Material agency and re-formatting 'who is us'

Will urban nature and urban ecology demand a different way of thinking and practicing politics than we are used to? Córdoba brings together, the "dense comings and goings of urban life," a quickly shape-shifting "recombinant ecology" with high energy input and the filtering of species into what ecologists call urban adapters and urban avoiders, according to Hinchliffe and Whatmore.[33] New encounters are bound to happen. How are we to organize our politics together with the wider more-than-human community that we share the city with? What is involved in this politics that needs to take into account the everyday toil of human and more-than-human life forms as they go about their lives? How could the emotions of fear and affection play a role?

One conventional answer to this question has been to prolong the modernist project of building centralized strategies. Just as waste management was solved through building networks of pipes and pumps, since the 1990s strategies to handle cohabitation with other species have

[32] This aligns with Reno's analysis of waste (2014), not as "matter out of place," but as "signs of life" in a bio-semiotic sense.

[33] Hinchliffe and Whatmore (2006) quote G Barker's notion of "recombinant ecology" (see their article for full reference). For ecologists' treatment of species as urban adapters/avoiders, see edited volume by Niemelä et al. (2011).

developed around notions of biodiversity and ecosystem services. When translated as tools of management—often materialized as habitat maps, biodiversity networks, or tables with contingency costs and 'trade-offs'—these typically re-enact the long modernist-colonialist strategy of separating nature and culture and appointing value to other life forms from a Western and anthropocentric epistemological viewpoint.[34] These forms of registering the non-human world mark a clear line between them and us, just like the fixed conventional grating did. The maps and tables of value manifest this line of demarcation, and circulate as a convention among decision-makers, experts and the public to mark out what we should appreciate and protect, and where we can build and exploit; and who belong to "us"—the empire of man (*sic.*) vs. the empire of animals.[35]

The answer we are developing here attempts to stay localized and sustain other dimensions of cohabitation that involve, among others, uneasiness, curiosity, fear, pain, and fascination. Since these often fall outside centralized strategies and tools of registration, there is an active erasure or silencing of the affective ecologies that make up our habitat and worlds. Instead of a definite strategy, we are working towards a politics of urban ecology that is complemented by tactics; the use of material arrangements (devices) that can enable affective configurations that can re-work how we live together.[36] Our proposed grating aims to enact this type of politics. It shows what is normally imperceptible; the degradation of materials from a building. As such it belongs more to the paradigm of 'food' than that of household fixtures or appliances. In this way, it helps us to perceive and understand the material flow that is disseminated to the environment and to sense the scale at which other artifacts degrade and how they influence our habitats. Through these mediators (the gratings), our lack of relationship (for the most part) with the systems that process our effluent becomes evident. As we have noted, humans expel feces, urine, blood, semen, chemicals from medical, personal hygiene and cleaning products, as well as grey and pluvial water into the sewers, among other waste. We discard these in order to never see them again, marking territories *in abstraction*

[34] See Peder Anker's *Imperial Ecology* (2001) for the origins of ecology as a science that *par excellance* was developed to control environments and peoples across the British Empire. We also note that there are more bottom-up approaches to biodiversity, see e.g. Arturo Escobar's early call (1998) and useful problematization in the context indigenous knowledge practices.

[35] See Jens Lachmund's (2011) on the development of habitat maps in Berlin from the 1960s. Ernstson (2013) and Ernstson and Sörlin (2013) have studied biodiversity mapping and ecosystem services in Cape Town.

[36] In their *Living Cities* article, Hinchliffe and Whatmore (2006) argue for a "politics of conviviality" along similar lines as us, although with more Deleuzian connotations, foregrounding the outside of any diagram where new relations, identities, sensibilities can emerge and proliferate. They would however most certainly stay away from engaging with Rancière's notion of politics as aesthetics and the "partition of the sensible" as we intend here. Although there is no space, Katherine Wolfe (2006) has brought an interesting reading of how Rancière notion of politics could communicate productively with Deleuze's idea of the "imperceptible," in spite the former's reservation of the political potential in the philosophy of the latter.

without having direct relationship with the results of our polluting. The alternative grating invites a new "partition of the sensible" in a very material and bodily way. But, also in ethical-political terms as it produces a shift in human appropriation and what or whom is being included/excluded as part of the city.

Michel Serres tells us how territory was once demarcated with urine, feces, blood, and semen. Today, by being able to ignore our corporeal excretions through the material arrangement of the modern sewage system, we deny the territorial aspects that result from our *vital* presence: "Let me remind you that the word *pollution*, with its religious and medical origin, first meant desecration of places of worship by some excrement, and later the soiling of sheets by ejaculation, usually from masturbation".[37] At a time when ecological crises expose the short-sightedness of some modes of appropriation and development paradigms, our devices (as in tools, machines, computer algorithms etc.) continue to perform the functions for which they were conceived, and thus continue to create tendencies for us humans to behave in 'this' or 'that' way, a centrifugal force part of a gradient created by complex machinic bio-geo-cultural ensembles.

We argue that daily exposure to other vital realms is necessary to gain more understanding of complex ecological interplay, including those relationships that seem most undesirable, as well as to reach a stage of maturity of the production of the 'artificial', where (design) proposals simultaneously consider the integral life cycles of products in relation to multiple beings. However, this cannot only operate at the exclusive levels of logos and function—as in rational beings doing the correct thing, or as automatic functions that maximize energy-use—but also at the affective and intimate level of human emotional registers, by experiencing fear and joy; and as engagements with others to constitute affective ecologies.

Our proposal could be seen as part of contemporary efforts to re-evaluate our place 'in nature'.[38] Aligned with archetypal ideas such as *Pachamama*, the term used by Andean pre-Hispanic cultures to designate Nature and its corresponding human ethical responsibility of respect for those (human and non-human) that comprise it and which we are dependent upon, or the current scientific version, Gaia, with its nascent global-legal regulations and imperatives. This has animated hopes of rediscovering indigenous-historical cosmologies that can reconfigure alternative ways to relate to Nature, and more contemporary post-humanist claims to give voice to non-humans or configure a 'parliament of things'; all expressing a need for alternative approaches to our relations with the biosphere.

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[37] Serres 2010 p. 34.
[38] Apart from Serres (1995).

However, in relation to these calls it is important to note that our *device* still *divides* and organizes an 'above' and 'below', human and non-human binary, correspondingly.[39] The device actually tries to maintain a separation, an outside to its own relationality, which is based on human dominance and control. Thus the grating is not a source of food for cockroaches, but a trap for them and their predators, the scorpions. There are particular human interests in this human-scorpion entanglement being enacted through the grating. What the device arranges is *a higher degree of exposure* to worlds that we humans are not normally in contact with.

Realms of exposure

We are affected, on an everyday basis, by myriad material configurations enacting the natural-artificial continuum. In return, we affect these configurations by constantly transforming them. This is quite plain. What we are calling your attention to is to *the extent that we are not aware of our affections*. Or, how our actions of affect, through the material arrangements we conform and have around us on a daily basis, our truly cyborgian world, influence the world we inhabit and share with others. With Córdoba and through the sewage system as an example, we can see the clear divisions of the human domestic environment and the 'underworld' of sewage. A habitat that has been created partly by us humans, and is now inhabited by many others, and where the use of chemicals to 'combat' these other beings, kill not only target organisms but also more organisms further downstream, affecting a wide range of lifeforms at different scales. Our work through design attempts to *expose this lack of contact* with basic processes that are vital to any ecological niche, including our own.

While expert-based strategies of 'biodiversity mapping' and 'ecosystem services' might teach some humans about ecological complexity, intervention of the type we describe in this paper complements such strategies in several ways. First, by involving humans on an everyday basis, environmental education and participation is increased and made distributive by delegating agency for 'educating' to non-human artifacts (the biodegradable grating in this example). Second, it rearranges the 'map' by directly affecting the degree of participation and distribution of the beings involved, which always implies that once in operation, devices such as our grating need to be re-evaluated to assess and understand the kind of interactions that were made possible through their materialities. Design, as a future-oriented activity prefigures versions and possibilities that are never realized totally as expected.

[39] However, it does so by materializing an uncertainty principle, not knowing who or what is going to establish contact with it, it is produced to degrade and disseminate organic and inorganic compounds with chemical compositions that are not toxic to life forms.

Crucially, this work attempts to expose ontological aspects of design; the preferences and behavior that seem invisible and taken for granted, with the intention to increase our participation in processes that might be difficult but are necessary to negotiate, the (inarticulate) interests of more-than-human collectives.

A more-than-human political moment?

Our design might therefore also be interpreted in light of what Kate Booth and Stewart Williams, in a special issue on Jacques Rancière recently called "a more-than-human political moment".[40] There they where analyzing Australian wild fires "breaking free of wilderness and burning the settled lands of human habitation"[41], drawing on Rancière's idea that a 'proper political moment' only occurs when the current order of things (the so-called police order) is ruptured and a new collectivity is materialized that demands a shift in *what can be sensed*, what can be seen and heard, a new "distribution of the sensible".[42] Although there are a series of questions about how one can translate Rancière's notion of the political to operate on the more-than-human—perhaps in particular the notion of equality and political subjectification—we, like them, mean that Rancière is useful for speculating on the political in a more-than-human world, affected by climate change, loss of biodiversity, and not least cross-cultural and world-wide urbanization.

However, while Booth and Williams speculate with the dramatic, violent, and destructive event of a fire, our speculation on scorpions and peoples' bathrooms provides a more intimate and everyday setting to think about more-than-human political moments, especially how these 'moments' could be constituted and enacted in the daily rhythm of life (and death). The device can then be said to operate at two levels of politics; a 'micro' politics, minute in its practice and becoming at the singular domestic level, and at a potentially massive 'metabolic' and 'mass educational' scale if installed in thousands of households, disseminating nutrients with effluent through a distributed network of city dwellers.

Our pollution marks our territories, as Serres contended. The biodegradable grating device however, operates to re-connect us with parts of living.[43] Besides the different morphology of the device, the main particular feature that distinguishes it from current gratings

[40] Booth and Williams 2014.
[41] Booth and Williams (2014, p. 182).
[42] Rancière 1999.
[43] See Reno (2014) for a critique of Serres's (2010) treatment of waste as appropriation through pollution. Drawing on bio-semiotics and a reflection on the signals that animals send through their scat, Reno (2014) makes a radically positive and non-anthropocentric interpretation of waste, arguing to move theorizations of waste from a position of "matter out of place" to a position as purposeful "signs of life". Our work resonates with his emphasis of the "livliness of waste" (p. 19). See also the footnote below on bio-semiotics.

is its 'expiry date' in combination with the degrading process that suggests this obsolescence. It is the maintenance required, a maintenance intentionally hard-wired into the device, that pushes us to be part of something exterior (the life of sewage systems and scorpions, the areas where our bodily effluent is ultimately disposed of), making impossible the strict separation between spheres of dwellings.

Still, how to remain in contact? Bruno Latour reminds us that "all social scientists agree [that] groups need to be made and re-made anew through some other non-social means, and that there is never a grouping that can sustain its existence without some keeping up."[44] These "sorts of expressions," he continues, "flow effortlessly from our keyboards. But their precise effect depends on *how exactly we understand ways of speaking* which all allude to the 'making' of groups".[45] The 'speaking' metaphor surfaces as in Rancière, to suggest that what we do not hear, listen to—or more generally, what we cannot sense—we regard as not existing. As with wild fires in Australia, it is really difficult for people in Córdoba to ignore the 'voice' of scorpions. There has certainly been a rupture in the constitution of who is to be counted as affecting common life in the city. But, is there a political assembly in which these yet-to-become-citizens can take their rightful place? Maybe it is here, at this everyday micro-scale that our proposal might do its most important political work, effecting change through assisting the making (and maintaining) of more-than-human-groups; a new collectivity becoming present that pushes for a re-constitution of the political community.

Rancière asserts that while not simply a person, individual or group, a political subject is "an *agent* of the division of the arche" where the *arche* is the polemical constitution of the community.[46] This strict non-anthropocentric treatment of the political subject opens towards a more-than-human interpretation of what the political could mean. Beyond the rupture of the order of the *polis*, the established distribution of the sensible, a political subject inserts "*a new mode of counting* the uncounted and including the excluded"[47]. Taken together then, and moving from the everyday setting to the constitution of the political assembly, the material design of

[44] Latour 2005, p. 36; our italics.
[45] Ibid.
[46] Rancière (2014, p. 45; our emphasis). In Greek the word *arche* (pronounced [arké:]) has two meanings, origin and commandment with the former being based on the law of birth (e.g. "blood line," family, "race"), and the latter on the rule of law (e.g. a state instituting who is included and excluded, say citizenship in France or Sweden). Their polemical relation constitutes the *arche* and defines democracy as "the regime of the political" (Rancière 2014, p. 44). Note also, that, being explicitly asked by Jane Bennett on whether he "thought that an animal or a plant or a drug or a (nonlinguistic) sound could disrupt the police order [an important philosophical and political distinction in Rancière's thought], Rancière said no: he did not want to extend the concept of the political that far; nonhumans do not qualify as participants in a demos" (Bennett 2010, p. 106). See also a development of this discussion in Booth and Williams 2014.
[47] Ibid, p. 45.

the grating produces accountability on part of humans to maintain the system. But, there is also a material re-formatting of the 'modernist and sanitized home' so that the more-than-human 'voice' of the underworld can be 'expressed', 'heard', and 'sensed' through the increasingly gray color of the (degrading) grating. And if not heeded, maybe the underworld will make itself heard through a tragic and violent encounter with a scorpion in your bathroom. Through such design, at least part of the complex of living beings in the city's underworld can assert themselves, not by representation by humans, as in 'the friends of the scorpions', nor in the name of 'biodiversity protection'. Rather, it is through their own modes of living that they can demand us to consider a change in our behavior and politics to reach new configurations for co-habitation.

If this new political community of co-habitation comes into being, what could it mean? With Serres, we understand this community not in terms of a 'flat ontology', a limitless or borderless community as some post-humanists and object-oriented ontologists might hope for where humans and non-humans merge seamlessly into one another. Instead, borders and their demarcations are still present through the alternative device/grating:

> Clearly [Serres says], we have to meditate on the function of the border… this *dividing line* strangely consists of three layers. The first is on the inside and protects the inhabitant with its softness; the exterior one threatens possible invaders with its hardness. The layer in the middle is riddled with pores, passages, portals, and porosities through which, often by semiconduction, a living being or a thing enters, is locked in, leaves, transits, attacks, or waits hopelessly. The prepositions *in, for, to, from* describe the first layer; *out of* and *against* the third strip; *between* and *through* the intermediary one.[48]

In abstraction, no longer able to delimit a territory based on our excrement, we inhabit a world that we no longer own.[49] Serres calls this 'tenancy' instead of 'ownership'.[50] By extension, our

[48] Rancière 2010, p. 43.

[49] Throughout this chapter, we find several affinities with bio-semiotic studies. In relation to Serres' point on the discord between our behavior and our technologies, bio-semiotician Jesper Hoffmeyer suggests what he calls "semiotic fitness," arguing that "the magnitude of the flow of energy and the semiotic controls guiding the utilization of that energy… have constituted the pivotal points in both the historical process of civilization, and in the evolution of life on earth." (2008, p. 345) This provides reasons for why our grating proposal can be understood as a form of *attunement* (Ávila 2012), a bio-semiotic technology in its "usefulness as tool for semiotic activity of every sort," i.e. for communication between humans, nonhumans and all their combinations (Hoffmeyer 2005, p. 343-344). For an explanation of open thermodynamic systems as life processes, see Schenider and Sagan (2005).

artifacts (from mass-produced domestic products, to high-tech devices and big infrastructure networks) compel us to repeat the procedure of leaving our traces on every part of the planet, disseminating novel chemical combinations that do not take into account any other being but humans, nor any other being's chemical or metabolic flow. By entering at such quick pace and interrupting local lifecycles, the biosphere fails to process them, which unravels new, unknown and harmful dynamics for many species, including our own. Performing as a border, the grating we propose mediates these passages *between* different 'worlds' (of the 'human-home' and the 'scorpion-underworld') and it does so *through* its material components, with the hope of contributing toward a thinking, sensing, and doing that is life affirming. Politically, this mediating border, this device, can be seen as a manifestation of the responsibility that comes with the acknowledgment of our tenancy.

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Figures. High-resolution figures to be submitted later.

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[50] "The world, which was properly a home, becomes a global rental, the *Hotel for Humanity*. We no longer own it; we only live here as tenants." (Serres 2010, p. 72).

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