Third Knowledge Spaces between Nature and Society: A Dialogue

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Tanja Bogusz & Moritz Holtappels *

Abstract: »*Dritte Wissensräume zwischen Natur und Gesellschaft: Ein Dialog*«. The planetary ecological crisis has softened the well-established borders between the natural and the social sciences. The Anthropocene not only induces new modes of experiencing and inquiring nature, but also shakes the fairly robust differentiation between conflicting epistemic positionalities between explanatory, interpretative, and normative research approaches in a most profound way. For the social as well as for the natural sciences, nature, instead of being a mere resource, has become a political topic. But what does it mean to do research on the environment within the Anthropocene? Through a dialogue between a marine biogeochemist and a sociologist of science, we discuss the possibilities to experiment with the methods and reflexivities of a growing number of intertwined nature-society complexes. By exploring what we call *third knowledge spaces between nature and society* through our research experiences, we offer an example in putting into question our respective disciplinary positionalities. We hope to contribute thereby to a growing number of inter- and transdisciplinary attempts to turn the climate and biodiversity crisis into experimental cooperation and, finally, enhance the degrees of freedom to create a shared future.

Keywords: Anthropocene, co-laboration, interdisciplinarity, transdisciplinarity, public, experimentalism, human-environmental interactions.

How We Wrote the Paper

The following dialogue started with a written exchange that lasted several weeks. The time intervals between the contributions ranged from short-term queries by telephone and e-mail to several days in which we had time to gain insights into the frames of reference and literature of each other. While these pauses were useful to

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contemplate on our respective approaches, we were not interested in reaching out for a common view behind the scenes. We felt that the open-endedness of such dialogue with breaks in between is important and most suitable for free reflections, especially across disciplines. The dialogical text form, however, comes at the expense of the respective disciplinary depth of arguments and references. We further would like to point out that, by nature of a dialogue, the views and expectations of one's own and other's discipline particularly reflect many personal "positionalities," that is, rather individual impressions and experiences within the two disciplines we are representing here. The dialogue is meant as a starting point for a mere practice-based collaboration, and the reader is invited to join our interdisciplinary little learning-cabinet with an open and curious mind.

1. Disciplinary Containers versus Interdisciplinarity

Moritz: I will start by describing my research field and my motivation, or better my sequence of motivations that led me to the different stages of becoming a natural scientist and finally to a dialogue with social sciences. The initial motivation to study marine biology came from my diving experiences, during which I was literally submerged into a completely new world where speech is absent, and observation is everything. My decision was mainly driven by curiosity, but in retrospect I also chose a topic that promised a certain reference to the world outside society, while I would not follow my other interest, which at the time was political economy.

During that time, it was not possible in Germany to study Marine Biology from the beginning. A Bachelor (Vordiplom) in Biology was necessary which also included disciplines such as physics and chemistry and especially the methodology in setting up experiments, writing protocols, and presenting results. During my studies I learned about the many different methods and approaches used in field studies to collect samples and measure specific variables, all of which can shed light on a single research question from different angles. Interestingly, it was also the research methods that motivated me to leave aside the more ecological biology – in which species identification and counting were the most important, and for me not very attractive, activities – and to turn instead to a research field called Biogeochemistry.

Tanja: But if your interests covered societal questions as well, why did you finally choose biogeochemistry?

Moritz: I found that biogeochemistry is at the crossroads of many disciplines (as the name reveals) and covers many spatial and temporal scales, seeking to understand how the interaction of chemical, physical, biological, and geological processes shape the natural environment and its interacting spheres (biosphere, hydrosphere, atmosphere, lithosphere, pedosphere, cryosphere). The most versatile agents in shaping the natural environment are

microorganisms such as bacteria, which connect the micro- with the macroscale and the ancient with the present earth, as they are the main players in the global cycling of essential elements, especially those that are fundamental for life, such as carbon, nitrogen, and phosphorus (Canfield, Kristensen, and Thamdrup 2005). As a system science, Biogeochemistry demands a focus on the interfaces of overlapping spheres or entities (for example, Marum Cluster of Excellence: The Ocean Floor – Earth's Uncharted Interface) to trace the cycling of elements through the total environment. A main interest is to understand the transport and transformation processes involved, but some of a Biogeochemist's work can be compared to that of an accountant who is balancing the in- and outflow of elements through sinks and sources, measuring their pool size and residence time in a certain sphere (Gruber and Galloway 2008).

In global elemental cycles, the anthropogenic factor is constantly increasing. The cycling of carbon and nitrogen are directly linked to CO_2 emission and nitrate fertilization, two processes that move on at rates that significantly exceed the planetary boundaries (Rockström et al. 2009). Society is mostly seen from the perspective of an independent observer, that is, the natural scientist, who has to take human beings into account. Also, the calls of the funding agencies – which usually ask to address these pressing issues – do not change this view as they are also asking for the perspective of the scientists, and moreover, ascribe a rather functional attitude to the subjects of the calls. While working as a scientist and looking at society as a factor in global elemental cycles, I am at the same time discussing social and political topics, even compensating from work by engagement in social projects. This divide is probably quite common. Maybe there are good reasons why the social spheres of science and politics are kept separated, such as the simple fact that an open and curious attitude towards the environment is easily squashed by the tensions of political powers. But it is also strange to be paid by society to observe how the climate crisis unfolds and at the same time not to react to it adequately.

However, in my perception, much of the separation between science and politics has vanished in recent years. This process is likely driven from both sides, but personally, I see the politically motivated disintegration of facts to mere opinions as the turning point upon which many scientists became politicized as scientists. Because of this development, I feel a strong need to exchange views between social and natural scientists with regard to the position of science in society and politics. How can we modify the interface between science and society so that we can make use of the scientific knowledge to increase the degrees of freedom in the tight relationship between nature and society? How do you, as a sociologist, relate nature, society, and politics facing these challenges?

Tanja: I think that the character of the interface between science and society indeed echoes the relationship societies have developed with their respective environments, and, especially, with nature. I find interesting the way you described your becoming a natural scientist by taking, at least in the beginning, an active distance to society. The same goes, I think, for many sociologists and anthropologists as well (Bogusz and Descola 2013). But society strikes back – and so does nature!

When I worked ethnographically with marine taxonomists at the Parisian Museum for Natural History in Paris, and later during a biodiversity expedition at the coastal zone of Papua New Guinea in 2011-2013, I witnessed a similar concern to the one you just described: Marine biologists were, on the one hand, very connected to what in sociology we would call a positivist approach on their objects. But, on the other hand, they were also morally engaged citizens who wanted to make a difference facing climate change and the loss of biodiversity. Methodologically speaking, both parts represent two different worlds: One, where scientific reasoning consists in recording nature's situation and deducing analytical consequences (the positivist, or empiricist part), and the other, where normative, ethical, and even political levels of reasoning come in (the reflexive, critical part). But does that mean that reflexivity only emerges when nature – or science – is contested by society? I do not think so.

Following John Dewey's experimentalist philosophy of knowledge (Dewey 2008), I rather think reflexivity is the baseline for any kind of knowledge. However, the kind of reflexivity Dewey assumed was neither reduced to individuals nor to political problems or critique. Rather, it emerges from experiences challenged through trials caused within human-environmental relations in general. Any researcher, but also any lay person, may meet such trials. The difference between everyday and scientific reflexivity only consists in making a profession out of creating trials – or experiments – as discovery-devices.

If, in the case of the natural sciences, society strikes back, we might add that society was already there from the beginning. And if, in my case, within the social science, nature strikes back, there is no doubt that the modern world we are living in was always dependent on the very nature it has formally excluded. Not only modern society but sociology as its administrator has thus, and despite its multi-paradigmatic profile, "never been modern" (Latour 1993, 2018). So, in both cases, nature as well as society act as generators of reflexivity. However, I am wondering if the modes of reflexivities they enact on our respective disciplines are the same. I would like to develop on this further with you.

When I started to study sociology, I also discovered a mode of distancing myself from society and politics, though a bit different from what you described. I was too frightened to dive in the deep seas, but I loved to immerse

myself into unknown social worlds through ethnography. As an educational climber I had experienced such immersion long before I knew that I could translate the commuting between different social classes into a science. What fascinated me in sociology was the idea of not only doing this professionally and getting in touch with many different living worlds, but also of doing this through methodological and systematic exploration. Generating knowledge by actively engaging with the unknown might be linked to what you describe as curiosity. I think this kind of reflexivity driven by a curiosity that is nourished through different spatial and epistemic positionalities features an important similarity between our activities.

2.   Part II: Getting Acquainted with Public Problems

Moritz: But how did you get in touch with the natural sciences? What was motivating you?

Tanja: Until I was acquainted with Science and Technology Studies (STS), my link to nature was restricted by the common epistemic separation between the natural and the social sciences. Consequently, I followed the academic division of labor: My "province" – in the sense of Dipesh Chakrabarty (Chakrabarty 2000) – was society, not nature. But the mounting concern of nature's degradation, as well as the debates within sociology and anthropology on human and non-human enactments on nature and society, has shaken my taken-for-granted sociological positionality.

Having said this, I am convinced that the ecological crisis is not just another research topic. It is deeply changing the fundamental epistemic orderings we have grown up with. When the social – and thus the political – enters nature, and nature enters the social, we might therefore, firstly, ask what these respective transformations mean for the entanglements between our research practices and knowledge. I understand your plea to increase the degrees of freedom in the tight relationship between nature and society in such a way that you see the common field of cooperation in doing politics together. But as a sociologist, I am trained not to confound my science with a normative political practice. Rather, I am wondering if degrees of freedom could be reached on a more basic level, that is, to think about possible commonalities between our respective research experiences. What do you think?

Moritz: For natural scientists it is probably less problematic to engage in environmental politics because it is easier to claim (justified or not) that we are merely interpreting the nature out there, without self-serving motives. I think the normative stance becomes less contestable because the position of nature in politics expanded from a weak exploitable kingdom that needs our protection to an extensive threat to our society. But let us keep this out for

now and discuss possible commonalities between natural and social science. Where would you start?

Tanja: We could start by discussing methodology. For instance, you have described your approach in biogeochemistry as systemic, what we in sociology would call holistic: integrating heterogeneous elements to produce a most complex, as well as well-accountable idea of social (nature's) dynamics. This is very interesting because in sociology we not only have a system theory (Niklas Luhmann who developed it from theoretical biology, see Luhmann 2008), or theories of social mechanisms (Gross 2009), but also many approaches that try to integrate heterogeneous entities within STS and Actor-Network-Theory and the anthropology of nature (Callon 1999; Verran 2002; Descola 2013; Tsing 2017; Tsing, Mathews, and Bubandt 2019). Unfortunately, these approaches are either strictly theoretical and/or qualitative. They only rarely embrace numbers, correlations, and quantitative or experimental data modeling. That makes it difficult to put them into a real dialogue with the way natural scientists are reasoning.

As the anthropogenic impact on nature is so evident, I would like to understand how exactly humans are present in the biogeochemical data you are generating. What is their mode of representation? Do you see humans as external factors acting on nature's fate, transformed into chemical entities or formulas? How narrow is their entanglement with the natural entities you are observing and modeling? Or do humans and non-humans already represent some sort of "hybrids" in your data, in the sense of Ulrich Beck (1986) or Bruno Latour (1993)? I would be curious to learn more of these aspects from your research. Could you imagine practices of modeling your data by integrating qualitative, for example, experiential/contextual/reflexive, knowledge in it?

Moritz: I am afraid that in our profession we see human beings mostly as simple external factors that consume a certain amount of resources, often in a non-sustainable manner. As a natural scientist, I am not used to study agents that have intentions driven by self-conceived reconstructions of the environment. Although humans are an important factor in the present-day biogeochemical cycles, we usually do not consider the complexity and reflexivity of the social you have to deal with. There are models, for example, future projections of terrestrial nitrogen loads entering the ocean, which anticipate changes in agriculture and related fertilizer usage by farmers (Seitzinger et al. 2010). But such interfaces to society are mostly established by economic data and reflect alternative concepts of environmental managing.

Most often, the human factor appears in the form of what you call "hybrids" in sociology – a mode of knowledge of nature that enters society in form of a new technology and reflects back as a severe perturbation of the natural/social environment – but we do not approach these hybrids in a

cooperative way from several sides, including the various scientific disciplines, or even society itself.

The different perceptions and evaluations of the various hybrids is probably one of the reasons that complicate the matter. For example, in 1999, an ABC News Poll asked to vote for the most influential invention of the 20th century and came up with: computer, airplane, television, nuclear power, and the like – inventions that indeed had a strong imprint on our everyday life. Interestingly, the same question was answered by natural scientists very differently. In a Nature millennium essay, Smil (1999) suggested, "the Haber-Bosch process has made the most difference to our survival" in the 20th century, because "the world's population could not have grown from 1.6 billion in 1900 to today's 6 billion [7.8 billion in 2020] without the Haber-Bosch process." This process, hardly known to the public, describes the synthesis of nitrogen fertilizer from atmospheric dinitrogen, which tremendously increased the yield in agricultural food production.

An interesting side note, exemplifying the often-erratic way how science enters the social, is that the Haber-Bosch process was also essential for the production of explosives and accelerated the industrialization of this process in Germany during the First World War. Anyway, by now the Haber-Bosch process is the largest contributor to a buildup of reactive nitrogen in the biosphere, causing the anthropogenic disruption of the nitrogen cycle that, before its invention, was mainly controlled by microorganisms in soils and aquatic environments (Holtappels, Lam, and Kuypers 2009; Kuypers, Marchant, and Kartal 2018). As such, the anthropogenic nitrogen input to coastal ecosystems contribute to numerous negative human health and environmental impacts, such as loss of habitat and biodiversity, increase in blooms of harmful algae, eutrophication, hypoxia, and fish kills (see, for example, Diaz and Rosenberg 2008).

It is interesting that not only the drawbacks of such a fundamental invention are perceived so poorly (which would be understandable) but also the benefits. From a natural scientist's perspective, there seems to be insufficient public awareness of the material foundations of human life and the risks that threaten these foundations, which points to a misaligned interrelation between science and society in general. I assume that the social sciences face similar problems when much of the gained scientific knowledge is left aside to assess the social foundations of human life and improve, for example, the response towards social upheavals and disparities.

This does not seem to be a mere problem of knowledge dissemination and science communication, but it goes deeper. Here, I would like to refer to your aforementioned definition of reflexivity as a baseline for knowledge production – that is, reflecting on experiences and trials in the human-environmental relation. It becomes apparent that there is no joint reflection and knowledge production by science and society, as society is only asked for its

opinion on experiences made by scientists, while own experiences cannot be included. Society is usually not involved from the very beginning, that is, during the assessment of a potential crisis situation and emerging risks. Crisis response is thus based on trust in authorities and in the experience and judgement of governments and scientific institutions, while the practical knowledge of lay people, their experiences, and their judgement are not considered. The society seems passive most of the time but is activated only to legitimize a reaction. For democratic and liberal societies, the question arises if and how the society can develop a mutual sensitivity towards the various human-environmental complexes that allow for a reasonable and timely response when they evolve into a crisis.

I suggest that such gaps between science and society as well as between various science disciplines can only be bridged by a joint practical engagement on a local level, where experiences can be shared, and knowledge production is a genuine cooperative effort. Most transdisciplinary projects known to me that include, for example, social sciences, environmental politics, and natural sciences do not really close the gap but rather represent alliances where disciplines match up for joint funding but follow separate agendas collecting knowledge for the respective disciplines. I feel that this may be resolved only if the society/local community takes a central role in defining the problem, which will then be examined together. I could imagine that at this practical level the integration of the different modes of knowledge production, for example, qualitative and quantitative approaches, can be really fruitful.

Tanja: You describe quite exactly what I am into by developing what I call "sociological experimentalism" (Bogusz 2018). While climate change and biodiversity loss are widely acknowledged to be probably the most fundamental challenges for nature and the world society, and despite many ambitious research programs and agendas to overcome this situation, I observe the same phenomenon as you do: real inter- and transdisciplinary exchange and cooperation is seldom put into practice. This is not surprising given the robustness of the epistemic and methodological divide between the social and the natural sciences. And your example on the Haber-Bosch-process tips strikingly on the disparity between naturalists and common knowledge considering the materiality of socio-economic and political dynamics.

But there are basic similarities as well, still waiting to be explored for what you call "joint reflection and knowledge production." I think it is important to profile these similarities in more detail and more systematically before entering towards an inter- or transdisciplinary agenda. This might happen, as you said, very concretely by exploring such features within a local socio-ecological issue, such as, for instance, a transdisciplinary exploration on what might happen when rivers would flood not only far-reaching, but our own cities. Within such transdisciplinary, and, most of the time disruptively

installed real-laboratories, heterogeneous actors, humans, non-humans, technologies, and infrastructures are challenged to cooperate neatly (Bogusz and Reinhart 2017). To be prevented against such catastrophic moments, disaster control units today create scenarios and rehearse possible consequences. But I share your observation that non-scientific, for example, expert's expertise, more than often, is not taken into account. Once a natural or technical disaster has taken place, the different modes of knowing nature are set back into their social, organizational, cultural, or disciplinary containers. Sociologist Brian Wynne has shown the consequences of this backlash facing actual crises in his classical piece on "Sheepfarming after Chernobyl" (Wynne 1989). Wynne explored the importance of sheep farmer's reflexivities after the radioactive clouds had entered the Cumbrian Highlands in 1986. Due to their long experience in collaborating with the sheep's behavior within their nature, they became aware that there must have been more radioactivity than assumed by scientists and the local government. In a way, the sheep where "prepared" because of the Sellafield nuclear accidents in the 1950s and 1970s – to avoid radiation, they chose different paths, unusual and formerly unknown to the sheep farmers.

Considering these forms of experiential knowledge, anthropologists of nature distinguish between "prevention" and "preparedness" (Keck 2020). As scientific evidence suggests, the actual global sanitary crisis is a consequence of the Anthropocene (Di Marco et al. 2020). It gives a striking example on how around the world, as well as disciplinary, different forms of reflexivity and knowledge production are displayed to deal with the coronavirus. However, instead of awaiting the next global crisis, preparedness seems to be a much more reasonable, adequate orientation towards our respective modes of knowing nature and society than prevention (Bogusz and Keck 2020). But how to start? And where? I agree with your suggestion that we should focus on concrete public problems.

Through my naturalist's expedition-study, I got acquainted not only with the challenges marine biologists are facing, but also with their aptitude to address and problematize the public concern of ecological degradation impacted by humans (Bogusz 2019). They, as well as most naturalists working on biodiversity loss and climate change, do not only associate nature and society very concretely, but, more than often, stay at the crossing line between socially unequal and culturally heterogeneous associations while the political field calls for straightforward solutions. In my case, study on marine invertebrate taxonomy for instance, this endeavour was successful when co-laboration[1] was possible. Co-laboration might show a way beyond the problem of

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[1] "Co-laboration" departs from "Collaboration", following Niewöhner (2016, 10), in that it means working in a third knowledge space: "Collaboration usually rests on a shared goal or at least intention – a similar sense of being in the world perhaps. […] Co-laboration on the other hand

formally displayed, yet practically avoided, transdisciplinary knowledge integration.

Moritz: Wait, I do not understand. What then is the role of what you called "real-laboratory" before? Who creates it, what is happening there and how does the co-laborative approach contribute to it?

Tanja: In the social and political sciences, there is a broad discussion on the term real-laboratory, and it is defined in different ways, for instance, as "real-experiments" (Groß, Hoffmann-Riehm, and Krohn 2004) or "mode-2-science" (Nowotny, Scott, and Gibbons 2014). Generally, the term *real-laboratories* describes public gatherings of scientists, civil society, laypersons, and stakeholders around a given problem. In the field of ecological issues, the concept has gained special attention to resolve conflict of aims between, for instance, social and ecological sustainability. In these cases, real-laboratories are used to manage and monitor especially public critique against infra-structural innovation, such as wind power plants nearby residential areas, new transport systems, the conservation of lakes and rivers at the expense of local fishery practices (Bergmann et al. 2010), or green city planning (Engels and Walz 2018). Most of these studies are indeed very interesting and inspiring in their effort to integrate multiple actor's perspectives. However, this integration poses a huge problem when real-laboratories are driven by a mostly governmental approach. The governmental position, stemming from the political sciences, is seeking for problem-solving public participation and is, therefore, often lacking opportunities for the integration of citizens who do not have the cultural capital (Bourdieu 1980) that is tacitly required by such real-laboratories. This is a highly complex endeavour constantly repeated in the reports – how to reach out for and enact this cohort?

Science and Technology as well as Intersectional Studies have taught us that the definition of a public problem, an issue, is not only a very demanding practice (Crenshaw 2017; Marres 2007; Sismondo 2007). Moreover, as it represents a selection and classification (Bowker and Star 2000), it rules out other positionalities, other experiences, practices, devices, and knowledge, and therefore other possibilities of issue-making. While the governmental approach may be successful at the first glance, the real-laboratories I have in mind depart from these examples, firstly, in that they are explorative – the problem is not yet settled – secondly, in that they are based on social, cultural, and disciplinary inequalities – or what I call heterogeneities (Sennett 2012) – and, thirdly, in that they integrate material and non-human entities (Marres 2012). These heterogeneities are not only sectorial (for example, scientists work with stakeholders), disciplinary, or ontological (human/non-human),

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contains the concepts 'labour' and 'laboratory'. It is not about a joint opus as in cooperation, but about a shared process of labour. It is about conducting joint epistemic work, experimenting with formats […]. Co-laboration is a distinctly disciplinary project […] with the purpose of advancing anthropological knowledge production."

but always social as well. Those assumptions provide the dynamic, albeit uncertain ground for the co-laborative approach I am interested in.

I define co-laboration as a practice that explores such uncertainties collectively, processes social and experiential differences, and figures out participatory solutions to problems. As the works of classical pragmatist John Dewey have shown, "democratic experimentalism" – a situation we actually experience through the current global sanitary crisis – is an ongoing learning by doing, which is characterized through experiential differences that might lead nonetheless to consistent collective action. Within that practice, co-laboration describes a special feature and moment of participation, where the definition of a (public) problem is not yet completed. It is the moment where the real-laboratory still has to be settled, where its features, scope, and scale are not yet defined. Instead, it is open for public contribution. What can we learn from this practice for democracy? I believe that this temporary incompleteness is as necessary for scientific cultures as it is for democratic cultures because it allows for the integration of formerly unknown, as well as heterogeneous experiences, perspectives, and human as well as non-human actors. Many problems arise exactly because the definition of what a problem is has been settled by a small number of persons before any inter- or transdisciplinary alliances are created. But the social, cultural, economic, or disciplinary homogeneity of those having settled the issue, albeit mostly driven by fair purpose, systematically rules out the richness and diversity of experiential knowledge – as described by Wynne and others (Collins and Evans 2002). It consolidates social inequalities and flattens experiential as well as epistemic complexity. I think this is true for non-western knowledge (Go 2016) as well as for sociocultural alterities in general. I could span this further, but now I am too curious to hear more about what you just mentioned at the end – could you give examples, from your own research or other observations, of where exactly you think social-scientific and qualitative reflexivity might be useful to integrate those different modes of knowledge and experience?

Moritz: I have to say that for me our dialog is also a crash course in social science, which I really enjoy. I have not heard about the distinction between prevention and preparedness before, so I looked it up and was struck by the very convincing argument that in order to prepare for the worst case you have to take the perspective also of the non-human environment – a perspective which is of course familiar to me, but now it is embedded into a different context, namely that of a problem which is not defined by myself as [a] natural scientist. The latter is actually a consequence in the transdisciplinary approach, which is worth discussing. Instead of following my own research objectives, which usually leads to further specialization and buildup of scientific capital, I have to give away control to a collective endeavor. Instead of picking up a problem for my own research, the problem has to pick me. In such a context I would consider myself rather as a citizen with a scientific

background and not as a scientist. So, I will come up with an idea of a potential real-laboratory that concerns me as a citizen, more precisely as an inhabitant of the city of Bremen. Let me explain.

Current models of climate change simulate different scenarios depending on the ability of humans to reduce greenhouse gas emission. We are still on a trajectory close to the worst-case scenario (RCP8.5, Schwalm, Glendon, and Duffy 2020), and so far, there is no reason to assume that this will change. Much of the research is now related to the consequences of climate warming and how the crisis unfolds in the most climate sensitive regions of the earth – for example, the sea ice loss[2] and permafrost thawing (Biskaborn et al. 2019) in polar regions. The media further report on more extreme weather events – many of them still far away – while in northern Germany, especially in Bremen, some may welcome a climate with less rain. Still, I find it interesting that the climate crisis is seldom anticipated on a local level. The region around Bremen, for example, has a lowland topography only slightly above sea-level. The RCP8.5 climate scenario predicts a sea-level rise of already 1 meter before 2100 with a continuing accelerated rise thereafter (Church et al. 2013). How are inhabitants of Bremen prepared for this development? Further projections predict increases in extreme weather (heat waves and heavy rainfall), river flooding, and changes in overall precipitation. All this calls for a collection of different modes of knowledge including not only experts in climate sciences, hydraulic engineering, and water management but also the social sciences and society. A joint assessment of climate developments and predictions; possible responses and preparations; anticipated consequences for the local community, economy, social life, agriculture, and ecosystems have to be co-elaborated. So far, this knowledge is only collected within the authorities. In 2018, the government of Bremen published a climate adaptation strategy (Klimaanpassungsstrategie Bremen 2018), which encompasses a framework for actions, targeting, however, primarily the actors of public authorities. I wonder if that is the kind of real-laboratory that you have in mind?

3. How to Get Immersed in Possible "Real-Laboratories"

Tanja: Spontaneously I would say no. Yet, I am not an expert of the intriguing Bremen case, but I see your point and I will try to develop further on this in a minute. As you said before, exchanges like ours here could open disciplinary borders and shake our respective scholarly-driven positionalities productively. So, for me, the real-laboratory starts with interactions like these. It starts when people, things, and infrastructures come into a dialogue on the

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[2] See http://www.meereisportal.de/en/ [Accessed September 5, 2020]).

basis of differential positionalities. We have to struggle to find a common language precisely because we do not have too much in common. We have to create third knowledge spaces not only between our respective disciplines, but also within concerned publics. The Danish anthropologist Kirsten Hastrup (2014, 140) took this term from the historian of science David Turnbull, who defined it as an "interactive, contingent assemblage of space and knowledge, sustained and created by social labor." In her ERC-granted global research project Waterworlds, Hastrup and her team explored such third knowledge spaces at coastal zones from the arctic to the African coast, where the rising sea as a consequence of ice melting and global warming meets different approaches, positionalities, and knowledges on hydro-social enactments (Hastrup and Hastrup 2015). Instead of imposing a monitoring concept from the outside – especially from the global north – the project was about learning from different ontologies in human-environmental relations through a multi-sited ethnography. By merging the local with the anthropological knowledge, a third knowledge space was generated, ready for more comparative exploration and assessment on a global scale.

Such endeavors imply that we must make our very specific experiences, our very specialized modes of apprehending nature and society understandable for each other. It seems banal to say this, but efforts like these are certainly the basis for democratic practices. To do this means indeed to give away control. As we feel so comfortable in our disciplinary containers, to give up the certainties we carry with them, that is, to deliberately give up our positionalities, creates an experimental moment.

I like when you said that instead of picking up a problem for your own research, the problem has to pick you. In general interdisciplinary research, such approaches are often understood as too vague or, from a fairly masculine perspective, as too passive. The display of achievement and certainty is an important part of the modern narrative that has become part of our scientific *déformation professionnelle* (professional deformation). However, every serious researcher knows that research is an up and down between trial and error, between failure and success. The history books are full of examples on how scientific discoveries were made just by chance. And there is no doubt that these "chances" did not produce bad science – quite the opposite! It is a form of immersion into the unknown – maybe a bit like diving. You cannot predict exactly what you will see in a minute. And this makes it so fascinating, right?

Ethnographers are acquainted with that, too. British cultural anthropologist Marilyn Strathern said about immersement – as integral part of ethnographic practices – that "[immersement] yields precisely the facility and thus a method for 'finding' the unlooked for" (Strathern 1999, 3). So, I think we do not have to give up research while entering a real-laboratory. Instead, such real-laboratories might invite learning to enact both positionalities –

scientific as well as civic, or human, if you prefer. They provide opportunities as temporary devices for being picked by problems defined by collectives and entities not anticipated by us. I think if the social and natural sciences had more experience in assisting in the creation of such devices, experience in "co-elaboration" as you said – great expression, by the way! – we were better prepared for the many human-environmental crises we are actually facing.

So, let me come back to your example of the sea-level rise in Bremen and the question of prevention vs. preparedness. Indeed, the perspective of the non-human-environment is crucial, especially for us social scientists. Sadly, the actual data on the ice loss in the Polar region are too evident and too basic for the fate of the globe. Still, the idea of real-laboratories I just developed differs from strategies of adaption because adaption means acting when the problem is already settled. In my ears it sounds like prevention instead of preparedness. It makes me think about my observation of a taxonomist marine biodiversity expedition at the coastal zone of Papua New Guinea in 2012. What mattered most for them was to gain a most comprehensive assessment of species to provide foundational knowledge for biodiversity monitoring in this rather understudied area. But they were confronted with public critique because the people where not integrated in the process of local hydro-social problematization. This was not the fault of the taxonomists, however, as they had to grapple with many issues regarding their disciplinary positionality. From this experience, I developed the idea of an approach where different concerns can be explored from the outset by social scientists before natural expeditions take place, for instance. Another example for preparedness yet to be further developed could be a slight modification of the Bremen case.

Living now in the coronavirus pandemic, we might feel that prevention is better than nothing. And considering the concrete danger of sea-level rise in Bremen or Hamburg for instance, it is hard to argue that the problem is not yet in the world, is not yet settled in a way. But maybe the question of what can be deduced from it as a (public) problem (Dewey 1954) becomes more crucial here. So, what could be the character of a real-laboratory where the general problem of sea-level rise is already settled? First of all, I think the decision on how to face the problem should not be restricted to public authorities. Problematization is thus part of a process that could lead from prevention towards preparedness. It should be organized more democratically, through "co-elaboration" of "matters of concern" (Latour 2004a), of the multiple bits and pieces that constitute the expected effects of the problem. What kinds of effects are expected? For which parts of nature and of society? Who is concerned by which consequences if planned action will be implemented in the city, in the region? Which issues can be figured out? I am convinced that public authorities give their best to take most of this into account, but usually the public is only mentioned, as you said before, when it comes to information.

So maybe for the Bremen-case a good starting point for a real-laboratory where prospective co-elaboration should be at the baseline of any action would be to ask two questions: What kinds of issues will arise together with the sea? And what is the role of the public in facing these issues; who is the public? What kinds of experience, knowledge, and expertise may be situated within the public? What about the fish and their fellow marine residents who change their habits as being part of the global spectators (and, therefore condemned to be a sort of public) of human degradation? What about the farmer who observes, on an everyday basis, the transformation of the animals, the soil, and the environment? What about the shopkeeper by the riverside who prepares his entry against possible flooding? What about the citizen-scientists, birdwatchers, shell collectors? How could the public authorities, along with the social, natural, and engineering sciences, valuate and integrate these modes of transdisciplinary reflexivities? And how could such reflexivities be transformed, from prevention to preparedness?

I think the reflexive shift is neatly linked to different time-horizons. In a published announcement of the city of Hamburg, I found – considering the question of expertise-mobilization of preventive action on climate change – a very interesting passage stressing that the envisioned coping-strategy is based on a "middle-range-level." And then it is added, "too early action on adaptation would bind resources unnecessarily, taking action too late risks of costs and damage" (Aktionsplan City of Hamburg 2013, 3). To me, this describes, on the one hand, a realistic organizational and logistic challenge. On the other hand, it testifies a tendency towards prevention instead of preparation. Preparation means to create a scenario as if the sea-level rise has already taken place, and to design and experiment with the most possible practical consequences, might they be dramatic or creative, in advance. It cannot be too early to start with this – as the sea is yet constantly rising (Boetius 2020). Do you agree?

4. Part IV: Outlook – Towards Third Knowledge Spaces between Nature and Society

Moritz: Indeed, the sea-level has already risen by 20 centimeters. But let me go back to our deviating view regarding prevention vs. preparedness for the Bremen case. I do not think that the problem of how the climate crisis plays out on a local level has already been determined in a way that allows us to define adaptation strategies. Maybe the climate models are too convincing in depicting a detailed future scenario, thereby blocking the view on the many uncertainties: For example, does the sea-level rise threaten only the dikes and dams, or will the salinization of groundwater reservoirs become the main problem, or will there possibly be a co-occurrence of North Sea storm surges

with increased precipitation and river flooding from the hinterland? Maybe the Frisian barrier islands and the Wadden Sea will be strongly reshaped or even disappear completely due to erosion. There are tons of unknowns and these are just the more physical issues concerning changes of the hydro-sphere, not to mention the ecological, social, and economic consequences. It is interesting to see that you have had the impression of a rather settled problem. Perhaps we can take a closer look.

I hypothesize that there is a tendency by (natural) scientists to intuitively address authorities when presenting results on environmental issues to a non-scientific audience. This makes sense as many calls for funding are initiated by large institutions and government agencies. In case of human-environmental problems, the intention is to pile up arguments that ultimately should lead to preventive action in a top-down manner. For a solid justification and argumentative reinforcement, scientific findings are readily interpreted (and enter society) as fixed truths. This, by the way, combines well with tendency to display achievement and certainty within the science community, as you described above. As such, the scientific findings remain object of a true/false-coded discussion in the public (Luhmann 1990) and can easily be attacked by, for example, climate change deniers, because there is always doubt and no end in seeking the truth. This could be avoided if the scientific findings are assessed rather by a risk/no-risk code that leaves room for the various unknowns and also connects better to our everyday life. This kind of evaluation perceives nature as a power and not as a protected zone, which makes communication with the political sphere easier. Finally, if the process of risk assessment includes the public and the various sources of knowledge, a state of preparedness may develop.

I think that the current pandemic crisis offers a few good examples for such open assessment of scientific findings. During the pandemic, several podcasts in Germany discussed the knowns and unknowns of the coronavirus. Interestingly, the daily changes of knowledge and truths about the virus did not undermine the scientific integrity but rather strengthened the trust in the collective scientific endeavor to deal with the unknown (Volk 2020). Some public opinion polls displayed a changing view on science itself and a growing awareness about how science approaches the unknown, and thus a better understanding of the informative value of study results (Wissen-schaftsbarometer Corona Spezial 2020). Even some experiences of trial and error have been made collectively, for example, that face masks were useless in the beginning but are now considered essential. I assume that the pandemic provides us with many more lessons from which we can learn how to prepare for other impending human-environment crises.

I like how you formulated the questions for a Bremen real-laboratory: "What kinds of issues will arise together with the sea? And what is the role of the public in facing these issues; who is the public?" These questions are so

basic that they include everyone who has "issues with the sea," and actually they invite the sea itself. You strip off any preconceived and professional classification of the problem. On the other hand, it is still difficult for me to imagine how such a real-laboratory is set up on a larger scale (not just the two of us), how it conducts research and how it deals with the findings. Although the problem should not be defined in advance, any such co-laboration needs structure or at least a sequence. Furthermore, the question remains whether and how the knowledge can be transferred to non-participants. My pessimistic side still has a gnawing concern that there is no pathway for the gained knowledge to enter society more widely. In the course of our dialogue, I was glancing through many of the interesting works of, for example Latour, Beck, and Luhmann (there was no time to really study them) and found it very rich and intriguing for shaping my view on society and nature. At the same time, I felt disappointment that even such valuable thoughts seem to resonate only in the world of (social) science, occasionally making it into the feuilleton. Why is it that society cannot make use of much of this knowledge to improve the life of humans and non-humans? Why is it that there is not a single experimental trial in the more than 190 nations of the earth to install, for example, a "parliament of things" (Latour 2004b)? These questions are naïve, but in a time of mounting human-environmental crises they become everyday companions. I think that all the knowledge we collect will not free us from the burden of experimenting and acting into the unknown, not only scientifically, but also personally and politically. And finally, all the non-humans around us will not stop talking, and if we listen, there might be some guidance.

Tanja: I think the answer to your questions is quite simple: These experiments have not been done because academia is not flexible enough to act into the unknown. But there is hope. Let us see what we have discussed so far and what might be concluded from our discussion.

We started our dialogue by exploring differences and commonalities between our respective disciplines and research approaches. I hope you agree if we stress the commonalities. Both of us where driven by distancing ourselves from societal common-sense knowledge through the – even bodily – immersion into unknown worlds and habitats, might they be social or natural. We agreed that this kind of immersion enacted quite particular forms of reflexivities. To explain your profession, you used the metaphor of an accountant, which can be compared to statistical accounts and correlations as well as ethnographic fieldnotes on social structures and activities. Furthermore, on the epistemological level, we even found similarities in the way of apprehending nature and society as, for instance, through systemic or holistic approaches that include, more than often, micro-meso-macro scales as well as historical (diachronic) and actual (synchronic) developments.

Despite these commonalities and despite the importance for a more systematic integration of the natural and the social sciences, we witness notorious obstacles to sharing the reflexivities linked to our respective disciplines and to translating them into what you called "co-elaborative" positionalities. Given the institutionalized separation between the spheres of the natural and the social sciences, as well as between the spheres of science and the public, it becomes apparent, you said, that there is no joint reflection and knowledge production by science and society. As a consequence, you proposed "a joint practical engagement on a local level, where experiences can be shared, and knowledge production is a genuine cooperative effort." I suggested to link this idea to what I call "sociological experimentalism," which is based on the idea that co-(e)laboration needs a democratic mode of problematization that is open to non-academic knowledge. You agreed by adding the importance of integrating the material foundations of societal development, as your striking example of the Haber-Bosch-process showed. However, we kept wondering how to overcome the politics of "alliances" where disciplines match up for joint funding but follow distinctive agendas that usually do not substantially reward the capacity to transfer and integrate different reflexivities as a central feature for scientific progress.

In the third and last part of our dialogue we discussed options for the creation of third knowledge spaces and co-elaboration that might give concrete opportunities to explore such transdisciplinary reflexivities. Ideally, they should be driven not by an already settled problem, but by a problem that "picks us." We found that the aforementioned a-professional mode of problematization is thus central in the creation of such spaces, which also allows for a shift from prevention towards preparedness. We took this approach from social anthropology, as well as from the issue of climate change and the rising sea that will affect not only far-reaching countries, but even German cities such as Bremen and Hamburg. Posing different questions might lead the way. I was asking what kinds of issues will arise together with the sea and what kinds of publics are concerned. You suggested that, instead of the true/false-code granted in the natural sciences, the code risk/no risk might not only better describe what is at stake, but also integrate – by the code itself – other experts, citizens, and the public as usually envisioned by politics and stakeholders. It gives way for a process of risk assessment that includes the public and its various sources of knowledge long before the problem has become an everyday challenge, as the corona pandemic now. From there, we found, a state of preparedness may develop. As a consequence, we argued for a dissolution of disciplinary positionalities as a trade-off for better co-elaboration, as well as for the need for issue-exploration as a first step towards a more symmetrical oriented public problematization.

As the sanitary and the ecological crisis actually accumulate on a global and transnational level, we can observe several political movements,

particular organizations, and sustainable graduate teaching, training, and research-institutions and funding agencies that have set up transdisciplinary ideas and programs addressing these burning issues. This is an important momentum for the creation of third knowledge spaces between nature and society. As the corona-pandemic shows, society as well as governance, are quite capable to change, transform, and adapt everyday practices and routines when necessary. This is a good indicator that societies can do even more: that they are also theoretically capable of transforming from prevention to preparedness. World societies in general, as sorts of real-laboratories within this sanitary crisis, have not only largely learned to act into the unknown, but they have also learned that this experimental shift does not mean that experiencing the unknown makes intelligent action impossible – quite the contrary. I think this is an important lesson and I hope there will be enough space, once this pandemic has been resolved, to build upon this transdisciplinary experience.

To conclude our dialogue with an optimistic eye, I think that the time is right to reload co-elaborative positionalities within and beyond academia. The abundance of more and more issue-centered inter- and transdisciplinary research is a good and fresh indicator for this, as, for instance the recent call for "marine social sciences" (McKinley, Acott, and Yates 2020). But despite the many efforts on inter- and transdisciplinary co-laboration, there is still a lot of epistemic, as well as methodological, work to do. With our interdisciplinary dialogue on the relation between nature and society, where differential positionalities have been displayed, compared, and streamlined for shared goals, we introduced a performative impulse for such approaches and programs. My hope is that facing the dramatic ecological situation of our time, society and the public will fuel the sensitivity and urgency for the practical purposes of third knowledge spaces that are smart enough to learn from, articulate, and handle the problems of the Anthropocene in the near future.

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