Chapter 3: Theories of society-nature relations

Overview

In this chapter, you will learn about sociological theories that are used for studying the variability of and changes in society-nature relations. You will learn that dialectical approaches, which do not contrast nature and humans/society in a dualistic way, but do distinguish them dichotomously, are criticised by relational theories in which this distinction is itself an object of study and is held responsible for ecological problems. Here, too, it becomes clear that "knowledge about nature" cannot simply be taken for granted in environmental sociology.

When someone says "I'm in a relationship", we know that the person is talking about a (still) unresolved relationship that probably does not conform to the institutionally standardised model of a marital partnership, may be temporary and is "unusual" in one way or another. This relationship will leave its mark on the future lives of those involved, it can also affect their social environments and goes beyond a purely platonic exchange of ideas. Thus, significant repercussions, side effects and interactions are to be expected. We recommend keeping this relational image with its successively unfolding consequences in mind for the following considerations on the messy society-nature relations. It can help to think about the unresolved connections and exchange relationships that not only lie outside social norms, but that even go beyond the way in which these norms can be thought and spoken about.

Constructions of nature provide the symbolic-discursive, one could also say cultural and implicitly normative basis of our *relations* with nature (→ chap. 2 on the social construction of nature). At the conclusion of our discussion on these social constructions of nature, we therefore stated that they always imply social instructions for action and should therefore be regarded as proto- or "knowledge-political" concepts (Kropp 2002): "Knowledge-political" means that the underlying knowledge is accompanied by political consequences, i.e., that supposedly neutral knowledge about nature itself has political effects. It favours certain approaches to evaluation and action, legitimises the domination of nature and classifies everything that is subordinated to human purposes as "natural". References to "naturalness" or "the nature of things" project and justify a social order that involves, for example, unequal options related to identity and agency for humans and animals, men and women, urban and rural areas or people in the Global North and Global South. As we summarised, constructions of nature are part of social power relations, the implications of which extend into everyday life and working environments. Our current relations to nature and many practical forms of nature appropriation are proving to be an unsustainable exploitation and utilisation of resources, ecosystem services, fertility, etc. and are producing few winners and many losers (Bonneuil & Fressoz 2016; Haraway 2016; Robbins 2019).

Representatives of relational sociological approaches, on the other hand, are calling for the rejection of modern industrial constructions of nature and the un-

sustainable society-nature relations legitimised by it, in order to achieve climate-friendly, environmentally and socially just development. Relational approaches problematise the underlying knowledge and bring to the fore the diverse and unexplained forms of interweaving, interaction and mixing (hybridisation) that were addressed with the image of the "relationship". From their perspective, relationships with nature appear as relational, diverse and ambiguous, embedded in the respective contexts of their emergence, interpretation and actualisation. Thus, relationships with domestic animals differ from those with livestock, and different relationships with nature are typically found in conventional and organic farming, based on their mutually exclusive worldviews. These examples are a reminder that there are disputes about our relationships with nature and the "right" or "legitimate" way of dealing with the non-human world, because every reference to nature is framed by socio-cultural worldviews and overarching, moralised patterns of interpretation.

If one assumes the plurality and hybridity of society-nature relations, which are therefore variable and evolve in the context of cultural as well as scientific/technical possibilities, it follows that society-nature relations can in principle be shaped. The idea that there is only one possible relationship that is predetermined by "nature" or the natural sciences then becomes recognisable as a social fiction that imposes order. Just as marriage describes a possible institutionally fixed relationship between two people, whereby the diversity of other relationship possibilities is socially limited, the industrial society's relationship to nature (which is oriented towards the instrumental use of nature) has arisen historically, is institutionally anchored and marginalises possible alternatives. However, the consequences of the environmental destruction legitimised by this, such as global warming and species extinction, are increasingly causing it to be called into question. The critique is often formulated from the perspective of the theories of knowledge and science, since the dispute about the "right" relationship with nature is essentially about questioning the underlying epistemology and its knowledge practices (Haraway 2013; Latour 2005).

In this chapter, we look at various theories about our relationship with nature. They are all based on the assumption that biophysical conditions and social practices, interpretations and ways of thinking are interwoven. While dialectical approaches continue to distinguish, at least analytically, between the natural and social spheres, relational theories abandon this distinction, instead considering them as empirically endpoints resulting from imposed practices of purification. In the following, we first present dialectical and then relational approaches in order to explore the theoretical possibilities and thus also make alternative relationships with nature conceivable. To do so, we will first discuss the concept of "nature relations" in general and its inherited anchoring in dualistic thought. Then, in section 2, we discuss how this dualistic thinking is dealt with in dialectical approaches, and in section 3, we discuss the conditions for conceptualising nature relations beyond the dichotomous distinction between nature and society in relational approaches.

1. Nature relations – a look at the modern dualistic perspective on the relationships between human and non-human agents

The sociological concept of society-nature relations (in the plural) first addresses a variety of human-society-nature relations that involve not only social metabolism with nature but also other experiences and relationships with nature. They are expressed, for example, in agricultural nature relations such as livestock farming, in forms of urban development and the handling of green infrastructures, as well as in interactions with domestic animals, agricultural crops, ornamental plants, bacteria, viruses, one's own body, and so on. When talking about our relationship with nature (in the singular), the emphasis is not on the diversity of the connections between human and non-human living beings and biophysical conditions such as raw materials, sun, water, energy, etc., but on the dominant characterisation of human-society-nature relations through prevailing patterns of thought, institutional and legal norms and culturally entrenched practices. This dominant characterisation consists first and foremost of an instrumental and objectifying relationship with nature rooted in the idea of human exemptionalism, that is the belief that humans are exempt from ecological and natural constraints. Within this framework, "nature" is conceptualised in Western thought as an object of social action. The focus is on how nature can be cultivated and utilised, from the Old Testament *dominium terrae* (Genesis 1:28: "Be fruitful and multiply, and replenish the earth and subdue it, and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.") to the Enlightenment writings of the English philosopher and jurist Francis Bacon (1561–1626), who asked about the possibilities of using knowledge to make nature subservient and suggested cataloguing it for this purpose, all the way through to current talk about nature as an "ecosystem service", gene pool or construction kit.

The prerequisite for this instrumental way of thinking about utilisation and subjugation is that nature is objectified as "the other": The opposition between nature and society, nature and technology, nature and art is the long-term result of social developments that began in Ancient Greece. Since the Enlightenment at the latest, this way of thinking is no longer conceptually "available", i.e., it can no longer be questioned because it is considered the only possible perspective. This view of nature has since had a "knowledge-political" effect in the form of modern epistemology (epistemology). Nature is thereby fundamentally opposed to the human and the social, is conceptually and epistemologically the other, the "non-identical", the self-acting (*physis*) with peculiar movements and laws that are fundamentally distinct from culture and technology. The strict distancing from this naturalness is a prerequisite for becoming human and in particular for the characteristic that is assumed to be unique to *homo sapiens*: "reason". In this way of thinking, the "human" realises their special position (Plessner 2019) when they learn to set themselves apart in order to mutate into a rational being, to discover and use nature as a counterpart, according to the corresponding basic features of Western philosophy (Böhme 1983). This opposition or contrast leads

to the "inescapable compulsion toward the social control of nature" (Horkheimer & Adorno 2002 [1947]: 27) and comes at a price:

> "Humanity had to inflict terrible injuries on itself before the self—the identical, purpose-directed, masculine character of human beings—was created, and something of this process is repeated in every childhood." (Horkheimer & Adorno 2002 [1947]: 26)

In the "Dialectic of Enlightenment", which was first published in 1947 in the face of the terrible atrocities committed by the Nazi regime, Max Horkheimer and Theodor W. Adorno (2002 [1947]) focus on the unintended repercussions of becoming human through the demarcation and objectification of nature: In this central work of critical theory, they shed light on how the mindset of instrumental rationality, which is deeply rooted in civilisation and focused on utilisation, led to the total appropriation of the object world and the cruel subjugation, exploitation and destruction of "other" people as well. This is where Donna Haraway comes in. With reference to the work of Maria Puig de la Bellacasa (2010), she discusses the "banality of evil" of the Nazi war criminal Adolf Eichmann, as analysed by Hannah Arendt, and remarks: "There was no way the world could become for Eichmann and his heirs—us?—a "*matter of care*". The result was active participation in genocide" (Haraway 2016: 36).

Only the differentiation and contrast of nature and society—or the context-specific contrast of nature versus culture, technology, art, people, and social practices—makes it possible to appropriate nature as an (external) "environment" and object. Nature, which humans are fundamentally a part of, appears from this perspective as a space or inventory that stands in opposition to human societies and which humans can appropriate, subjugate and use to satisfy their needs. In this dualistic epistemology, "rational human beings" and their works—namely culture, technology and society—are characterised precisely through their differentiation from a "nature" subject to laws and instincts, which is to be discovered, conquered, used, admired, subjugated and exploited. Any reflection on the relatedness to nature or the relationship to nature (in the singular) is consequently caught in a juxtaposition.

This epistemological dualism was widespread in sociology and can even be found in environmental sociology. In a reflected form, it also shapes current approaches for analysing society-nature relations and the related environmental problems, as we will explain in the first section of this chapter using the concepts of "societal relations to nature" (Becker & Jahn 2006; Becker et al. 2011) and "socio-ecological regimes" (Fischer-Kowalski 2011). However, these approaches no longer assume a fundamental dualism, but rather a dichotomy with two different sides. This is based on the assumption of an interactive interconnectedness with repercussions and interdependencies and the resulting dual character of society's relationships with nature (Brand 2014: 13). This dual character arises from the fact that practices of nature use—from food production to tourism—are always simultaneously shaped by cultural techniques, patterns of interpretation and institutional definitions on the one hand, and biophysical conditions on the other.

Due to this dual character, there are historically and culturally specific forms of interwoven material utilisation and cultural meaning creation: No meal is the sole result of *only* biophysical necessities and health requirements or *only* the creation of cultural meaning and socio-economic considerations. Rather, every eating style, like all other natural relations, inevitably has this interactive dual character. In the following illustration, we depict the area of interaction in society-nature relations as a grey overlapping area between the two spheres of nature and society, which are conceived as dichotomous. In it, biophysical structuring of natural classification is mixed with symbolic-discursive social determination. The biophysical structuring is theoretically attributed to material properties and their interaction. The symbolic-discursive structuring is explained on the basis of context-specific, culturally determined constructions of nature as well as the linguistic, respectively symbolic and discursive conditions of the relationship with nature and its perception (→ chap. 2 on the social construction of nature).

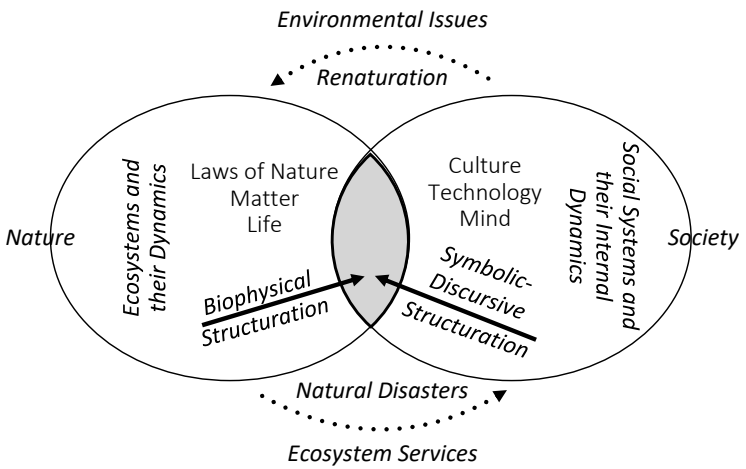

Figure 3: Interaction between society-nature relations in dialectical approaches; source: own illustration

Dialectical concepts are thus not strictly dualistic, but dichotomously structured. In them, the biophysical and energetic dynamics of ecosystems determine the sphere of nature beyond the area of interaction. From society's perspective, these are perceived as the "laws of nature" as well as the characteristics and peculiarities of matter and life, and are the subject of modern natural sciences. With regard to the social side, the conceptual starting point is the inherent laws of social systems, the social framework for interpretation and action provided by established institutions, influential discourses on the essence of nature and politico-economic power relations, which are reflected in cultural, technical and intellectual products and shape social practices related to how people deal with natural conditions. The investigation of this social side is the task of the humanities and social sciences. In dialectical concepts, the interactive mediation context is typically illuminated from two directions (shown as dotted lines in Figure 3). The first direction shows

the effects of society on nature – for example, through creating environmental problems (e.g., pollution) and solving environmental problems (e.g., renaturation or rewilding). The second direction shows the effects of nature on society – for example, in the form of socially relevant natural disasters, but above all as a source of ecosystem services for societies, such as food production and energy generation. In this context nature relations are primarily viewed from a functional perspective, in both directions. In contrast to relational perspectives, emotional or practical relationships play only a subordinate role beyond the dichotomously conceived interactions and the basic existential experiences of life (giving), ageing, illness and death. The insight into how much both natural disasters and social upheavals vary with natural-cultural conditions also comes rather short (cf. on this Beck & Kropp 2007).

Due to their functional orientation, dichotomous approaches are dominated by investigations into symbolic-discursive structuring and biophysical effects and repercussions, and how they are perceived and evaluated. Often a "purified" epistemological realism creeps back in with regard to the biophysical causes and effects, and a social constructivist view with regard to the symbolic-discursive structuring (→ chap. 1 on these epistemological perspectives). On their own, both perspectives are one-sided and based on the Cartesian dualism of the fundamental distinction between material things (*res extensa*) and mental phenomena (*res cogitans*). One criticism of epistemological dualism with regard to nature relations is that even in the natural sciences, findings are produced in socially determined cultures of knowledge and are thus semantically and discursively shaped (Knorr-Cetina 2013). Moreover, mental and cultural ideas do not arise independently of the biophysical forces that govern their development (Latour 1993). As we will see, Bruno Latour took up precisely this problematic separation into natural entities on the one hand and cultural or social phenomena on the other as a "modern constitution", which he said is responsible for the careless proliferation and interconnectedness of risky hybrid creations such as industrial agriculture, high-performance cows, nuclear energy, etc. (see section 3 of this chapter).

Bruno Latour and other representatives of relational approaches view climate change and species extinction—in other words, the deadly nature relations of the present—as a product of the far-reaching dualistic distinction between nature and society. From their point of view, it is precisely this wrong way of producing knowledge that leads to the ecological problems. If it were not assumed that (male) humans hold a special position and that their intellectual knowledge and cultural and technical abilities predominate the natural world, then, according to the ("knowledge-political") argument, human societies would appear as integrated components of ecological contexts that grow or die within those contexts and are therefore exposed to the diverse restrictions and repercussions of mutual relationships. The modern perspective of appropriation, however, with its knowledge practices, lifts *homo sapiens* out of their natural embeddedness in order to make this species the consequence-blind creator of new worlds according to its needs (instrumental exploitation).

In this epistemology, which has coagulated into our modern self-image, the world appears as a storehouse and humanity is legitimised to subjugate the cosmos and to use and abuse all resources and living beings as means for human ends. The resulting knowledge practices lead to a remodelling of the "environment", which is conceived of as the opposite of the social sphere. Within the framework of this view, according to the critique, the dualistically thinking, industrialised and modern subjects overlook the immense relational complexity of which they are a part (together with all other earthly beings and elements), and jeopardise the collective conditions of survival with their particular projects and one-sided perspectives.

In the following two sections, we first present dialectical-dichotomous concepts about society-nature relations and then relational concepts. But even here it is important to understand that discourses on nature structure nature relations – even in the sciences. As epistemologically anchored knowledge practices, the culturally shaped (modern, instrumental, romantic) constructions of nature (→ chap. 2 on the social construction of nature) lead to specific nature relations from which "we modern people" (Latour 1993) can hardly think our way out of.

2. Dichotomous theories: Different dynamics, co-evolution and interaction in society-nature relations

Two approaches in German environmental sociology represent a critical take on dualistic approaches without completely abandoning the dichotomous perspective: the Frankfurt conceptual framework regarding "societal relations to nature" by authors such as Thomas Jahn, Peter Wehling, Egon Becker, Diana Hummel and others (cf. Becker & Jahn 2006) and the framework for environmental sociological analyses by Karl-Werner Brand (2014). Both approaches reflect the close interconnectedness of nature and society. In the search for solutions to deal with the ecological crisis, however, they and similar approaches maintain the view of nature and society as two independent areas with different internal dynamics, from whose relationships and interactions socio-ecological structures of interaction only emerge in a secondary step. They focus their theoretical spotlights on the investigation of these structures, which, as institutionally fortified framework conditions of society-nature relations, only permit specific socio-ecological regimes (or *socio-metabolic regimes*) despite the variety of possible relations.

2.1. The concept of societal relations to nature

Dialectical perspectives on society-nature relations generally assume a historical intensification of increasing interdependencies between nature and society (→ chap. 1, Figure 2), which they hold responsible for environmental problems. This diagnosis of progressive interaction with risky interrelationships and repercussions is supported by the increasing degree of colonisation, conceived as co-evolutionary, with which human actions (particularly accelerated global economic growth) penetrate, transform and threaten the non-human environment, sometimes intentionally, sometimes unintentionally (Fischer-Kowalski 2011). This

"colonisation" is recorded as an "ecological footprint" (among other things) as part of material flow analyses for different sectors and regions. Material flow analyses and investigations into the "human-ecological systems of metabolism" make a valuable contribution towards raising awareness about the consequences of humans' increasing use and exploitation of ecological resources. However, they are conceptually caught in the dilemma of reducing the complicated dual character of society-nature relations to energy and material flows and largely ignoring the co-production of socio-ecological configurations in appropriation and transformation relations, which are shaped by cultural and socio-economic factors. Rolf Sieferle, for example, described the various mediated society-nature relations as the biophysical metabolism of a growing world population that takes place in three phases that are determined by energy production (Sieferle et al. 2006). Stronger co-evolutionary perspectives focus on the "colonisation" of nature together with the hybrid beings that emerge from it—humans and their artefacts—and on the social organisations that influence natural systems as "socio-metabolic regimes" (Fischer-Kowalski 2011). One criticism of the concept of the progressive colonisation of nature is that nature relations are more multidimensional and shaped by more factors than simply social metabolism. Another criticism is that humans and society were never really outside of ecological (metabolic) relations at any point in time, even if the dualistic opposition behind the problematic interventions hides this fact through cognitive separation and alienation. Nevertheless, the reconstruction of a hardening, progressive penetration of both spheres is useful for environmental sociological analysis.

The perspective of the Frankfurt Institute for Social-Ecological Research (ISOE) is also dichotomously conceived, but is more strongly orientated towards mutually influenced interactions. This perspective deals with the co-evolutionary interweaving of natural and social structures and conditions for action (Becker & Jahn 2006). The genesis of socio-ecological configurations—whether we are talking about their manifestations in modern European cities or in slash-and-burn agriculture in the Brazilian rainforest—is also seen as the historical result of interaction between biophysical and symbolic-discursive structures. In addition, technical, cultural and economic contexts are included in detail. Environmental problems, or problematic socio-ecological constellations, come into view as unintended consequences of an interaction dynamic that has entered a state of crisis. According to this approach, the analytical penetration and processing of environmental problems must start with the practices responsible for their emergence, their institutional framework conditions, the culturally dominant orientations for action, and an understanding of socio-ecological interactions. What is needed, therefore, is a conceptual framework for society-nature relations.

ISOE has been continuously developing this kind of conceptual framework for the last three decades (Jahn & Wehling 1998; Becker & Jahn 2006; Becker et al. 2011). The German Federal Ministry of Education and Research adopted this approach for its socio-ecological research programme in 1999 and promotes wide-ranging, interdisciplinary and transdisciplinary research with the aim of initiating and supporting processes of social transformation that will contribute towards

sustainable development. The aim was and is to overcome the separate consideration of sustainability problems in a) environmental research (which is determined by the natural sciences), and b) in the interpretative approaches of the humanities and social sciences. To this end, problem-orientated knowledge about systems, orientations and decision-making is being developed to help societies deal with their sustainability needs. This explicitly three-dimensional production of knowledge aims to provide an interdisciplinary and transdisciplinary understanding of the intertwined connections and contexts of sustainability problems, to identify and evaluate options for action, and to develop decision-making knowledge for transformative steps (→ chap. 10 on transdisciplinarity). Social justice issues, political frameworks and gender relations are given appropriate consideration and raise awareness about the importance of social power and conflict structures when it comes to the transformation of society-nature relations. In this way, socio-ecological research reacts to the irresolvable connection between ecological problems and social, political and economic developments, and criticises the existing forms of knowledge production in disciplines that are isolated from one another.

Rather, it places the connections and contexts as the central reference point for theory formation and empirical research (Becker & Jahn 2006: 86) at the heart of the theory of society-nature relations or "social ecology". Based on the crisis-ridden relationships between humans, society and nature (as a triangular relationship) and their politicisation, it ties in with critical theory. Thus, the theory of society-nature relations criticises the general production of scientific knowledge as affirmative, problem-ridden and trapped in centuries-old ways of thinking and worldviews, which, due to science's internal boundaries, stands in the way of dealing with socio-ecological problems. However, in order for scientific knowledge to be related to practical social problems, Becker and Jahn argue (with reference to Donna Haraway) that it must be developed into 'situated knowledge' that is relevant to specific contexts and constellations of origin in the border area between the epistemic cultures of the natural and social sciences (Becker & Jahn 2006: 22). Only from the perspective of a new science of social ecology with an integrated focus on the variable forms and configuration possibilities will it be possible to criticise the drawing of boundaries as practices of differentiation, which is carried out by both the social sciences and the natural sciences, and to move beyond the dualisms and dichotomies (Becker & Jahn 2006: 118). The diverse, hybrid composition of the relationships between humans, society and nature then become accessible for analysis as concrete versions of an "ecological configuration" (ibid. 71). Hence, the conceptual framework of society-nature relations exists within the area of interaction between the natural and social spheres, and focuses on evolving, historically and epistemologically shaped relationship patterns (cf. Figure 3). Although the "basic distinction" between nature and society is critically deconstructed as a product of historical practices of differentiation and hierarchies of power, the conceptual framework of society-nature relations retains this as a categorical distinction in order to make logical operations of differentiation and connection conceivable (Becker et al. 2011: 87). To this end, the framework provides conceptual tools to systematically analyse and

compare the time- and culture-specific relationship patterns that human subjects, groups and societies create and regulate in interaction with material and energetic biophysical elements. The tools are used for everything from the analysis of global material and energy flows to the investigation of nature myths and images of society (Becker et al. 2011: 77).

The concept of regulation[5] plays a key role here. It expresses that the conceivable diversity of practically produced, biophysical and symbolic-discursive relationships (as a plurality of society-nature relations) varies empirically only within the narrow limits of established patterns or regimes, just as the institution of marriage limits the diversity of forms of human relationships. Regulatory patterns are the intertwined, dynamic governance relationships between different elements, structures and processes in patterns. They are influential in a wide range of areas, such as food, transport, construction and housing. The term "regulatory patterns" suggests that the elements and structures found in these areas, such as the forms of food supply and demand, typical meals, nutritional knowledge, the types of food companies, technologies and conflicts, as well as the relevant legislation, should not be viewed as isolated phenomena, but rather as an overall configuration. It is emphasised that regulatory patterns are hybrid, i.e., they always have social and material dimensions. Moreover, the regulation of these relationship patterns, which is crucial for the further development and future viability of society, can also be shaped – but not on the basis of just one element, one process or one structure.

These enforced relationship patterns primarily regulate fundamental society-nature relations that serve the indispensable fulfilment of vital basic needs such as food, land use, work and production, housing, reproduction and mobility. They differ globally and in the respective fields of action and are characterised by problematic inequality. The basic nature relations are regulated at all levels of society, so that they can be continued across generations. Due to this general regulation, social groups do not all reinvent their forms of agriculture, mobility or energy supply, but instead shape them according to context-specific regulatory patterns and depending on social norms and power structures (Becker et al. 2011: 81). The theory of society-nature relations does not assume that governments or individual organisations or actors regulate society-nature relations – even if only in one area. Rather, regulation is seen as an overarching phenomenon that only emerges from the context of different strategies. Hummel and Kluge speak of socio-ecological regulations primarily in relation to the secondary problems that arise from technically, politically and economically closely interlinked constellations, which as regulatory problems require ongoing attention (Hummel & Kluge 2006: 251).

The concept of societal relations to nature can be used to examine the historically different forms of relationships that exist both in relation to the external and internal nature of human beings in the various fields of action. This examination takes place at different levels: At the micro level of the fulfilment of individual needs, regulatory patterns are expressed in social norms, culturally specific

5 Regulation is a control theory concept that was developed in political-economic analyses.

practices and social role patterns. At the meso level of social organisations and institutions, the socio-technical supply systems and technostructures (→ chap. 9 on infrastructure systems) influence the manner in which needs are fulfilled, including the unequal distribution and availability of essential goods. At the macro level of (inter)national, but also regional structures, the regulatory patterns of established production, property and gender relations are stabilised as "dispositives" for the fulfilment of needs. With reference to Michel Foucault, the term "dispositive" describes the interconnectedness of the ideas and preliminary decisions embedded in regulatory patterns as an overall framework that determines the possible practices and ways of thinking. The regulatory patterns and dispositives that evolved historically and are institutionally anchored at the macro level influence the scope for regulating society-nature relations at the meso and micro levels and thus limit the possible options. According to the concept of societal relations to nature, approaches for changing regulatory patterns either temporally, spatially or socio-culturally are seen as socio-ecological transformations. They can hardly be intentionally initiated at the lower levels without a corresponding change of the regulatory patterns above. Nor can they be ordered from above as long as socio-ecological practice is regulated by higher-level dispositives. Conceptually, however, unsuccessful regulation is conceivable, which manifests itself in risks, ecological problems and socio-ecological injustice and is deliberately criticised normatively in this approach.

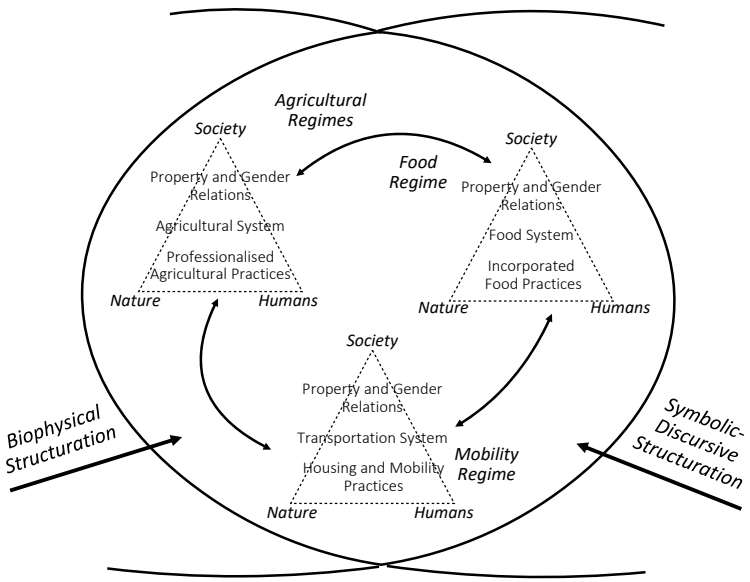

Figure 4: Society-nature relations as socio-ecological regulatory patterns or regimes; source: own illustration

In this figure, we have tried to illustrate how regulatory patterns in different fields of action, in this case food, agriculture and mobility, are a) interconnected, b)

resemble each other, especially at the macro level, c) are co-defined by specific infrastructure systems at the meso level, and d) give rise to typical practices at the micro level. According to the concept of societal relations to nature, these regulatory structures receive special attention as mediators of biophysical and symbolic-discursive effects. In them, the prior dichotomous distinction between nature and the social is illuminated as a more network-like pattern (Becker et al. 2011: 92).

2.2. Nature relations and the socio-ecological regime

Karl-Werner Brand's framework model for environmental sociological analyses is based on the dual character of society-nature relations and also seeks a more comprehensive perspective aimed at analysing the socio-material dynamics of interaction between society and nature (Brand 2014). In relation to the complex interdependencies between society and nature, Brand uses the key category of socio-ecological regimes. Like Becker, Jahn and their co-authors (2006), Brand sees socio-ecological regimes as institutionalised regulatory forms that are culturally anchored in worldviews and ideas about nature, knowledge and non-knowledge structures, dominant technologies and power structures. However, these regimes now do not concern different areas, but rather the epoch- and region-specific overall structure of social relationships with nature (Brand 2014: 151). In this respect, Brand does not assume a plurality of regulatory patterns in different areas, but instead a socially typical, socio-ecological regime. With reference to Hartmut Rosa, he emphasises that contemporary socio-ecological regimes are subject to a dynamic of acceleration in terms of their temporality and a globalised expansion in terms of their physicality and physiogeographic ties (cf. Rosa 2017). This spatial and temporal dynamic of acceleration and expansion transforms all (re-)production processes and the self-image of the subjects. Due to its inherent growth dynamic, which goes beyond the capabilities of institutional control, it leads to an "escalation of side effects" and conflicts structurally with the concepts of sufficiency and sustainability (Beck & Rosa 2014). As a growing spatial incongruence between ecological problems and institutional possibilities for dealing with them (Brand 2014: 102), this dynamic of acceleration makes the deliberate shaping and transformation of society-nature relations more difficult in modern network societies. In addition, socio-ecological regimes are characterised by increasingly interdependent technological (infra)structures, ways of thinking and intrinsic rationalities, which in turn, as socio-technical systems, are part of higher-level economic and societal regimes (→ chap. 9 on infrastructure systems). Their inertia and rigidity also stand in the way of socio-ecological transformation projects.

In his framework model, Brand distinguishes between two levels for the analysis of society-nature relations, namely an *inner* level, which contains the interaction processes between nature and society that are mediated by social metabolism, and an *outer* level, where the resulting feedback processes arise, i.e., the environmental problems as unintended side effects and the social, primarily technical, approaches for solving them (Brand 2014: 155). He suggests analysing the feedback pro-

cesses at the outer level in environmental sociological research in four dimensions, namely in relation to a) their causes, b) the underlying socio-ecological regimes, c) the disaster potential and associated social vulnerability, and d) the social perception and reaction patterns.

2.3. Summary: Society-nature relations and their difficult transformation

All dialectical approaches pay great attention to the history of different relationships with nature and the conflicts associated with them. If, for example, we want to change the patterns and rules of energy supply, we have to ask ourselves which debates provide the context for this to occur? And which political and economic power and conflict configurations will shape these changes? How are regional and economic opportunity structures changing in the course of the energy transition? How can society-nature relations be made more sustainable at the regional, national and international levels and how can the conflicting goals between the social, ecological and economic dimensions be dealt with? Looking at conflicts directs the analytical focus towards the contested perception of environmental problems, towards competing technical approaches for the use of natural resources, and towards controversial interpretations of climate change or technology risks. Ecological problems, technology opportunities, economic and political goals within and outside science are examined in relation to contested findings about their relevance. The study of natural, technological and environmental conflicts also takes into account the various social and economic models on which the conflicts are based and discusses their significance for socio-ecological problems.

Dialectical perspectives therefore look at the biophysical consequences of controversial forms of use and shed light on their multidimensional backgrounds, for example by comparing different forms of energy production. On this basis, they discuss the potential for change in spatial, temporal or factual comparisons. As a result, they move back and forth between the natural and social poles of society-nature relations. Dialectical approaches look at socio-ecological regimes and their resulting repercussions and interactions, and look for ways to identify the undesirable consequences of enforced regimes of nature relations in the supply systems in order to support transformations towards more sustainable and fairer nature relations, which must start at all the necessary levels. Such approaches also take into consideration the inertia of the regulatory patterns and regimes that are interlinked in a variety of ways. The advantage of these co-evolutionary approaches is their sensitivity to the dynamics of the crisis-ridden relationships between humans, society and nature and to the multidimensional configurations of socio-ecological problems. The disadvantage seems to us to be their strong focus on functional relationships with nature and, depending on the perspective, their tendency to conceptualise one of the two nature-society spheres as monolithic and passive, and the other as powerful and multifaceted. In our view, Brand's conceptualisation of epochal and cross-sectoral social-ecological regimes (2014: 151) tends to simplify the complexity and conflict potential of nature relations in a dichotomous manner. In contrast, the concept of societal relations to nature takes greater account of the interconnectedness of hybrid relationships (Hummel

& Kluge 2006: 248) and, in the search for solutions, illuminates their dynamic and crisis-ridden transformation beyond concepts of control (ibid. 238, 256).

Dichotomisation always harbours the danger of viewing nature and society as mutually exclusive and homogeneous units and thus underestimating the complexity of socio-ecological problems and their socio-political, technical, economic and material interrelationships, including the mutability of the human and non-human beings operating within them. As a result, the analysis reverts to the base level, which we criticised at the beginning, of viewing socio-ecological transformations as an external influence that society and its socio-technical innovations have on nature or, conversely, of reifying the natural limits and conditions on social possibilities for action. Consequently, the contradictions, conflicts and dynamics in various nature relations and their registration in and transformation by socio-technical arrangements are only schematically considered. Instead of interpreting the relationships between nature and society as a dichotomously structured inter-relationship, the relational approaches considered in the next section begin by viewing these configurations as a complex variety of assemblages and interwoven "enabling relationships".

3. Relational theories: Fluid relations, contested assemblages, and intra-action in nature relations

The theories and concepts of society-nature relations discussed in the first section do not consider concrete and in some circumstances specific relationships between human beings, non-human living beings and biophysical factors, but instead analyse these relationships in an overarching, overall context. They examine society-nature relations from the macro perspective of social theories and, in particular, analyse the social background of environmental crises, species extinction, and climate change. As we have seen, they explain relationships with nature by looking at underlying constructions of nature, overarching dispositives and regulatory patterns. Essentially, the phenomena analysed are thus attributed to natural or social factors and these are consequently presupposed.

Relational approaches reject this strategy and its reference to higher-level explanatory variables. Instead, they insist on thinking in terms of temporary partial connections and changing assemblages of human-nature-thing relationships at the micro level, and view this as what creates the macro level in the first place (Callon & Latour 1981). Subsequently, relational approaches regard the social and the natural not as the origin but as result of previous assembling activities (in French: *assembler*). Gilles Deleuze and Félix Guattari (1987) took the term assemblage from art, where it generally referred to combinations (e.g., collages), and used it with various definitions to describe co-functioning, volatile and heterogeneous combinations of practices, objects, and spaces. Bruno Latour (2007) and Manuel DeLanda (2016) elaborated on their thinking and have contributed towards an assemblage theory of contingent but consequential interconnectedness. As the following quote illustrates, the initial focus is on heterogeneous alliances and their active but fleeting formation:

> "What is an assemblage? It is a multiplicity which is made up of many heterogeneous terms and which establishes liaisons, relations between them, across ages, sexes and reigns – different natures. Thus, the assemblage's only unity is that of a co-functioning: it is a symbiosis, a 'sympathy'. It is never filiations which are important, but alliances, alloys; these are not successions, lines of descent, but contagions, epidemics, the wind" (Deleuze & Parnet 1969: 69, cited in DeLanda 2006: 1).

Relational approaches take an unbiased look at the emergence of contexts. They are interested in their possible diversity and interactive development into assemblages, associations and networks. In this networking perspective, identities and social roles only emerge through relationships with one another and are transformed through processes of appropriation and exchange with one another. They are thus considered neither predetermined nor pre-structured by intrinsic macro characteristics. Assemblages are formed from relationships between organic actors (human and non-human organisms) and technical devices (from pacemakers to nuclear power plants) and biophysical factors (climate, water, temperature, soil conditions, etc.). The concept thus explicitly overcomes the "Great Divide" that modern science has drawn between nature and society (Latour 1993), and with it the obliviousness of many sociological approaches to nature, facts and technology. Instead, relational thinking in terms of interrelationships and networks involves continuous exchange relationships. Figure 5 attempts to visualise this, even though the dynamics, interactions and adaptability are difficult to depict. The relationships in assemblages are diverse and reciprocal. They can be, among other things, parasitic, symbiotic, reinforcing or weakening, such as those between bees and beekeepers, bees and flowers, bees and sugar, or bees and pesticides. From the perspective of relational theories, the hybrid assemblages of living things and scientific/technical, organic and inorganic components emerge from reciprocal interactions that are both spatially and temporally situated as "ongoing stories" (Haraway 2016: 40). They change co-evolutionarily in the course of shared and interwoven stories of "becoming-with" (Haraway 2016: 12).

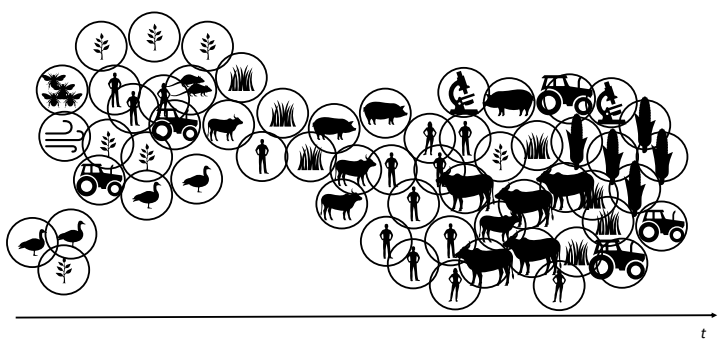

Figure 5: Relational co-evolution of variable elements in hybrid contexts; source: own illustration

This means that we cannot assume stable actors, stable environments, secure forms of appropriation, influencing factors or indeed social or ecological systems that determine framework conditions. Instead, in this networked togetherness, common conditions are only created through relational change. Some of the authors are thus reacting to concepts of biology that do not assume independent organisms and environments, but rather view the entire biosphere as a living being that is constantly changing, as suggested in particular by the "Gaia hypothesis" proposed by James Lovelock and Lynn Margulis (Lovelock & Sagan 1974). It emphasises the mutual interconnections, feedback and dependencies in complex interactions (cooperation and symbiogenesis).

As we explain below, non-human "actants" or "agents" are also regarded as actors capable of acting or having an impact. They are no longer regarded as exclusively passive, completely determined objects, but as interacting entities in social relationships. Their contributions to human society are discussed in four ways (Sayes 2014: 135): as the basis for the possibility of human societies, as mediators in social relations, as delegates of moral-political intentions, and as components involved in the assemblage of networks of agents with variable ontologies[6], times and spaces.

These conceptual shifts towards a methodological statement of the necessary consideration of hybrid assemblages and non-human *agency* mean that relational approaches negate deterministic understandings of human-nature-society relationships, essentialising[7] dualisms (human-animal, society-nature) and one-sided objectifications and hierarchisations, such as the narrative of humans' mastery over nature or their technical superiority. Although relational approaches recognise that anthropogenic processes have had planetary effects—the Anthropocene thesis—they also point to interactions with other species and elements involved that are also influential, such as viruses, bacteria, technologies, and climatic conditions. According to the relational critique of dichotomous approaches, the manifold interactions between these different agents[8] and their consequences would remain hidden in a priori distinctions and linear narratives, e.g., in the humanistic notion that humans occupy a special position in the world. In the following, we will present examples of the three best-known approaches that are particularly influential in the sociological discussion of society-nature relations.

3.1. Stories, figurations and the diversity of kinships in Donna Haraway's work

Donna Haraway is one of the most influential pioneers of relational concepts for analysing human-society-nature relationships. She is a biologist, philosopher and historian of science. In her dissertation, she considered the role of metaphors in the history of developmental biology (Haraway 1976) on the basis of Thomas

6 Ontology is the philosophical study of "being", which deals with what constitutes being or existence and what meaning it has.

7 The term essentialism describes a philosophical view according to which subjects or objects have an unambiguous, clearly definable, unchangeable essence (Latin *essentia* = essence).

8 The term "agents" is used here to summarise the various terms that will be introduced below (actors, actants, agents, companions).

Kuhn's work (1997 [1962]), who interpreted epistemological progress as contested shifts in schools of thought and paradigms. She focused on the power of thought patterns to structure knowledge and used the writings and lifeworld environments of three influential scientists to trace how their controversies about mechanistic, pattern- or organisation/system-related concepts, which were influenced by developments in neighbouring disciplines, led to a paradigm shift in the analysis of organic development processes. The major dualities that characterise the discipline of biology—structure-function, epigenesis-preformation, form-process—had been reformulated in the course of a disciplinary crisis in these processes of knowledge production (Haraway 1976: 17). According to Haraway, it was visual metaphors and exemplary objects of investigation that essentially structured the thinking of the scientists and their communities (ibid. 189) and linked it to overarching worldviews: "The barrier separating organicists and reductionists will not be breached by empirical study, because in the end people believe different things about the structure of the world" (ibid. 198). – even though at the same time they believe "that science can reveal nature" (ibid. 199). In her first book, she points out that thinking about natural phenomena is co-determined by symbolic and socio-political contexts, yet such thinking nevertheless refers to a reality that is conceptualised as ahistorical and referred to as "objective", while co-constituting material-semiotic worlds. In relational approaches, the adjective "material-semiotic" dissolves the dialectically conceived dichotomy of biophysical and symbolic-discursive structures. Authors use it to mark the fact that their objects of investigation, whether they are people, regulatory patterns, environmental problems or viruses, always owe their existence simultaneously to both material and discursive processes of production.

Inspired by her involvement in the women's rights and peace movements, Haraway developed her epistemological reflections on the material-semiotic production of knowledge into a feminist critique of science and society. Her discourse analyses of biological studies of the immune system and in primatology, alongside her writings on the theory of science, including "Situated Knowledges" (Haraway 1988), led to the much-cited "Manifesto for Cyborgs", which was first published in 1985 (Haraway 1991). In this manifesto, she calls for recognition that the distinctions between humans and animals, men and women, but also between nature and technology are made differently at different times and under different conditions, because "nature"—the supposed reference point—shifts with the material-semiotic conditions in which it is constructed, just like its counterpart, the concept of "culture". In order to make alternative and hybrid material-semiotic cultures of nature conceivable, Haraway allows the marginalised voices of *women of colour* and techno-utopian science fiction to have their say.

Using ironic terms such as "cyborg"—a hybrid of human, machine, science, fiction, imagination and experience—she attempts to undermine dualistic divisions and ways of thinking. In order to liberate the concepts of nature and culture from disastrous definitions and to be able to reconceptualise them along the lines of lived relationships, she meets the nature/social border wars with deliberately epistemological standpoints: positions from which responsibility for the conse-

quences of the scientific/technical constitution of reality can be taken and which are "committed to changing the world" (Haraway 1991: 159). Haraway thus also opposes ecofeminist and social constructivist approaches. She criticises the fact that these still subscribe to ideas about a supposedly stable authenticity ("female experience") and that they exaggerate the power of social discourses. As such, she argues, they can neither grasp the opportunities for self-determination found in the infinite repertoire of human-technology-nature relations nor the implications of the emerging field of *technoscience*[9]. Haraway's cyberfeminism project, on the other hand, is based on an epistemological infiltration of the dominantly organised dualisms and their justification of oppressive and exploitative relations. Through discursive, cultural, but also scientific/technical possibilities of situated, temporary and partial hybridisation, interconnectedness and, as we will see, the formation of sisterly bonds, she wants to open up alternative figurations beyond subjugation stories.

In her work, Haraway thus fundamentally rejects the universal epistemological perspective with its typical dualisms and, in particular, the claim of scientific subjects as "*modest witnesses*" who pretend to report objective truth about scientific objects. She is critical of this claim to knowledge that is free of cultural or biologically induced bias as it is only granted to privileged Western men, while women, people marked as belonging to the Global South or workers are always coded and objectified as the Other, just like non-human scientific objects. Instead, she argues in favour of consciously situated perspectives[10] within the sciences and beyond, which she also adopts in her own representations, for example when it comes to dogs, pigeons or bacteria, which she refers to together with humans as "critters" or "companions" at the feeding trough (Haraway 2016)[11].

In addition to feminist perspectives, the ongoing discussion of Michel Foucault's concept of biopolitics plays a central role in Donna Haraway's work. In his 1970 lecture "The Order of Discourse", Foucault (1971) had placed power aspects at the centre of the study of knowledge production. His discourse analyses promote the epistemological insight that orders of discourse curtail, channel and control the production of knowledge and meaning through the specific mechanisms of procedures of exclusion, classification and regulation. Discourses, he argues, constitute not only subjects and objects, but also the processes of their "production" and the dissemination of the corresponding knowledge. Against this background, Haraway defines situated knowledge as a locally produced, multilingual, interwoven and subversive knowledge that makes the traces of its creation visible (Haraway 1988). In contrast, she criticises the claim to absoluteness of supposedly objective, neutral scientific approaches and their often implicitly patriarchal,

9 The term *technoscience* was first used by Jaques Derrida, then taken up by Bruno Latour, and since then it has been used in *Science and Technology Studies* as a cipher for the intensified combination of technological, scientific, and economic practices of industrial capitalist and military production in the twentieth century, for example in biotechnology or, most recently, the development of artificial intelligence.

10 Situatedness means no universal and neutral knowledge is produced, but that knowledge is always culturally and temporally "located", i.e. situated, as we explain below.

11 To better understand Donna Haraway's work, we recommend reading "Staying with the Trouble. Making Kin in the Chthulucene" (2016).

anthropocentric and racist character, and counters them with avowedly activist and oppositional standpoints.

Even "nature" is no longer to be merely the "raw material of culture", "appropriated, preserved, enslaved, exalted, or otherwise made flexible for disposal by culture in the logic of capitalist colonialism". Instead, nature is to be "pictured as an actor and agent" (Haraway 1988: 592). Haraway does not assume a pre-existing world with stable beings which are there prior to any interaction and which can be discovered. Instead, with reference to Latour, she clearly stated in an interview that nothing exists before this relationality (Penley et al. 1990). Even a cell does not simply wait to be appropriately described, but is contingently embedded in specific relationships between instrumental, social, material and literary technologies and is nevertheless real. As a consequence, Haraway portrays the "cultures of nature" that are encountered as effects of historically malleable power relations and at the same time concentrates on the stubborn and subversive practices of overcoming one-sided processes of attribution. She sees the recognition of the *agency* or *agencies* of non-anthropomorphic beings as "material-semiotic actors" as the only way to liberate the entities assigned to the natural sphere from objectification and to transform them from determinate means into ends in and of themselves. Whether it's about gender or the agency of pigeons, she always explores the concrete relationships, the embodied and variable constitution of her ephemeral objects, and their situated practices of demarcation, using the ethnographic methods typical of Science and Technology Studies.

Her book "Staying with the Trouble" (2016) focuses on unstable relationships, associations and kinships – cross-species and multiform, between humans and machines, humans and dogs, corals and pigeons. In the face of overpopulation, species extinction, and climate change, Haraway advocates for people to "Make Kin, Not Babies" (2016: 103). She urges her readership to see themselves as "earthlings" (ibid. 103) and become kin to other mortal species, and to abandon the destructive understandings of the self that are informed by purpose-driven individualism and anthropocentrism, along with globalising cosmopolitanism and the epistemology of human exemptionalism. Her motto is "becoming-with instead of becoming" (ibid. 71): To this end, she tells hybrid "ongoing stories" (ibid. 40) instead of essentialisms and universalisms, thus opening our eyes to previous and possible future entanglements. At the heart of her explorations is the search for relationships that allow for mutual empowerment, for making a difference for each other and with each other, to increase the capabilities of all players, not to diminish them. Haraway assumes that subjects and objects, living beings, technologies and "environmental factors" emerge in a network of relations in which bodies, ideas and capacities for action are only produced and transformed in reciprocal relationships. This represents a radical understanding of the situated co-evolutions of "material-semiotic worlds" that are capable of being shaped and in which permanent answers for living together must be found. These lived responses are necessarily partial, selective and not always compassionate, but also prone to conflict and violence, because nothing can connect with everything and support everything (Haraway 2016). That which is material becomes manifold

and fluid in them, so that Haraway is considered a pioneer of New Materialism, in which the one-sided view of discourses, bodies and constructions is dissolved.

We should "stay with the trouble" in the face of the reductionist determinations of naïve naturalism and radical culturalism (→ chap. 1), but also in the face of the idols of progress and capitalism, which Haraway, with reference to the concept of the Capitalocene, holds responsible for the problems of the present. For her anti-categorical accounts, she chooses a restless style of writing that is associative rather than analytical in order to avoid determinism and identity politics. She wants to explore cross-species relationships in a caring and considerate way, break through categories, investigate complex figurations and tell open stories about hybrid figures from different perspectives, especially those that make it possible "to cut the bonds of the Anthropocene and the Capitalocene" (Haraway 2016: 5). She views storytelling itself as a "knowledge-political" *worlding practice*. For this, she repeatedly emphasises, it matters what concepts are used, "what stories make worlds, what worlds make stories". (ibid. 12). The key question in the Anthropocene is whether and how cross-species, responsible relationships can be narrated, composed, disassembled, and generated in the heterogeneous and interwoven fabric of thought and life. Haraway suggests it is primarily the sciences that are responsible for answering this question, alongside art and science fiction. They should tell complex, engaging stories by depicting relationships with an eye for the diversity of relations and interactions, and by exploring risk-sensitive "worlding practices" (ibid. 86). As one of many examples of this, Haraway cites Bruno Latour's Gaïa stories that describe the search for critical zones in which shared existence is possible. We will take a look at these stories below.

3.2. Actor networks, propositions and associations in Bruno Latour's work

Like Haraway, Bruno Latour's examination of society-nature relations began with science studies, i.e., the investigation of how knowledge about nature and natural elements comes about. Latour first used ethnographic methods in laboratories and libraries to investigate the practices by which knowledge about living beings and biophysical entities is produced and subsequently distributed in the sciences within a framework of diverse translation processes. These studies illustrate how natural phenomena are simultaneously constituted and integrated into overarching networks related to their social utilisation and application. This makes it clear how little these practices correspond to the modern claim that an independent, external nature is "discovered" by neutral scientific investigation. In a study published jointly with Steve Woolgar in 1979, "Laboratory Life. The Construction of Scientific Facts" (Latour & Woolgar 2008 [1979]), the team of authors turned the ethnographic gaze from foreign, colonised peoples to the laboratory as a culturally exotic world and reported on it in the style of the great explorers' accounts. The study records in detail how scientific findings emerge from individual laboratory findings, measurement protocols, statistical series, lectures and note-taking techniques, always embedded in the available laboratory equipment, research routines, personal interests and elaborate processes of coordination, in order to finally end up as decontextualised "facts" in publications.

These and other ethnographic studies in the laboratories of renowned scientists contributed to the emergence of *Laboratory Studies*, which follow the production of knowledge and the recording of the world in everyday scientific and technical laboratory practices. Latour and Woolgar's analytical work centres on linguistic metaphors, discourses and symbols, social interests and needs for distinction, but also includes the laboratory instruments and the neuroendocrinological objects of investigation themselves as relevant elements. They are worthy of attention as participating "actants" because their involvement in social laboratory practices is necessary for the scientific attribution of facticity. Objects are thereby accorded a certain *agency*: Hormones, apparatuses, specialist histories and researchers jointly enable "inscriptions" – inscriptions that produce reality as networks of actors, but which later disappear behind facts in the scientists' reports[12] or are made invisible by the reifying black boxing of scientific representation. Laboratory Studies aims to unpack this black-boxing of scientifically produced facts, to reveal the underlying socio-technical arrangements behind the fabrication and distribution of agency, and to make the construction processes and consequences of *matters of fact* into public matters, into *"matters of concern"* (Latour 2008).

On this basis, Latour subsequently elaborated the actor-network theory together with, in particular, Madeleine Akrich, Michel Callon and John Law. Initially, this was done as a methodology guiding research, later, and especially since the publication of the book "We Have Never Been Modern" (Latour 1993), as a social theory critical of the present. Actor-network theory (ANT for short) has been taken up by many disciplines around the world and provides significant impetus and one of the most widely discussed theoretical points of reference for environmental sociology and the sociology of technology. Its development is directly linked to science studies and extends it in three directions, which we will explain below, namely:

1. the extension of the attribution of agency beyond the laboratory to all socio-technical arrangements and their natural, technical and material elements,
2. the fundamental consideration of classifications and identities as the temporary result of translation and stabilisation processes in actor networks (rather than as ex ante starting points), which, however, are ignored due to a self-deception that is constitutive of modernity, and
3. the necessary realisation and careful negotiation of these networking and composition processes from a democracy theory perspective within the framework of political ecology.

Firstly, Latour introduced the almost anecdotal extension of the consideration of agency not only in relation to human, but also to non-human and technical actants, as a counterpoint to the uncritical adoption and reproduction of essentialist assumptions about people, culture, nature, and technology. Just as the emergence of scientific knowledge has been examined and portrayed, sociological knowledge production should also be critically reconstructed. How does "the social" come about? Who is acting, for example: the EU, the current EU Commis-

12 Latour speaks of *factish* – a cross between faith and facts (Latour 1999).

sion President, old European preferences or the emissions directive for new cars? They all "prescribe"; they are "different ways to make actors do things" (Latour 2005: 55). In Latour's relational ANT, all the aforementioned actors and actants are agents that differ only in the degree of their respective figuration, that is, whether they are already determined as collective or individual actors. In this sense, ANT transfers concepts from sign theory—as a conceptually less captious "infra-language" (ibid.)—to epistemology and ontology in order to protect itself from an essentialist reproduction of categorical attributions. As a consequence, "society" is not already there, but must be understood as the result of hybrid, mobile associations in which a multiplicity of entities[13] relate to each other in a network-like manner and reproduce themselves in an entangled way. Not only in the laboratory, but in general, all relevant elements should be included in the understanding of socio-technical assemblages, including lactic acid bacteria, key racks, door openers, speed humps, reactors and soil crumbs, because they stabilise social associations, make reciprocal determinations and thus open up or close off opportunities for mobilisation and networking. Bruno Latour was interested in the social, i.e., interactive, complementary and controversial constitution of "compositions" – the actor networks. He advocated for a "new sociology" (2007) to adequately grasp the associated processes of forming and limiting agency, assertiveness, power and control, in which a wide variety of entities are included, modified, and reprogrammed. The new sociology should not continue to exclude the natural, material and technical from the outset, but should consider it equally ("symmetrically") in the development of theory due to its considerable importance for the stabilisation and destabilisation of modern societies.

The study of the contested processes of establishing and dismantling networks and assemblages is also at the centre of many case studies in Science and Technology Studies, in which the methods of ANT are used to trace the formation of hybrid arrangements in various fields of action. Central to these methods, in addition to the symmetrical approach without prior distinctions, is the reconstruction of processes of mediation and "translation" (Callon 1984): This traces in detail how agency, materiality, knowledge, and meaning emerge from interrelated operations of mediation and networking, as well as efforts to stabilise them, how they change, and how they can also fall apart again (Latour 1996). Social action is thereby always conceived as inter-action, as action that is shared with and distributed to multiple entities. From this perspective, innovation processes in particular are a major source of the continuously growing number of hybrid entities derived from what is called nature and technology as well as organisation and technologisation (Akrich et al. 2002). For environmental sociology, this relational approach changes the picture significantly: The earlier large-scale concepts of nature and society with their dichotomously conceived characteristics are replaced in ANT by temporary associations between heterogeneous and hybrid actants and elements that transform each other reciprocally. In his early study "The

13 In case studies and thought experiments, humans, animals, plants, bacteria, technologies and materialities, but also socio-technical configurations such as ships, transport facilities and economic goods are observed as co-acting entities (cf. Sayes 2014: 136).

pasteurization of France" (Latour 1988), Latour devoted his attention to the biologist and French national hero Louis Pasteur, who brought together a variety of competing forces, including microbes, farmers, pasture fences, industrialists, and politicians. Thus, he not only succeeded in explicating microbes, but by developing scientific knowledge about them, he was also able to redefine French stables and hygiene practices: in short, all of society. Compared to Haraway, who tends to presuppose patriarchal and capitalist interests, Latour paid more attention to the interests and programs of the actants involved, the negotiations that lead to their connections, and the attempts to harden the inherently unstable, mobile network and render it unavailable to further attempts at incorporation, than he did to "knowledge-political" or, as he wrote, "cosmopolitan" endeavours.

Secondly, processes of mediation and translation, as well as the disregard for those processes that is typical for modernity, play a crucial role in ANT. The concept of translation processes is invoked to explain that innovation and transformation processes not only lead to "something new entering the world" (the simple but inaccurate implementation notion), but that the things that already exist also have to be transferred or shifted into new arrangements with new kinds of agency, roles, and identities. In Latour's words, it refers to the "creation of a link, that did not exist before" (Latour 1994: 32) between two arrangements through which all the elements and agents involved are modified and assume a new position in the emerging network. It is true that in innovation processes, on the one hand, new kinds of networks and connections are created (e.g., for electromobility, high-performance cows, biotechnical cultivation methods and markets, buildings, or energy supplies) that undermine and redefine previous distinctions (Latour 1994; Callon 1984). And these new formations leave traces as "the result of ongoing practices through which actors, in the course of their interaction, elaborate ad hoc rules to coordinate activities" (ibid. 50). This makes it possible to study the process by which they are assembled and fabricated by looking at the controversies surrounding their arrangement. For example, which networking actors succeed in bringing together batteries, vehicle chassis, charging infrastructure, tax incentives, car manufacturers, and drivers in such a way that they eventually displace the internal combustion engine? Which actors and elements will be left behind, who will have to change their goals, their characteristics, and their relationships in the context of which controversies? These questions can be investigated with the tools of ANT and shed light on the underlying "linking" or "mixing" that is used to recruit participants and to network different roles, interests, capabilities and resistances in such a way that all participants change their positions and together form reality as a new socio-technical arrangement.

On the other hand, and herein lies the critique of ANT in terms of Science (with capital S) and social theory, both the scientific disciplines and society's self-image and risk management negate precisely these processes of involvement, engagement, mobilization, and representation (Latour 1993; Callon 1984). According to the central thesis, nature and society, humans and technology, global and local, macro regulatory patterns and micro-actions are again separated and differentiated (despite their obvious intermingling) due to a kind of consti-

tutionally anchored, "knowledge-political" purification process. This makes the de facto composition invisible, so that no collective responsibility is taken for its consequences. The growth of risky hybrids that is permanently driven by science and technology—the products of biotechnology or cyber-physical systems controlled by artificial intelligence come to mind—therefore escapes institutional control, for instance through legal and democratic institutions. This growth and its potentiation through global value chains, whose increasing risks are ever more opaque, takes on the form of an escalating revolution of the side effect (Beck & Rosa 2022: 153) that threatens to present modern societies with problems that are almost impossible to solve. Yet this growth is quasi "constitutionally" out of society's sphere of perception. For these reasons, Latour avoided the term "climate change", which linguistically suggests that it is about the change of the (external) climate, and criticizes both climate research conducted only in terms of natural science and social science approaches that are limited to the study of societal climate consequences and discourses. Instead, he favoured talk of "global warming", which better sensitises us to the underlying processes of the shared, multifaceted, and risky transformation taking place in the human-technical-ecological collective: "We may then be able, finally, to understand these nonhumans, which are, I have been claiming since the beginning, full-fledged actors in our collective; we may understand at last why we do not live in a society gazing out at a natural world or in a natural world that includes society as one of its components. Now that nonhumans are no longer confused with objects, it may be possible to imagine the collective in which humans are entangled with them." (Latour 1999: 174f.).

Latour (Latour 2005: 185ff.) uses the terms "proposition" and "articulation" (Latour 2005: 199) to open up an alternative view of ecological, technical, and material elements in actor networks. While the "modernist constitution" externalises them as neutral tools or a force majeure, ANT internalises them as "mediators" from which impulses emanate and which need to be adequately represented. The non-human is thereby not seen as a neutral means or mediator between human agents (such as microbes or cows between farmers and consumers), but as players who can intervene in these relations and in the definition of these relations, not without changing itself (Latour 2005: 37)[14]. But if complex social associations have to be permanently fought for and performatively maintained, as per the political argument of ANT, then a framework must be found for the responsible organisation of these processes of hybrid networking, such as a "parliament of things" (Latour 2004). The aim of this parliament would be to determine together and from a variety of perspectives, which links the various members of existing collectives want to enter into, which risks and costs they are willing to accept and how they can live together in a shared world. These questions and their equally epistemological, sociological and political discussions have formed a kind of (cosmo)political ecology and have been a focus of publications over the last two decades.

14 Beat Sterchi's novel about a cow called Blösch makes this clear.

Thirdly, Bruno Latour turned his attention to the problems caused by growing chains of hybrids and their side-effects, i.e., the major challenges that threaten the present and the future, such as the hole in the ozone layer, species extinction, overheating of the planet and pandemics. So if living beings, society, technologies, artefacts and science do not act independently of each other and cannot be conceived of separately, but instead—as described by ANT—form a hybrid "collective", then, according to Latour's democratic-theoretical conclusion, the question arises as to how the consequences of the hidden translation practices such as species extinction and global warming can be internalised: How can institutional procedures be found for the development of less risky forms of coexistence? Since the complex problems can no longer be attributed to technical constraints or the laws of nature, given that ANT has revealed the tangible interests, political claims and moral prescriptions involved in their multiplication and expansion, ANT consequently calls for a framework of prudent diplomatic mediation in order to tame the risks democratically through the careful articulation and negotiation of interests. The carefree proliferation of unstable hybrid beings is to be channelled into a public "cosmopolitics" (Latour & Weibel 2005) in order to enable the joint production of good (we would say "sustainable") arrangements in the thin, "critical zones" of the planet. Hybrid production should consequently be slowed down, better articulated, controlled and democratised (Latour 2004). In his book "Down to Earth" (Latour 2018), the original French title[15] of which would translate as "Where to land?", Latour called for the abandonment of the globalising, placeless view of the Earth in favour of the renewed acknowledgement of our "earthboundness". Since people neither look at nature from the outside nor are they part of a predefined nature, yet are nevertheless exposed to the interactions of everything earthly, it is necessary to institutionally and politically redefine the coordinates of the political. Beyond the modernist orientation points of global-local and, related to this, progressive-conservative, Latour claimed that the careful composition of a liveable Earth is at stake, recognising the fact that the geopolitically available space for this is limited. Europe appears to him as a suitable starting point for this: "Theres nothing like an Old Continent for taking up on a new basis what is common, while observing, with anguish, that the universal condition today entails living in the ruins of modernization, groping for a dwelling place." (Latour 2018: 106).

Latour stated, however, that in the "new climate regime" (Latour 2017: 3) so far the opposite has taken place. The incessant deepening of ecological risk situations is justified by the overpowering constraints of capitalism, competition and nationalism (not only by Trump, etc.) and is presented as insurmountable, so that in these ruins of modernisation it is no longer nature that is externalised as pre-existing and uncontrollable, but the self-endangering social order. In his last book, "Où-suis-je? Leçons du confinement à l'usage des terrestres" (2021; in English: After Lockdown: A Metamorphosis?), he took up the experience of lockdowns and restrictions to people's freedom of movement caused by the Covid pandemic as a dress rehearsal of future geosocial localisations. Earth's inhabitants should

15 Où atterrir? Comment s'orienter en Politique (2017).

use the painful experiences of human connectedness with everything earthly for the exploration of those critical zones in which they will live in the future due to the co-produced pandemic-prone and heated world. The planetary is political, one could summarise, and therefore the search for freedom and emancipation must be resumed in a way that is more compatible with the rather strange forms of complete internalisation between new coordinates, perhaps those of extractivism versus commoning.

3.3. Agential realism and intra-action in Karen Barad's work

More recent developments in relational approaches include the theories of "new materialisms" (Coole & Frost 2010). The most important proponent of these theories is the physicist Karen Barad. Her work follows in the footsteps of Michel Foucault, Judith Butler, Donna Haraway, Bruno Latour and the quantum physicist Niels Bohr. They have all countered the universal view of truth, knowledge, structure and matter in a poststructuralist way by highlighting its historicity, situational production and "knowledge-political" changeability. Barad is likewise concerned with the relationships between humans and the reconfigured world that they themselves have changed. She also focuses on overcoming dualistic assumptions about agency and cause-and-effect relationships, and on the relationship between material phenomena and the social practices of their representation (Barad 2007: 34). With her programmatic consideration of matter and materialisations, Barad radicalises relational approaches from the perspective of a feminist science theorist. She, too, decisively distances herself from anthropocentric humanist epistemologies; she does not conceive of human subjects as external or independent and equipped with special capabilities for action and agency that mean other (biophysical) phenomena are dependent on their will. Based on her insights into the constitution of scientific knowledge, she instead calls for a fundamental rethinking of our understanding of scientific rationality, laboratory practices, their results and their ethics of responsibility, because the relationships between humans and other agents, according to the term used here, are epistemologically and ontologically uncertain and unstable, but nevertheless objective.

Barad thus also assumes a situated knowledge that is dependent on measuring devices ("apparatuses") and thus inevitably a partial knowledge. She looks at the participation of "agentive" (i.e., effective but fluid) matter that has changing properties in the cognitive process (Barad 2007: 137)[16]. She conceives of "phenomena" such as the observer and the observed (speaker positions, bodies, atoms) as interdependent. According to Barad, bodies and matter are not passively and determinately involved in the production of knowledge, but instead

16 In this respect, Barad builds her conceptual reflections about the epistemological and ontological multiplicity of matter on her interpretation of Werner Heisenberg's uncertainty principle and Niels Bohr's complementarity principle, which are explanatory approaches that were developed in physics to deal with the mutually complementary and mutually exclusive observations of wave-particle duality (Barad 2003). Trevor Pinch (2011: 434), in turn, criticises Barad for attributing an authoritative character to this production of knowledge in physics, thereby overshooting the goal of including forgotten matter because she herself now forgets social constructivist analyses of the social embeddedness of knowledge.

interact and intra-act in an epistemologically controversial, ontologically unstable and politically resistant way – not least because they are first formed as material-discursive phenomena by boundary-drawing apparatuses. At the centre of her theory of agential realism, which is conceptually an oxymoron, is therefore the concept of "intra-action". Barad uses this concept to focus on the relationships *within* the subjects and objects of phenomena or materialities rather than the relationships between them, which in principle only come into the world as the result of relationships: "Neither discursive practices nor material phenomena are ontologically or epistemologically prior" (Barad 2003: 822). She thus takes up Foucault's thesis of the epistemological production of subjectivity and power (and the power to define things), but without limiting this to the realm of the social or subordinating the realm of the non-human, material to these practices. Rather, she argues that "agential realism takes account of the fact that the forces at work in the materialization of bodies are not only social, and the bodies produced are not all human" (Barad 2007: 33f.). For her agential realist conception of power, she therefore reworks the traditional understanding of causality into a concept of "intra-activity", which "signifies the mutual constitution of entangled agencies" (ibid.: 33). Again, agency is the result of an interplay, in this case of the complex activation of different agentive entities that cannot be recognised and distinguished in advance, because they are only (re)constituted in the processes of intra-action. In contrast to Haraway and Latour, however, the prior distinctions implode not only in relationships and new hybrid beings, but also in the active or acting subject or object.

Subsequently, Barad also consciously takes an epistemological position and conceptualises matter[17] as temporary, productive, relational, and complex entities that produce transformations and are only ever selectively captured by apparatuses. She understands the necessarily situated knowledge not as a scientific failure, but as constitutive for the investigated elements, which would not exist without their partial illumination in laboratory facilities, and the same applies to the observers themselves. For they, too, do not exist outside the world and simply observe it in the laboratory, but instead create themselves and their worlds intra-actively, co-constituting them. For the intertwined productions of ontology and epistemology, Barad, like Haraway and Latour, calls for a conscious, post-humanist and responsible attribution of responsibility, and for the entanglements of ethics, knowledge and being to be taken seriously (Barad 2007). However, it remains unclear from which standpoint responsibility can be assumed for more than situational micro-relationships.

We will leave it at that with our brief description of agential realism. It is important for us to emphasise that this radically relational perspective does not stop at the external boundaries of the elements and actors under consideration, but rather considers them in relation to their interconnectedness with processes of

17 Regarding her understanding of matter, Barad writes: "In an agential realist account, matter does not refer to a fixed substance; rather, matter is substance in its intra-active becoming—not a thing but a doing, a congealing of agency." (Barad 2007: 151).

knowledge production and also incorporates the capacities to act and interests involved.

As a consequence of their analyses based on science studies, all of the relational approaches discussed here call for a stronger assumption of responsibility in scientific practices when dealing with problematised "environmental" relationships. For environmental sociology, this suggests the need for a much broader engagement with its objects of investigation and the importance of searching for alternative ways of describing problems and finding solutions. Conceptually, relational approaches make it possible to view the social as a complex system with many unknowns, in which the course of action is determined less by linear cause-and-effect chains, overarching ideologies, institutional frameworks or technoscientific control fantasies than by an infinite variety of unpredictable and incalculable interactions and consequences. They open up new possibilities for including the dimensions of complex ecological configurations that have so far been excluded from sociological investigations as material, technical or natural, and more generally, for rethinking this traditional mode of demarcation and a priori differentiation. However, for us, the most important contribution made by relational approaches is the way they facilitate thinking about new approaches to the formative experiences of climate change and pandemics in contemporary society. Relational approaches allow us to consider socio-ecological assemblages in all their historicity, variability and entanglement with specific interests, assertive groups of agents and technoscientific innovations. They thus provide us with scientific terms and concepts to reflect on the misalliances and connections that are not "institutionally sanctified" which exist beyond anthropocentric demarcations and "knowledge-political" divisions, and for a fundamentally different kind of environmental sociology in times of pandemics and global warming.

What students can take away from this chapter:

- Knowledge about the significance and implications of social and, in particular, technoscientific constructions of natural phenomena for society-nature relations
- An understanding of the dual character of society-nature relations
- An insight into the co-evolutionary multidimensionality and socio-technical entanglement of society-nature relations
- An insight into the debate about the agency of human, non-human and other agents
- Knowledge about the differences between dialectical and relational approaches to society-nature relations and human-technology-nature relations

Recommended reading

Callon, M. & B. Latour, 1981: Unscrewing the big Leviathan; or how actors macrostructure reality, and how sociologists help them to do so? *A key text in actor-network theory from 1981 that will teach you the basics of ANT.*

Haraway, D., 1991: Simians, cyborgs, and women: The reinvention of nature *A helpful anthology for anyone wishing to read Haraway's work.*

Latour, B., 2018: Down to earth: Politics in the new climatic regime *A small book that will help you to understand the extent to which the basic political distinctions need to be rethought in order to facilitate a sustainable understanding of the threatened conditions of existence on Earth*.

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