

On the Art of Co-Creation:

A Contribution to the Philosophy of Ecological Economics

Carsten Herrmann-Pillath

Background paper for Keynote Lecture:

ESEE 2019 | CO-CREATION – MAKING ECOLOGICAL ECONOMICS MATTER, Turku, Finland, June 18-21 2019

Max Weber Centre for Advanced Cultural and Social Studies, Erfurt University, Germany

Email: carsten.herrmann-pillath@uni-erfurt.de

Website: cahepil.net

The declining status of science in society

A hallmark of our times is the decline of the social and political recognition of science as an independent source of facts about the world and arbiter in public debates. This problem is salient in the controversies about global warming and the necessary policy responses (Latour 2015). Economist would conventionally explain this phenomenon in terms of the growing clout of naked interest group politics. But many observers notice that there are more complex and possibly enduring forces at work. In my view, these mainly relate to three phenomena:

- The first is that after the revolutionary advances of physics, chemistry and biology in the first half of the 20th century, science is increasingly facing principled limits to further growth of scientific knowledge (Rescher 1999), especially with regard to grounding policy recommendations in scientific knowledge. This is increasingly diagnosed also for economics (Pyndick 2013; see e.g. the editorial comment on Nordhaus's and Romer's Nobel award in *The Economist*, October 18, 2018).
- The second is that this allows for the renaissance of alternative regimes of truth, such as religious truth of judicial truth (Latour 2012; think of the actual verdicts on Bayer corporation in the Monsanto/Glyphosate case, with Bayer leaders obviously believing in the scientific evidence that Glyphosate does not cause cancer, and US juries rejecting this argument).

- The third is that in the political arena, there is growing tension between public opinion as necessary driver of democratic processes and the claims of science-based expert knowledge, often expressed in outright populist rejection of science and even aggressive actions against its institutions (for example, President Bolsonaro in Brazil launches a battle against universities by announcing budget cuts of 30 percent).

These developments create a difficult environment for disciplines such as Ecological Economics which are engaged in intra-disciplinary debates about even fundamental assumptions of economics, possibly undermining not only their own legitimacy in the larger public, but also of the discipline altogether. Therefore, Ecological Economists increasingly venture into radical rethinking the conventional assumptions about ‘normal science’ (Strand 2018). My paper is a contribution to these efforts.

Can philosophy help?

I am going to explore the role of philosophy in regaining lost ground for science. I focus on a new concept that is traded among Ecological Economists, ‘co-creation’. I agree that it is central for grounding Ecological economics in philosophy, more specifically in ontology and epistemology. One may ask, why is this intellectual labour necessary? There are two reasons.

First, Ecological Economics manifests various and substantial debates about foundational issues such as whether a ‘shallow’ or a ‘deep’ understanding of ecology should be adopted (Spash 2013). After creating the new subdiscipline of economics, the relationship between the two terms of ‘ecology’ and ‘economy’ has never been satisfyingly resolved, which is salient in the often-heated controversies about specific approaches such as ‘ecosystem services’ or ‘nature capital’. This is not only a theoretical issue, but has immense practical consequences, since economics in general is a science that aims at guiding practical decisions in the economy, business and politics. For example, whether Ecological Economists follow economics in putting human welfare at the centre stage, hence adopting analytical anthropocentrism (Llavador et al. 2015), or whether they adopt the perspective of other living beings, ecosystems, or even the ‘Earth’, whatever that means, has far-reaching consequences for all practical policy approaches and decisions (Brown 2016).

Second, Ecological Economics is programmatically wedded to interdisciplinarity, in both directions of the sciences and the humanities. Therefore, it is necessary to create systematic and coherent conceptual linkages to these various disciplines and their conceptual frames. This requires meta-disciplinary reflection which can be powered by modern philosophy.

In this essay, I want to sketch some very basic aspects of these problems in discussing the role of co-creation in restating the nature of Ecological Economics as an ‘art’. In introducing this controversial idea, I want to systematize and focus many ideas that are currently floating around in the discussions about ‘post-normal science’ (Strand 2018). Conventionally, the notions of ‘art’ and ‘science’ are juxtaposed, in the sense that science pursues the goal of objectivity, i.e. the ‘view from nowhere’, whereas art aims at expressing radical subjectivity, rooted in the ideas of individual artistic creativity (at least in the Western tradition). This resonates with many other methodological assumptions, such as Max Weber’s idea of ‘value free’ science. Economics clearly pursues the goal of science, often in distancing itself from other fields of the social sciences and the humanities, which are being criticized as being value driven. In turn, Ecological Economics criticizes economics partly by making claims of being better grounded in science, as clearly articulated in the thinking of one of its founding fathers, Georgescu-Roegen. Many Ecological Economists maintain both positions, one is claiming to be ‘more scientific’ than standard economics, the other, however, is to express dedicated value judgments that might guide human action (Spash 2012).

I will argue that these intellectual struggles can be pacified if we overcome the juxtaposition between science and art. I will defend the view that ‘art’ is an epistemic activity that pursues truth on par with science, if we deal with hyper-complex systems and ‘wicked problems’: *Art is the science of co-creation*. Recognizing this epistemic role of art and exploring the implication that science-based policy is artful design, can be a powerful antidote against the social forces that increasingly undermine the epistemic status of science in society.

Art and co-creation

Interestingly, the concept of ‘art’ and related terms have been sometimes used in economics in referring to certain ways of economic reasoning that renders it more realistic and practically relevant. For example, Leamer (2012) speaks of the ‘craft’ of economics, and the expression of ‘art of central banking’ is often used (originating in Hawtrey 1932). These ways of speaking

express the diagnosis that many economic theories seem detached from reality and often maintain assumptions that are difficult to reconcile with facts on the ground and do not provide sufficient guidance for practical action. For example, in macroeconomics it is widely recognized that most of the research done by academic macroeconomics after the ‘rational expectations’ revolution, adorned with several Nobel awards, is irrelevant for conducting modern central bank policy, and indeed the discipline seems in intellectual disarray today (Mankiw 2006; Buitert 2009; Romer 2018).

If we look at the case of central banking in some more detail, the rhetoric of ‘art’ refers to various aspects. One is that assessing the state of the economy is an exercise in assembling results from many different analytical views and put them together in a well-reasoned synthesis. In doing this, the central bank decision makers always need to keep in mind that the central bank is a pivotal player in generating the current and future conditions of the economy. In deciding about its actions, they need to analyse its causal impacts which requires an understanding of how the engine of the economy works. However, at the same time they are aware that their decisions already influence the economy in the moment when they are communicated and hence influence the expectations of the economic agents. Acting in this very complex setting is said to be an ‘art’, not ‘science’.

In the central bank example, we already find two necessary conceptual ingredients to discuss the idea of co-creation.

- The central bank faces the problem that it cannot simply approach and analyse the economy as an entity that is separate from itself. In most abstract terms, if we treat the central bank as ‘subject’ and ‘the economy’ as object, the central bank is both. This was recognized in the ‘rational expectations’ revolution, for example, when discussing the problem of time-inconsistency. The central bank needs to predict its own actions when forecasting the future state of the economy.
- At the same time, the central bank cannot operate the economy like an engineer who designs and runs a machine. Central bank communication is pivotal, mediated via expectations of economic subjects: The central bank produces economic impact via continuous interactions with all other economic subjects.

In other words, central banking is an art because the generation of macroeconomic states by means of monetary policies is not like using levers to move a mechanism, but is their co-creation

by many actors, including their interaction with the perceived object, ‘the economy’ (often dubbed ‘markets’ by practitioners). But this is not a special property of the central bank. The economy as an object is a product of co-creation, and this ultimately means that it can no longer be approached as an ‘object’ that is independent from the scientific subject.

Breaking through the subject-object divide

If we move to a highest level of abstraction, the two conceptual ingredients of co-creation mean firstly, that there is no clear-cut ontological separation between subject and object in which ‘objective scientific analysis’ can be grounded, and secondly, that the central bank as a subject can only act in conjunction with other subjects. Here we have the two senses of co-creation:

- firstly, that there is no separation between subject and object and that the acting subject always interacts with its object in co-creating the action and its effects, and vice versa;
- and secondly, the action and action consequences are always co-created via the interaction of many subjects, which needs to be anticipated in designing plans for action.

If we introduce an intermediary level of analysis between the concrete central bank example and the abstract consideration of subject-object relations, a most important philosophical perspective is to recognize that economics as a science is performative (Herrmann-Pillath and Boldyrev 2014; Boldyrev and Svetlova 2016). Without going into details here, performativity of economics means that economics does not simply describe and analyse ‘the economy’ as an object that is ontologically independent from doing economics, but that economics also creates the economy (Callon 2007; Çalışkan and Callon 2010; in principle, an important intellectual precursor is Polanyi 1944). In economic sociology, the seminal example was that the theory of finance, once translated into practical applications, also transforms the way how the economy works (MacKenzie 2006). Or, accounting methods that are based on economic theory also create the ‘things’ aka ‘assets’ that are the objects which economic action targets (Vosselman 2014). Accordingly, the performativity of economics means firstly, that the economist as scientific subject co-creates the economy, which in turn influences the ways how the economist perceives it; and secondly, this performativity only works via the interaction between the economist and all other economic agents, who therefore co-create the economy collectively.

As we see, co-creation is a fundamental phenomenon in doing economics. One way of generalizing this is offered by Karen Barad's (2007) theory of 'intra-action' which states that all phenomena, including the most basic facts of physics, are not 'objects' that are being analysed by the epistemic subject aka 'scientist', but are emerging in the 'intra-actions' between subject and object. This is not simple radical constructivism that would root all reality in the subject but means that co-creation is a fundamental ontological feature of the world as the force that generates 'phenomena'. As Barad elaborates, Bohr's interpretation of quantum physics is a most universal recognition of this, as opposed to subjectivist interpretations of quantum statistics pursued by Heisenberg. The world is intra-action and can be neither reduced to subjectivity (radical constructivism) nor to objectivity (positivist science).

How to create things with economics

Let me give a practical example from Ecological Economics that illustrates co-creation in this sense of ontological creativity of the subject-object 'intra-action'. This is fisheries and has been analysed extensively by both economic sociologists and ecological economists. In economic sociology, the fisheries were explored in the context of critical discussions over Actor-Network-Theory and Callon's approach to performativity (Holm and Nielsen 2007). Callon (2007) and others argued that economic models of markets are not just descriptions, but in applying them become 'real', in the sense that they create real objects, most generally, of course, 'markets'. In the fisheries context, this thinking applies for the introduction of 'individually transferrable quotas' ITQs based on neoclassical economic theory and its conceptualization of property rights. This is only one example for the extremely influential idea in Environmental and Resource economics (as distinguished from Ecological economics) that resource over-exploitation can be remedied by establishing private property rights for a resource and creating markets for trading these rights (as in other cases, such as pollution permits). In the fisheries case, it means that based on measuring the resource base (i.e. diverse and highly mobile fish populations) the total quantity of fish biomass is divided into quotas that can be assigned to individual agents (often, 'vessels' which in turn are owned by other agents). This transformation has immense consequences, such as fundamentally changing the social structure of fishing traditionally being community-based, for example. It also creates the various forces of economic interests which induce actors to accommodate and eventually to assimilate the economic model, thus creating a complex network of actor identities and practices that embody the economic model. This even

includes the interests of the fish, who, in Holm's (2007) words, may 'hunt for the best owners': That means, if we approach the ecological system consisting of fish as prey and fishermen as predators, the transformation of the hunting practices according to the economic model also serves the interests of the fish since they are optimally managed, in the sense of making the fish population sustainable. This intuitively corresponds to Barad's 'intra-action' (see also Callon's 1986 famous founding paper on ANT on the fishermen at St Brieuc Bay).

This analysis overlooks another factor highlighted by Hiedanpää and Bromley (2016: Chapter 10), namely that the ITQ management is based on the establishment of sovereign rights on the coastal zones as exclusive economic zones. That means, the ITQ model builds on the flawed blanking out of the fact that there are already state property rights on the fisheries. This implies that in justifying the approach, the distinction between resource rent (triggering the over-exploitation of oceanic resources in open access conditions) and economic rent (generating from limiting market access) is blurred. In fact, in creating the ITQ market access is limited via quasi property rights, thus turning fisheries into assets that create economic rents which can be appropriated by the incumbents and materialize when quotas are sold to new entrants. Hence, they are rights to market access, but not property rights on fish as living entities.

Holm (2007) uses the catchy term 'cyborg fish' in referring to the phenomenon that the entire system creates 'fish' as an artefact of markets: For example, many living organisms in a catch are treated as 'waste' and are being discarded even though they are also essential members of the maritime ecosystem. In my own work (Herrmann-Pillath 2018), I interpret this as the fish becoming part of the 'technosphere' as an emerging regulative and ontologically creative part of the Earth system, thus transforming the biosphere into an artefact. This process is driven by co-creation. As emphasized by ANT, we cannot just reduce this on mere subjective projections of humans on the world, in the sense of social constructivism. What is involved is a vast network of humans, technological devices (such as sonars and computers) and living organisms in which a new kind of entity is co-created, the 'cyborg fish'. In Searle's (1995) terms, the fish become 'observer-dependent facts', but 'facts', after all.

How to reach through at the 'Ding an sich' by means of philosophy

Let me return to more fundamental philosophical considerations. The distinction between subject and object stays at the centre of Western conceptions of science (for example, Chinese

thinking in Imperial times radically discarded this separation, assuming that meditation can lead to knowledge about the external world). However, European philosophy already went beyond this simple juxtaposition exactly when the sciences emancipated themselves from philosophy, especially in the shape of ‘philosophy of nature’. This was achieved by post-Kantian German idealism which established the intellectual bifurcation between rationalism and what Charles Taylor (1989) aptly called ‘expressivism’. Kant posited the radical distinction between subject and object in his argument that the ‘thing in itself’ is not accessible to human epistemic activity. Accordingly, what we access as ‘reality’ is itself determined by basic epistemic structures such as space and time. Against Kant, Hegel, Schelling and others posited the thesis that subject and object are interrelated in various ways, thus allowing for access to ultimate reality – but not in the sense of a simple correspondence theory of establishing claims of truth. Basically, there are two possible ways. The first is to centre on action as primordial epistemic medium, with the consequences of action also working back on the subject via its products (this is expressivism, Taylor 1985). The second is to conceive the subject as being just a moment in a larger totality in which epistemic processes evolve, such that individual knowledge can directly participate in the world as an evolving structure (Hegel’s ‘world spirit’). In other words, post-Kantian idealism envisaged the co-evolution of subject and object, and in this entanglement ultimate reality is grounded.

I leave it with these very broad and coarse characterizations (for more detail, see Herrmann-Pillath and Boldyrev 2014). What is important for discussing co-creation is that German post-Kantian idealism recognized the creative dimension of action, including epistemic activity, and assumed that this is part and parcel of a larger evolving system in which subject and object are embedded. These ideas left an enduring legacy in philosophy, even though the internal debates were often driven by the immanent critiques of those very same positions. Yet, they factually created a kind of ‘background condition’ for all these more specific philosophical developments. As one important example in our context I mention American pragmatism as emerging from the seminal contributions of Peirce, Dewey, Mead and others, who were avid readers of the German idealists. In their views, the separation between subject and object is overcome in creative action directly involving the world, and hence ‘reality’ is manifest in the experience gained in successfully acting in the world. As action is transformative, and as we are also inseparable parts of the world, our actions also transform ourselves. At the same time, this action is always enabled by the scaffolds of human sociality, i.e. communication and

cooperation among humans: In modern terms, all epistemic activity is embedded in social cognition.

Climate as a 'Ding an sich'

Again, let me illustrate these fundamental philosophical ideas with a topic taken from Ecological economics (for a related argument, see Szerszynski 2010). What is climate? Morton (2017) has argued that climate is a 'hyperobject'. Without stretching the argument too much, we can argue that climate is a 'Ding an sich'. How can we access climate epistemically? What we experience, is local weather conditions. Science has built a huge arsenal in rendering climate as a scientifically grounded notion. But there are serious and principled limitations to achieving 'objective' or 'true' knowledge about climate in the sense of unequivocally identifying the causal structures and forces that generate climate phenomena, which, after all, in terms of data points, relate back to pre-scientific notions of 'weather', though apparently 'objectifying' them in terms of measurement procedures and the integration of measurements into data-sets that scale on different levels, up to the global. But the only way to identify causal forces is to build climate models. This is because we cannot conduct experiments with the climate as a totality which encompasses us.

Hyperobjects may be just seen as 'systems', but as such they are 'objectified' or 'reified' in terms of the standard conception of the subject-object dichotomy. We face serious difficulties and limitations in dealing scientifically with hyperobjects aka hypercomplex systems, for a wide range of reasons, including scale differences to the range of our own perception and action (we cannot 'see' the climate, as opposed to seeing, say, an animal), we cannot operate controlled experiments (a local climate experiment might interact causally with other localities in an unknown and unpredictable way), we are part and parcel of the climate in the sense of living 'in it' (unless we create a totally insulated spaceship), and so on.

That means, climate is what we create as 'climate' by means of our science. Given the nature of that object, there are principled limitations to reaching a full scientific understanding, especially in terms of our capabilities to predict climate change. If we recognize this properly, it means that climate phenomena are 'intra-actions' in Barad's sense. However, the difficulties are leveraged by the fact that we know that we already do a global scale 'natural experiment' with climate: We change it by our actions anyway. While we are investigating climate, we

simultaneously change the causal dynamics that we want to establish ‘objectively’, i.e. independent from us as epistemic subjects.

But are we really special in doing this? If we consider the issue in terms of the Gaia model of the Earth system, once life emerged on Earth, it became endogenous to the evolving biosphere. In that sense, we are surrounded by hyperobjects like watching Godzilla and other mythical beasts in their perennial battles: The biosphere is a hyperobject, but so are markets, the international political system after the peace of Westphalia, and so on. All these systems meet the defining criteria for being ‘hyperobjects’, and when we consider the impact of humans on the climate, this is not about what we as single individuals do (nothing), but what hyperobjects do to each other within which we are embedded and of which we are parts. Then, we must admit that we neither understand markets nor climate scientifically, and so we cannot understand how they interact.

We are part and parcel of Earth system evolution

I am proceeding with this intellectual ‘creative destruction’ to open the vista on the relevance of German idealism for reflecting on these issues. If we draw the parallel between our impact on climate and the impact of the biosphere on climate, we do not only notice the central role of action in determining the causal interdependencies – just interpret ‘life’ as ‘autonomous agents’ in the sense of Kauffman (2000) which are conducting complete thermodynamic work cycles governed by the goals of maintaining their metabolism and reproduction. We also have a totality, the evolving biosphere, of which we are a part, by definition, including our epistemic activities. What if we are just a stage in the evolution of the Earth system (Lenton et al. 2018)? Is Gaia the naturalistic version of Hegel’s ‘world spirit’?

This is not a new idea. Vernadsky, who coined the term ‘biosphere’, envisaged its evolutionary continuation as ‘noosphere’, the sphere of human thinking. This seems to harmonize with the recent proposals to consider a new geological age, the Anthropocene, which have triggered an intensive and fascinating interaction between the sciences and the humanities, in my view, prescient of the emergence of art as the science of co-creation (Malhi 2017). This concept has also been criticized for being overly anthropocentric, and indeed, the question is whether and how we can conceptualize the evolutionary continuity between biosphere and the human domain. One possible way is to concentrate on the notion of information, in the more precise

sense of semantic or functional information: This idea stands at the centre of pragmatism and means that we interpret information in terms of its role in governing life as a system of goal-oriented action, or adaptively valuable information. One strand of research allows for explicitly and systematically working out the details of the view, modern biosemiotics, harking back to the foundational work on semiotics by Peirce (Deacon 2012; Herrmann-Pillath 2013; Wheeler 2016).

I cannot delve into the details, however, and therefore just illustrate the point with another example from Ecological economics. One hallmark of the biosphere is its capacity for growth harnessing solar energy via photosynthesis, while at the same time minimizing waste by almost complete recycling of all components of the biomass. The information that governs this amazing ‘hyperobject’ is embodied in distributed form in the genetic code of all living organisms that go back to the chemical origin of life. So far, the technosphere, the system created by human action, but not human design, cannot achieve this feat, but threatens to destabilize the biosphere via its failure to achieve sufficient levels of recycling. The possible way out may be finding an evolutionary trajectory that would directly translate biosphere information into technological information, i.e. harnessing solar energy for achieving almost complete recycling, hence a bionic circular economy. For achieving this, human thought and inventiveness is crucial, but insufficient, as the evolutionary trajectories emerge in systemic contexts, such as the economy or science, which are not themselves subject to human control and design. In other words, the challenge is to find a performative trajectory for the co-evolution of biosphere, economy and science, and other domains, that eventually sustains basic constructional principles of the totality of the Earth system (Lenton and Latour 2018; compare Kleidon 2016 on the underlying continuity of physical principles).

Artfully co-creating the Earth

This is the point where the notion of ‘art’ comes in to play. Art was central in German idealism as one activity in the culmination of human spiritual development, hence was conceived as a most sublime form of knowledge. Schelling, for example, thought that metaphysics must ultimately result in a poem of the status of the ‘Divine comedy’ (Hogrebe 1989). This fusion of art and science did not last for long in Western intellectual history, starting with romanticism, and resulting in the growing and deeper fissure between the ‘two cultures’ of the sciences and

the humanities. I posit that we need to go back to the climax of German idealism and approach science and art as epistemological activities not only of the same status, but actually as two sides of the same coin. In a nutshell, *I define art as the science of co-creation.*

Again, let me explore this in direct reference to Ecological economics. My distinction has already been implicit in a very stimulating fictitious scenario drafted by Hiedenpää and Bromley (2016: Chapter 6). They tell a counterfactual history of climate policies that would start out from establishing a ‘Scientific Commission on Climate and Society’ instead of the IPCC. This Commission would have collaborated with climate science (hence the WMO) and not with UNEP, but with UNESCO. Why that? If we take stock of the current state of climate policies, the problem seems to be a specific conceptualization of the relationship between human action, the environment and political decisions. In the reasoning of this essay, this is to conceptualize a clear divide between the environment and the human domain and to treat climate change as an ‘externality’ in the economic sense, that is, following the subject-object logic. However, today we know that this approach fails because it does not tackle the more fundamental issue that we are part and parcel of the Earth system, and that (in the pragmatist sense) our ‘habits’ drive our actions. What is less needed is the design of specific policy instruments, such as a carbon tax, but a radical change in our ways of thinking and our lifestyles. Economists normally assume that rational agents would just achieve this when costs and benefits change, as induced by a carbon tax or an emissions trading system. As Hiedanpää and Bromley argue, in creating the existing institutional regime of international climate policies, the climate problem is being performed as an ‘economic problem’, thus necessarily triggering all forces that commonly drive economic policies, especially juxtaposing the economy (growth, jobs, and all that) and climate, which, tragically, appear to block all substantial progress in solving the current dilemma.

In terms of my contrast of art and science, the IPCC approach is science based, Hiedanpää’s and Bromley’s fictitious organization would be based on ‘art’: This is salient in the choice of the UNESCO as partner organization of the Committee. In metaphorical words, the task is to draw a new painting of the blue planet in a collective effort of humanity, but not to engineer a trade-off between economy and climate.

Less picturesque, what is the difference between art and science in the current context? Clearly, I do not argue that art is a lesser medium of gaining and applying knowledge than science. When I use the term ‘science’, I refer to what emerged as science after the post-Kantian great

divide. But this is a way of doing science which easily falls into the trap of scientism. In this view, the problems in dealing with hypercomplex systems of co-creation are simply interpreted as reflecting gaps in current scientific knowledge, and the belief is typically articulated that future progress will eventually result into more powerful knowledge and hence more effective action. Contrary to this position, I define art as the science of co-creation. In which way does this relate to the conventional understanding of art as radical subjectivity?

The art of living

One strand in modern philosophical thinking also revealed a deep affinity to the arts, music and literature, Critical theory as seminally developed by Horkheimer and Adorno (1944). Horkheimer (1937) famously drew the distinction between ‘traditional theory’ and ‘critical theory’. In my parlance, this distinction refers to the recognition of the entanglement of subject and object if theories have performative effects. ‘Critical theory’ means to recognize the role of science in shaping the society of which it is a part. This comes close to Marx’s famous critique of ‘fetishism’: Traditional theory, in claiming an ‘objective’ analysis of its objects, overlooks that it directly participates in shaping the way how we perceive the objects. We act on these objects but are not able to identify their true nature and meaning.

Now, one way to break through the veil of fetishism is artful creation of realities behind the veil. In the current context, an interesting example is the way how Morton (2017) uses art objects to illustrate the meaning of hyperobjects. In fact, there is along tradition in science to apply art in producing ‘objective’ images of the world, such as in the production of atlases (Daston and Lorraine 2007). Interestingly, this is also true for climate sciences, and we even have down-to-earth (pun intended) methodological recognition of ‘intra-action’ in terms of the renaissance of the role of ‘informed judgment’ in identifying phenomena (such as taxonomies of clouds) vis-à-vis methods that would aim at maximally shrinking the role of ‘subjectivity’.

Again, let me further substantiate this with an example from Ecological economics. Previously, I already referred to the deep troubles of the economics of climate change, which are especially visible in the widely recognized deficiencies of ‘Integrated Assessment Models’ as championed by Nordhaus. One of the central issues is fixing the discount rate (Pyndick 2013), which therefore in practice is a deeply politicized issue (Auffhammer 2018). Nordhaus himself early suggested to use the long-run market interest rate, thus assuming that the market is not only a

medium of aggregating over individual time-preferences, but even of depicting this aggregate in an ‘objective’ way. One radical solution of these dilemmas is proposed in Llavador et al. (2015) (see also the discussion in Heal 2016), namely integrating climate models and economic models without a damage function (which to a certain extent defines away the fundamental economic trade-offs in climate policies). At the same time, they change certain fundamental assumptions about welfare: Most interestingly, they treat education not only as producing human capital as an input, but also as a consumer good that directly generates utility. The immediate effect is to drive the material intensity of production and growth down, hence envisaging the possibility of sustainable growth in the long run.

But what exactly does that mean, treating education as consumer good? Obviously, this is not a question of the ‘objective nature’ of education (embodied and reified as ‘human capital’). In my parlance, redefining education is an act of artistic creativity, and, in a more precise way, would entail the performative effects if such a model is widely adopted as a scientific reference. The model does not describe reality but creates an alternative reality in which all human agents would regard education as a consumer good, thus triggering substantial effects on how the economy operates. How would this reality be effectively created? Well, in the Hiedanpää and Bromley scenario it could have been triggered by the Commission on Climate and Society: Think of switching to a Ruskin-type cultural regime that estheticizes everyday life and imbues it with a different sense on meaning (Ruskin 1985). In this case, ‘art’ becomes not only a method of generating knowledge, but also of living it.

As we realize, art is a method to critically move beyond the veil of fetishism that relies on creating artful visions of alternative realities, possible worlds. This includes artfully showing ways how to realize those possible worlds.

The art of modelling ecology and economy

We can further substantiate ‘art as science of co-creation’ when looking at the current methodological debates about climate modelling. There are three fundamental problems from the philosophical point of view:

- The first is that models suffer the necessary complexity in integrating different scales, especially local effects and their interactions on higher scales (Verburg et al. 2016).

Since these are always co-created by local human populations, there is a need to integrate higher-scale systemic knowledge with local knowledge. This has resulted in new approaches of participatory modelling (Videira et al. 2018), which can be conceived as ‘applied co-creation’.

- The second is that models are only useful for forecasting if they factually are performative, in principle. By this I mean that the model describes a reality in which human actions are generated in an incentive-compatible way. If the model makes assumptions about human action in the future that cannot materialize, it fails predictively, too (Bai et al. 2016). By ‘incentive-compatible’ one should not only consider economic incentives, but also how these are framed, i.e. all aspects of cultural factors that contextualize human action. Methodologically, this means, for instance, to include narratives into models (Moezzi et al. 2017). Indeed, scenario building is a form of science-based artful design of possible futures.
- The third problem is that global models suggest a degree of systemic integration which is elusive (Latour 2015). Even though causality as driven by physical or chemical processes may in fact achieve global scope, causality of living systems is localized, and especially so for human societies: As many critics have pointed out, the ‘Anthropocene’ is the age of Western capitalism, gobbling up all other forms of human societies (Bonneuil and Fressoz 2017). This may also impact on biophysical causalities: For example, most modelling approaches take the nation state for granted as a unit, but cities and networks of cities are in fact major drivers of developments (Biermann et al. 2016).

Considering the three points in combination, co-creative modelling appears to be a far cry from established methods of computer-based analysis of mathematical models. Although these remain an essential ingredient, they would need to be integrated with other methods, and, most importantly, would include other actors than the ‘expert’. This integration, I claim, is itself an act of artful design and cannot be based on scientific principles, in turn. This critique being expressed, I believe that the current practices, for example, of scenario building and assessment in the field of biodiversity have already moved in this direction (IPBES 2016).

Hiedanpää and Bromley (2016: Chapter 9) offer an illuminating example, the policy towards wolf populations: If this is only informed by scientific ecology and does not include local knowledge, policies may utterly fail. This is currently also emerging as a political issue in Germany: In local communities in Eastern ‘Länder’, the wolf has become a politicized figure

which even drives voters into the arms of the radical right, who is the only political force that adopts a tough stance towards wolves. This seems to be a narrative of the struggle between science and populism. But in fact, it reflects deep flaws in ecological modelling that separates ‘nature’ as object and humans and subjects. In the real world of rural communities, wolves and humans are still embedded in a shared ecosystem, and over centuries, if not thousands of years, the wolf has become an integral part of the imaginaries of local culture. If the scientific models do not explicitly include these dimensions, they will lead to policies that are not sustainable. That means, designing a workable ecological model of wolf populations is a creative act of art, possibly even including the aesthetics of local imaginaries.

More generally, the challenge to modelling is to explicitly include the ‘subjective’ dimension, i.e. the human capacity of sense-making and interpretive powers which eventually motivate actions which are constitutive elements of the biophysical causalities in the Anthropocene. However, at the same time we need to recognize that these capacities are also embodied in human technology: If we consider the technosphere as emergent phenomenon of the biosphere, how far does the technosphere manifest its own goal-oriented structures, and how far is human sense-making actually driven by autonomous technosphere processes (Haff 2014, 2016)? On the one hand, modelling the technosphere may highlight its physical properties in the most general sense, which would also allow for recognizing its ontological continuity with the biosphere, as I pointed out earlier, such as in terms of the role of information and energetic transformations. But how can we explore developmental possibilities that inhere in currently emerging goal structures of the technosphere which are not our own ones? In using models to forecast the future, we need to include the mechanisms that generate futures beyond what is emerging in human discourses (Schulz 2016). For example, science fiction can be one epistemic mode by which we can explore mechanisms that are embodied in the technosphere (Raven 2017; Szerszynski 2017).

The art of valuation

In concluding this essay, I want to give a few hints at how we can reconstruct Ecological economics as an art, and what this implies for the practical work of Ecological economists. One of the central issues in Ecological economics is valuation: How can we put value on ‘nature’, ‘the environment’ or ‘biodiversity’, if the economic system and its endogenous valuations do

not generate these values? Indeed, value is one of the pivotal notions in economics, and the approach to valuation should differentiate Ecological economics from both standard economics and ecological sciences.

A most interesting notion is that of ‘ecosystem services’, which had immense impact on the growing clout of Ecological economics and ecological sciences in designing national and international policies. In my perspective, ecosystem services are values designed by artwork with performative intent. Once we recognize this, we can substantially enhance and improve the ecosystem services approach (Gomez-Baggethun 2018). The ecosystems services analysis is one input into a more comprehensive and multi-dimensional process of analysing economic systems with multiple functions and transcending the anthropocentric orientation of conventional economics. This can be achieved in a stepwise expansion of the viewpoints from which the value of a certain ‘service’ can be assessed (as suggested by the concept of ‘deliberative monetary valuation’, overview in Kenter 2018). For example, a certain plant could be valued by indigenous communities in a traditional belief system that governs their interactions with the environment: Identifying and recognizing this value is not only important to explore the multiple dimensions of value, but also to understand functional interdependencies, such as when the belief system, in which the plant plays a role, contributes to local ecosystem sustainability in toto, which also includes the original ecosystem service, thus connecting the two valuations. The next expansion would be to include the perspective of non-humans, for example, of other animals that may rely on the plant as food, or the plants themselves (Myers 2017).

The latter perspective is particularly difficult to achieve. Scientific approaches in the traditional sense might aim at deducing such a perspective from general concepts of ecosystem health, for instance (critical overview in Goldberg et al. 2016). In this case, a top-down analysis would connect human benchmarks of ecosystem sustainability with a hypothetical reconstruction of the value that various species would have for each other. That would include complex trade-offs: For example, the contribution of a large predator to the sustainability of the population of rodents may be conceived as positive even from the perspective of the prey. Obviously, this can only be achieved via imagination, or, artistic creativity on part of the human observer. In more exact terms, this means to create an interpretation of the complex (bio)semiotic network that ultimately constitutes the systemic coherence of the ecosystem in terms of the interactions between its niches, hence the multiplicity of species-specific ‘Umwelten’.

In other words, once we expand the concept of ecosystem services to a much broader concept of valuation, we recognize that it means to decipher the full biosemiotic dimensionality of an ecosystem, i.e. the multiplicity of views within that system, of humans, plants, or animals. This means to co-create the ecosystem: Right in the sense of Darwin's famous final paragraphs of the 'Origin of Species' which paints the image of the "entangled bank". Co-creation is a process in which we firstly, artfully achieve an understanding of the semiosis that creatively works in unfolding and maintaining the interactions within the system, and secondly, we craft our own actions on this knowledge and perceive ourselves as an integral part of it (on a related idea of 'geosemiosis', see Baker 1999, 2017).

In doing this, we need to go back to values. Whereas conventional economics tries to neutralize the value issue by radical subjectivity, Ecological economics would ground the notion of value in a co-creative process that would result in shared values within humanity and even beyond. The synthesis of scientific analysis and the co-creation of values is art. How can we practically implement this? One way is to recognize the central role of minimizing suffering and recognizing the integrity of all forms of life, which translates similar concepts in social philosophy in a non-anthropocentric way (Sayer 2011). As Wheeler (2016) emphasizes, this can be enabled by reflecting on fundamental biosemiotic affinities of all forms of life, which have been recently identified by Damasio (2019) as 'feelings'. In the philosophy of mind, feelings are mostly treated as the ultimate instances of 'qualia', i.e. irreducible subjectivity. Thus, they seem to be the fertile ground for human artistic creativity, but not adducible to 'science'. Damasio argues that there is fundamental continuity of feelings as a shared property of life across all living beings, which enables what Rosa (2016) calls 'resonance' as a foundation of our meaningful and productive relations to the world of which we are a part. I expect that based on this idea, we can promote another Darwinian revolution: 'Gaia-centring' values and valuation. This would only be possible as a performative act (as envisaged in Latour's 2015 discussion of the theatrical performance 'Gaia global circus').

If we remain in this picture, the Ecological economist would assume various roles as a writer, director and even actor in the theatre of doing Ecological economics. This does not mean that facts do not count. After all, we appreciate great creations of art and literature as manifesting a reality behind what we experience in our daily interaction with the world. Many artists ground their work on meticulous research of facts on the ground. In establishing these facts, Ecological Economists must rely on scientific methods put to the scrutiny of the scientific community. But

in creating new hypotheses and venturing to transform their research in policies that work in the real world, they must excel in the art of co-creation.

References

- Alberti, M. (2015): Eco-Evolutionary Dynamics in an Urbanizing Planet, *Trends in Ecology & Evolution* 30(2): 114–26.
- Auffhammer, M. (2018): Quantifying Economic Damages from Climate Change, *Journal of Economic Perspectives* 32(4): 33–52.
- Bai, X., S. van der Leeuw, K. O'Brien, F. Berkhout, F. Biermann, E. S. Brondizio, C. Cudennec, et al. (2016): Plausible and Desirable Futures in the Anthropocene: A New Research Agenda, *Global Environmental Change* 39: 351–62.
- Baker, V. (1999): Presidential Address: Geosemiotics, *GSA Bulletin* 111(5) 633–645.
- Baker, V. (2017): Interdisciplinarity and the Earth Sciences: Transcending the Limits of the Knowledge Paradigm, in: R. Frodeman, J. Thompson Klein and R.C. S. Pacheco, eds., *The Oxford Handbook of Interdisciplinarity*, Second Edition, Oxford University Press.
- Barad, K. M. (2009): *Meeting the universe halfway: quantum physics and the entanglement of matter and meaning*. Duke University Press, Durham.
- Biermann, F. X. Bai, N. Bondre, W. Broadgate, C. A. Chen, O. P. Dube, J. W. Erisman, et al. (2016): Down to Earth: Contextualizing the Anthropocene, *Global Environmental Change* 39: 341–50.
- Boldyrev, I. und E. Svetlova (2016): After the Turn: How the Performativity of Economics Matters, in Boldyrev, I. und E. Svetlova (Hrsg.), *Enacting Dismal Science: New Perspectives on the Performativity of Economics. Perspectives from Social Economics*. New York: Palgrave, 1-28
- Bonneuil, C. and J-B. Fressoz (2017): *The Shock of the Anthropocene: The Earth, History and Us*. London: Verso.
- Brown, P. G. (2016): Ethics for Economics in the Anthropocene, in: Brown, P. G. und P. Timmerman (eds.), *Ecological Economics for the Anthropocene: An Emerging Paradigm*. New York
- Buiter, W. (2009): The Unfortunate Uselessness of Most 'State of the Art' Academic Monetary Economics, VOXEU, March, <http://voxeu.org/article/macro-economics-crisis-irrelevance>
- Çalışkan, K. and Callon, M. (2009): Economization, part 1: Shifting Attention from the Economy Towards Processes of Economization, *Economy and Society*, 38(3), 369-398
- Callon, M. (1986): Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay, in Law, J. (Hrsg.), *Power, Action and Belief: A New sociology of Knowledge?* London, 196-223
- Callon, M. (2007): What Does It Mean to Say That Economics is Performative? in MacKenzie, D., F. Muniesa and L. Siu (ed), *Do Economists Make Markets? On the Performativity of Economics*, Princeton und Oxford: Princeton UP, 344-357
- Damasio, A.R. (2019): *The Strange Order of Things: Life, Feeling, and the Making of Cultures*, New York: Vintage.
- Daston, L. and P. Galison (2007): *Objectivity*, New York: Zone Books, 2007
- Deacon, T. W. (2012): *Incomplete Nature: How Mind Emerged from Matter*. New York: Norton.
- Gomez-Baggethun, E. (2018): Ecosystem Services, in: Spash, Clive L., ed, *Routledge Handbook of Ecological Economics: Nature and Society*. London New York: Routledge.
- Haff, P. K. (2014): Humans and Technology in the Anthropocene: Six Rules, *The Anthropocene Review* 1 (2), S. 126-36
- Haff, P. K. (2016): Purpose in the Anthropocene: Dynamical Role and Physical Basis, *Anthropocene* 16, S. 54-60.

- Hawtrey, R. G. (1932): *The Art of Central Banking*, Abingdon: Frank Cass.
- Heal, G. (2017): *The Economics of the Climate*, *Journal of Economic Literature* 55 (3), 1046-63
- Herrmann-Pillath, C. (2018): *The Case for a New Discipline: Technosphere Science*, *Ecological Economics*, 149, 212-225
- Herrmann-Pillath, C. und I. Boldyrev (2014): *Hegel, Economics, and Institutions: Performing the Social*, Abingdon und London
- Hiedanpää, J. and D. W. Bromley (2016): *Environmental Heresies: The Quest for Reasonable*. London: Palgrave Macmillan.
- Hogrebe, W. (1989): *Prädikation und Genesis: Metaphysik als Fundamentalheuristik im Ausgang von Schellings „Die Weltalter“*, Frankfurt am Main: Suhrkamp.
- Holm, P. (2007): *Which way is up on Callon? MacKenzie, Donald, Fabian Muniesa and Lucia Siu (eds), Do Economists Make Markets? On the Performativity of Economics*, Princeton and Oxford: Princeton University Press, 225-243.
- Holm, P. and K. N. Nielsen (2007): *Framing Fish, Making Markets: The Construction of Individual Transferable Quotas (ITQs)*, in Callon, M., Y. Millo and F. Muniesa (eds), *Market Devices*, Malden et al.: Blackwell, 173–195.
- Horkheimer, M. (1937/1992), *Traditionelle und kritische Theorie: fünf Aufsätze*. 7. Aufl., Frankfurt am Main
- Horkheimer, M. und T. W. Adorno (1944/2016): *Dialektik der Aufklärung: philosophische Fragmente*. 22. Auflage. Frankfurt am Main
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2016): *The Methodological Assessment Report on Scenarios and Models of Biodiversity and Ecosystem Services*, Bonn: IPBS.
- Kauffman, Stuart A. (2000): *Investigations*, Oxford: Oxford University Press.
- Kenter, J. O. (2018): *Deliberative Monetary Valuation*, in: Spash, C. L., ed, *Routledge Handbook of Ecological Economics: Nature and Society*. London New York: Routledge.
- Kleidon, A. (2016): *Thermodynamic Foundations of the Earth System*, Cambridge: Cambridge University Press
- Latour, B. (2012): *Enquête sur les modes d'existence: Une anthropologie des modernes*, Paris: Découverte
- Latour, B. (2015): *Face à Gaïa: Huit conférences sur le nouveau régime climatique*, Paris: Découverte
- Leamer, E. E. (2012): *The Craft of Economics: Lessons from the Heckscher-Ohlin Framework*, Cambridge: MIT Press.
- Lenton, T. M., S. J. Daines, J. G. Dyke, A. E. Nicholson, D. M. Wilkinson and H. T.P. Williams (2018): *Selection for Gaia across Multiple Scales*. *Trends in Ecology & Evolution* 33(8): 633–45.
- Lenton, T. M. and B. Latour (2018): *Gaia 2.0*, *Science* 361, 6407: 1066–68.
- Llavador, H., J. E. Roemer und J. Silvestre (2015): *Sustainability for a Warming Planet*, Cambridge: Harvard University Press.
- MacKenzie, D. (2006): *An Engine, Not a Camera: How Financial Models Shape Markets*, Cambridge and London
- Malhi, Y. (2017): *The Concept of the Anthropocene*. *Annual Review of Environment and Resources* 42, 1, 77–104.
- Mankiw, N. G. (2006): *The Macroeconomist as Scientist and Engineer*, *Journal of Economic Perspectives* 20(4), 29-46.
- Moezzi, M., K. B. Janda and S. Rotmann (2017): *Using Stories, Narratives, and Storytelling in Energy and Climate Change Research*, *Energy Research & Social Science* 31: 1–10.
- Morton, T. (2013): *Hyperobjects: Philosophy and Ecology after the End of the World*, Minneapolis and London: Minneapolis University Press.
- Myers, N. (2017): *From the Anthropocene to the Planthropocene: Designing Gardens for Plant/People Involution, History and Anthropology* 28(3): 297–301.

- Polanyi, K. (1944/2001): *The Great Transformation: The Political and Economic Origins of Our Time*. Boston
- Pyndick, R. S. (2013): Climate Change Policy: What Do the Models Tell Us? *Journal of Economic Literature* LI (3), 860-872
- Raven, P. G. (2017): Telling Tomorrows: Science Fiction as an Energy Futures Research Tool, *Energy Research & Social Science* 31:164–69.
- Rescher, N. (1999): *The Limits of Science*, Pittsburgh: Pittsburgh University Press.
- Romer, P. (2016): *The Trouble With Macroeconomics*, mimeo, <https://paulromer.net/the-trouble-with-macro/>
- Rosa, H. (2018): *Resonanz: eine Soziologie der Weltbeziehung*. Berlin: Suhrkamp.
- Ruskin, J.(1985): *Unto this last, and other writings*. Harmondsworth, New York: Penguin Books
- Sayer, R. A. (2011): *Why Things Matter to People: Social Science, Values and Ethical Life*, Cambridge und New York: Cambridge University Press.
- Schulz, M. S. (2016): Debating Futures: Global Trends, Alternative Visions, and Public Discourse, *International Sociology* 31(1): 3–20.
- Searle, J. R. (1995), *The Construction of Social Reality*, New York: Free Press.
- Spash, C. L. (2013): The Shallow or the Deep Ecological Economics Movement? *Ecological Economics* 93 (2013): S. 351-62
- Spash, C. L. (2012): New foundations for ecological economics, *Ecological Economics*, 77, 36-47.
- Strand, R. (2018): Post-normal science, in: Spash, C. L., ed, *Routledge Handbook of Ecological Economics: Nature and Society*. London New York: Routledge.
- Szerszynski, B. (2010): Reading and Writing the Weather, *Theory, Culture & Society* 27, 2–3, 9–30.
- Szerszynski, B. (2017): Viewing the Technosphere in an Interplanetary Light, *The Anthropocene Review* 4(2): 92–102.
- Taylor, C. (1985): Hegel’s Philosophy of Mind, in: C. Taylor, *Human Agency and Language. Philosophical Papers*, Cambridge, S. 77-96
- Taylor, C. (1989): *Sources of the Self: The Making of Modern Identity*, Cambridge
- Verburg, P. H., J. A. Dearing, J. G. Dyke, S. van der Leeuw, S. Seitzinger, W. Steffen, and J. Syvitski (2016): Methods and Approaches to Modelling the Anthropocene. *Global Environmental Change* 39, 328–40
- Videira, N. Antunes, P. and Santos, R. (2018): Participatory modelling in ecological economics: lessons from practice, Spash, Clive L., ed, *Routledge Handbook of Ecological Economics: Nature and Society*. London New York: Routledge.
- Vosselman, E. (2014): The ‘Performativity Thesis’ and Its Critics: Towards a Relational Ontology of Management Accounting, *Accounting and Business Research* 44 (2), 181-203
- Wheeler, W. (2016): *Expecting the Earth: Life, Culture, Biosemiotics*. London: Lawrence & Wishart.