



**Boehnert, J. (2017) 'Ecological theory in design: participant designers in an age of entanglement', in Egenhoefer, R.B., ed. *Routledge handbook of sustainable design*. Abingdon, Routledge, pp. 86-98.**

This is an Accepted Manuscript of a book chapter published by Routledge in '*Routledge handbook of sustainable design*' on 07/08/2017 available online at:

<https://www.taylorfrancis.com/chapters/edit/10.4324/9781315625508-9/>

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Chapter 6

Ecological Theory in Design:  
Participant Designers in an Age of Entanglement

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## **Ecological Theory in Design: Participant Designers in an Age of Entanglement**

In a 1964 paper titled ‘Ecology – A Subversive Science’ Paul Sears proposed that if ecology was taken seriously it would “endanger the assumptions and practices accepted by modern societies” (11-12). Five decades later aspects of this disruptive vision have infiltrated mainstream design. Prominent design theorists talk about participant designers, the circular economy, biomimicry, bioregional design, transition design and many other concepts that support sustainable design. Responsible organizations claim to address sustainability agendas as an integral part of every design brief. In progressive places, the various design disciplines are developing new norms informed by the environmental sciences and ecological theory. And yet despite the hard work by many designers concerned with sustainability, this transition is not happening fast enough to stop the trajectory of increasingly serious environmental risks. Ecological theory is still relatively new to design theory and so all ideas within the context of this new ‘age of entanglement’ need to be disentangled from the ecological illiterate assumptions of modernity.

Humankind has initiated a new geological epoch known as the Anthropocene. The *anthropos* (Greek for ‘humans’) are dramatically affecting Earth system processes and are now responsible for cascading crisis conditions (including but not limited to climate change). While there is much debate on the nature of the challenges associated with sustainability, one thing is certain: designers and other disciplines must develop less ecologically destructive ways of living on this planet. This goal requires a thorough understanding of the nature of environmental problems and the various ways in which these problems can be addressed.

The Earth sciences (geosciences) describe a wide assortment of environmental problems with great precision. These sciences include ecology, biology, geology, geography, atmospheric sciences, hydrology, soil sciences, etc. Earth system scientists warn that three planetary boundary conditions have been breached (Steffen *et al.*, 2015). The evidence on climate change is unequivocal. The science is contested by the contingent of climate deniers and hard-core anti-environmentalists that dismiss environmental harms entirely. What is almost as controversial are interpretations of the causes of environmental problems and the many different proposed solutions.

Ecological theory is a foundation for informed decision-making and problem solving on environmental issues. It is a body of knowledge that proposes more functional ways of conceptualising human-nature relations as a basis for the design and development of more sustainable ways of living on this planet. It supports a transition from a dualistic, reductionist and exploitative perspective to a worldview that is participative, relational and complex. Observations in the Earth sciences are a catalyst but the vital work that ecologically literate sustainability advocates must now do involves philosophical, cultural, social, technological and political transformations. Design has an important role to play in these transitions.

Considering the severity of many unintended consequences of design and development, questions to be investigated by ecological theorists include: ‘what gives some people the right to commit ecologically damaging activities that destroy the lives of others, now and in the future?’ A responsible enquiry based on this question shatters many basic assumptions about what constitutes good design. As Sears predicated, ecological thought is disruptive. For this reason it is not always welcome in places where it is urgently needed.

### **Ecological Theory**

Ecological thought challenges the intellectual tradition wherein the environment is available to be endlessly exploited and where humanity must conquer the non-human natural world to

survive. The design of sustainable ways of living requires a different perspective. Ecological thought emphasizes the intricate interconnectivity and interdependency between humans and the non-human natural world. The term ‘non-human nature’ accentuates the fact that humans are also part of nature. Non-human nature actively influences the course of history (i.e. consider how new germs have transformed societies). A complex web of life-sustaining ecosystems enables humankind to flourish – or not. For several decades now scientists have warned that many of the ecosystems services that we depend on have been seriously damaged and de-stabilized by human activities. Effective responses to these problems depend on thorough analysis of their origins. A review of the historical circumstances and the ideas that have enabled environmentally harmful development and design is a starting point.

### **Historical Attitudes Toward Nature**

Attitudes towards nature have a variety of philosophical origins. Some of the most powerful and enduring ideas were those that emerged during the scientific revolution (circa 16<sup>th</sup>-18<sup>th</sup> centuries) and the Enlightenment (18<sup>th</sup> century). During this period Frances Bacon’s (1561-1626) empiricism, Rene Descartes’ (1596-1650) rationalism and Isaac Newton’s (1643-1727) mechanism emerged as the dominant constructs that influence the ways that nature is understood. Sustainability educational theorist Stephen Sterling claims that this worldview had “an ontology that emphasized a mechanistic cosmology, which was primarily determinist, and materialist; and an epistemology that was objectivist, positivist, reductive and dualist” (2003, 143). Enlightenment science holds that valid knowledge is derived from empirical evidence (based on observations, experiments and measurement tools). This approach to science has made dramatic technological progress possible – but it has also had other consequences.

Ecofeminist and historian of science Carolyn Merchant alleges that Frances Bacon (known as father of the scientific method) created a powerful cultural metaphor of nature as female and as a force to be mastered, controlled and made to submit. This way of describing nature is dramatically different from earlier ideas:

The removal of the animistic, organic assumptions about the cosmos constituted the death of nature – the most far-reaching effect of the scientific revolution. Because nature was now viewed as a system of dead, inert, particles moved by external, rather than inherent forces, the mechanical framework itself could legitimize the manipulation of nature (Merchant 2001, 281).

The scientific revolution created a new conception of the world as passive, available for utilization and in need of being controlled. Bacon wrote that nature was to “take orders from Man and work under his authority” (quoted in Harding 2006, 26). Ecological theorists allege that this conceptualisation created the framework for exploitative human-nature relations.

### **Origins of Ecological Thought**

The word ‘ecology’ was coined in 1866 by Ernest Haeckel (1834-1919) as “the science of relations between an organism and the surrounding outer world”. Haeckel was a biologist, a philosopher and also a talented artist who created detailed drawings of microscopic life forms, plants and animals. Thus the study of ecology was linked to image-making from its conception. Unfortunately, ecology has also been linked to racist and oppressive philosophical interpretations. This includes some of Haeckel’s own theory. Later, Jan Smuts (1870 –1950) coined the concept of ‘holism’ and used references to nature to advance racist political policies including racial segregation in South Africa. Nature was mobilised by Hitler and the Nazi regime in 1930-40s as a means of presenting the Aryan or Germanic master race as genetically superior *Übermensch*. The ways in which erroneous interpretations of nature have been used to justify the exploitation of certain groups of people is an on going problem.

In the early 20<sup>th</sup> century physicists Einstein, Heisenberg and others conducted experiments that proved that an observer is a participant that influences experimental results. This breakthrough challenged the subject/object dualism in the scientific tradition. Quantum physics revolutionized the understanding of observation, perception, participation, relationship and influences. These insights took many decades to influence ecological thought and will take even longer to become embedded in design. Over a century later design theorists describe how ‘participant designers’ (Slavin 2016, Ito 2016) are part of the world that they aim to influence in an ‘age of entanglement’ (Oxman 2016, Hillis 2016). I will describe what it means to be a participant designer later in this chapter.

Meanwhile, over the course of the 20<sup>th</sup> century ecology developed into a science concerned with feedback mechanisms with the intention of understanding and ultimately controlling natural processes. These reductionist, positivist and instrumentalised approaches to ecology are still prominent. This paradigm has been challenged with increasing clarity over the past sixty years as more integrated, systemic and holistic ways of understanding human nature relations have been articulated.

### **Characteristics of Ecological Thought**

A critique of reductionist science with its atomism, dualism and anthropocentrism is a basis for ecological theory. Ecological theorists claim that reductionist science erases complexity: “knowledge gains in rigour what it loses in richness” (Santos 2007, 27). Furthermore, it reduces the complexity to alienated elements such that “knowledge gained from observation of the parts is necessarily distorted” (*Ibid*, 28). Vandana Shiva developed this argument in ‘Reductionist Science as Epistemological Violence’ where she claims: “reductionist science is also at the root of the growing ecological crisis, because it entails a transformation of nature such that the processes, regularities and regenerative capacity of nature are destroyed” (1988, unpaginated). Theorists such as Eugene Odum (1953), Barry Commoner (1966; 1971) E.F.Schumacher (1973; 1977), Herman Daly (1991; 1996), Murray Bookchin (1971; 1980; 1982), Val Plumwood (2002); Vandana Shiva (1988; 1992; 2005); Fritjof Capra (1975; 1982; 1996; 2002; 2014) and others have developed ecological theory in this tradition. A commons based ecological theory approaches ecology as a commons, to be understood as a community or a network forming an integrated whole.

The ecological paradigm offers a more comprehensive foundation for building sustainable ways of living on this planet. Thomas Kuhn famously described paradigms as the “entire constellation of achievements – concepts, values, techniques, and so on shared by the members of a given community” (1962, 175). The concept emphasizes how worldviews, frameworks and constructs are changeable. When a paradigm is no longer fit for purpose, more appropriate interpretative models replace it. Ecological thought offers a type of rationality, ethic, ontology and epistemology that acknowledge ecological context and prioritize mutually beneficial human-nature relations. The ecological paradigm proposes deep-reaching shifts in ways of understanding human relations within our ecological context.

### *Ecological Rationality*

Ecological thought describes a historic and systemic undervaluing or dismissal of non-human nature in modernist thought. This has led to a consistent underestimation of complexity. Philosopher and ecofeminist Val Plumwood describes “a cult of reason that elevates to extreme superiority a particular narrow form of reason and correspondingly devalues the contrasted and reduced sphere of nature and embodiment” (2002, 4). Plumwood describes a contemporary ‘crisis of reason’ propelled by attitudes and assumptions that dismiss the context that makes reason possible in the first place. Some enabling factors include the backgrounding of the activity and agency of nature and the remoteness and the distant consequences of actions in industrial society. Ecological rationality proposes more inclusive and holistic forms of reason that do not ignore that on which it depends.

### *Ecological Ethics*

Early ecological theorist Aldo Leopold advocated an extension of ethics to include the natural world. All ethics, according to Leopold, are based on “a single premise: that we are members of a community of interdependent parts” (2001 [1949]: 98). He proposed a simple ethic: “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise” (*Ibid.*, 110). The simplicity of this proposal is appealing but as the impacts of technological innovation, development and design have wide reaching consequences – ecological ethics are far from simple. Ethical decision-making is dependent on institutional, technical and communicative processes that make it possible to anticipate unintended consequences. With extended boundaries of concern, putting ecological ethics into practice is complex and political.

Ecological ethics are complicated by the remoteness of industrial processes, poor communicative links and unintended consequences. As unintended consequences are often distant (in time and space) or entirely unknown, the ethical practice requires concerted efforts to understand causality and risk in order to take greater precaution. All too often, it is more financially rewarding for industry to deny the existence of unintended consequences than anticipate and confronting problems before they happen. As new technology and innovation emerge faster than the social mechanisms and institutions to ensure unintended consequences are investigated and avoided, ethics are compromised. The result is more (and often amplified) unsustainable development.

### *Ecological Ontology*

Ontology is the study of the nature of being. Ecological ontology is our constitutive embeddedness within and as part of larger ecological systems on which we depend. Each of us is nested within the ecological context. Ecosystems come in many sizes, each nesting within larger systems (from microscopic to planetary). The ecological, social and economic systems can also be understood as nested systems (see figures 1). The economic order is nested within social order. The social order, in turn, is nested in the ecological order. The Earth will continue to evolve regardless of what happens to the social and the economic orders. Clearly ecological systems on various scales can be degraded and destabilized (i.e. significantly less biodiversity, dead seas, desertification, toxicity, etc.). Ecological economists argue that the economic system has not been constructed to respond to feedback from the systems in which it is embedded (the social and ecological systems) and on which it depends. The concept of nested systems describes how dysfunction arises when the systems that humans design do not reflect ontological interdependence and interconnectivity.

<FIGURE 1.1 HERE>

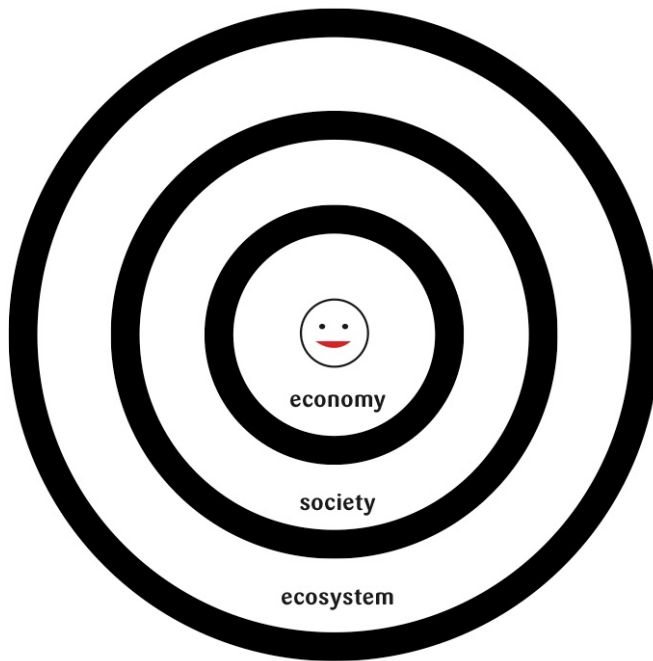


Fig 1.1 The ecosystem, society & economy as nested systems. EcoLabs 2014

### *Ecological Epistemology*

Epistemology is the study of the nature of knowledge and ways of knowing. In the book *Steps to an Ecology of Mind* (1972) anthropologist and cyberneticist Gregory Bateson described an ‘epistemological error’ in the current dominant worldview. Bateson wrote: “most of us are governed by epistemologies we know to be wrong” (493) and initiated the revision of epistemological premises in ecological thought. Within the context of a society with powerful industrial capacities, risks associated with this ‘epistemological error’ are severe:

I suggest that the last 100 years or so have demonstrated empirically that if an organism or aggregate of organisms sets to work with a focus on its own survival and thinks that is the way to select its adaptive moves, its ‘progress’ end up with a destroyed environment. If an organism ends up destroying its environment, it has in fact destroyed itself (*Ibid*, 457).

Humans are part of the natural world and dependent on it for survival but the dominant epistemological tradition denies this relationship. The narrowing down of ways of knowing to focus only on our own interests is one aspect of epistemological error.

When you separate mind from the structure in which it is immanent, such as human relationship, the human society, or the ecosystem, you thereby embark, I believe, on fundamental error, which in the end will surely hurt you (*Ibid*, 493).

Epistemological error is characterized by a number of fallacies that include: 1) the assumption that humans are separate from the non-human natural world; 2) the assumption that this separation creates a ‘natural’ competition; and 3) the assumption that competition and domination are the primary means to success. These premises have wide ranging implications.

The concept of epistemological error describes a crisis of perception. An ecological paradigm implies a shift in perception. Since design is a practice that is often concerned with perception, learning and encouraging people to do things in new ways, there are many ways design can help facilitate this shift. Communication design is especially well suited to nurture ecological perception by drawing attention to patterns, context, comparisons, causality, connections and complexity. In illustrating these types of relationships, “graphic design has unique potential to nurture the ability to ‘see systems’ – supporting both

ecological perception and ecological literacy” (Boehnert 2014, 1). While graphic design deals most directly with perception, all types of design both reflect and also influence how people understand and relate to the material world.

Language, communication, objects and cities are all constructed in ways that reflect the ideas and assumptions of the people involved with their creation (along with economic priorities that influence what type of work is done). Bateson explains that the world “partly becomes – comes to be – how it is imagined” (1980, 223). Designed artifacts, spaces, systems and communications are extensions of our ways of knowing. Epistemological error is thereby encoded into communication, artifacts and systems structures – reproducing cultural assumptions and making it difficult to identify alternatives.

This perspective limits human capacities to perceive, engage with and respond to complex problems. Sterling explains that “the dominant western epistemology, or knowledge system, is no longer adequate to cope with the world that it itself has partly created” (2003, 3). Ecological theory reveals epistemological blind spots and proposes alternatives. This “shift from mechanism, which has dominated western thinking for over three hundred years to a new organism; from the machine metaphor to the systemic metaphor of ecology” (Ibid, 8) is increasingly evident. Designers are in a good position to embed this vision into new communication, products and environments.

### *Alternative Epistemologies*

Feminist, class, race and indigenous scholars and activists have described how conceptual frameworks justify exploitation. Feminist theory critiques androcentrism and the supposed value neutrality of hegemonic ideologies and perspectives. Donna Haraway argues that all knowledge is situated: meaning that knowledge emerges out of a particular social, cultural and material context (1988). Feminist theory describes how conceptual frameworks and institutional practices reproduce oppressions: “Injustice does not take place in a conceptual vacuum, but is closely linked to desensitizing and Othering frameworks” (Plumwood 1999, 197). ‘Othering’ is the process through which the interests and needs of certain groups of people are denied the same considerations and rights as those with greater privilege.

Obviously women are not the only social group encountering oppression and many people face multiple and intersecting injustices. Ecofeminists extend feminist theory work to include non-human nature. They maintain that social injustices and environmental injustices are both enabled by othering frameworks. Since intersectional feminist strategies and other anti-oppressive work have in places worked to help make women’s and other groups’ needs and interests visible and actionable (these are ongoing struggles) – these strategies can also inform the work that needs to be done to confront the forces that deny the interests of non-human nature.

At least 7,000 indigenous societies around the world maintain a variety ecological epistemological traditions based on a “substantive reliance of interrelatedness of nature” (Lauderdale 2007, 741). TEK (traditional ecological knowledge) offers unique ways of conceptualizing human-nature relations often embedded in oral traditions. Indigenous people typically celebrate nature’s regenerative capacities with an ethic of care that is based on relationships and kinship. For this reason, many ecological theorists agree that traditional indigenous knowledge has “inclusive approaches to current environment problems and critical ideas on how to... create more equitable, less oppressive structures from which to approach the numerous crises” (Lauderdale 2008, 1836). While it is true that not all indigenous peoples have always been sound ecological stewards, they have cultivated place-based knowledge that has often supported relatively ecologically sustainable ways of living. In many places indigenous peoples now struggle against those who threaten their existence



with land grabs, pollution and resource extraction on their territories.. Biopiracy (meaning the theft of property, tradition knowledge and biological/genetic resources) is one of the many examples of the continuation of half a millennium of colonialism.

### *Epistemic Selectivities*

The ecological paradigm described above is still marginal. As a disruptive vision that exposes many common practices in society as deeply unsustainable, it is unwelcome by those with a vested interest in the status quo. Scholars studying the continued marginalization of environmental concerns refer to ‘epistemic selectivities’ as the dynamics that legitimize certain epistemological perspectives at the expense of others. Epistemic selectivities are “mechanisms inscribed in political institutions which privilege particular forms of knowledge, problem perceptions, and narrative over others” (Brand & Vardot 2013, 218). It is often psychologically easier for the materially privileged and powerful to ignore facts and entire ways of thinking that threaten their sense of entitlement. In this way, people with relative amounts of power avoid feeling complicit with the injustices that are a consequence of unsustainable development.

### **The Emergence of Ecological Literacy**

The design and development of sustainable futures demands specialized knowledge and skills informed by ecological knowledge within the various disciplinary traditions. David Orr coined the concept of ‘ecological literacy’ in 1992 as a type of education that imparts an understanding of our ecology context and of environmental problems along with new capacities to respond effectively. Orr argues that environmental problems are linked to how we think:

The disordering of ecological systems and of the great biogeochemical cycles of the earth reflects a prior disorder in the thought, perception, imagination, intellectual priorities, and loyalties inherent in the industrial mind. Ultimately, then, the ecological crisis concerns how we think and the institutions that purport to shape and refine the capacity to think (Orr 2004, 2).

Orr explains that environmental problems “are mostly the result of a miscalculation between human intention and ecological results, which is to say that they are a kind of design failure” (2002, 14). These design failures signal “inherent problems in our perceptual and mental abilities” but also suggest that improvements can be made through design (Ibid, 14). Design can be a powerful transformative practice when it is informed by an in-depth understanding of ecological theory. It should be evident that ecological literacy must become a pedagogic priority in design education. Ecologically literate education involves, according to Orr, an understanding of why it is necessary to work with (rather than against) natural forces; a basic familiarity with ecological processes; a historical understanding of how humankind has become so destructive; and capacities to work towards solutions (1992, 93-94). Ten years later Orr proposed more specific features of ecological design. He described it as a community process that aims to increase local resilience; as accepting limits; as eliminating the concept of waste; and as having to do with systems structure (2002, 180-183). These goals typically demand interdisciplinary collaborations beyond the scope of traditional design education. Ecologically literate design is systems aware (see Chapter 1: Systems Thinking and Design), enabling, collaborative and participatory. With ecological literacy, the scope of change required to address environmental problems become evident. But the awareness of the ecological impact of our actions is only the beginning of the journey as ecological literacy demands critical skills in diagnosing what the forces that reproduce the unsustainable. Ecological literacy is a basis for ethical and informed decision-making in a technological advanced civilization with severe ecological consequences.

### *Participant Designers*

The notion of a participant designer implies a profound transformation. With this perspective, designers are “participants within the systems they exist in. This is a

fundamental shift—one that requires a new set of values” (Ito 2016, para 17). MIT Media Lab Director Joichi Ito describes an internal shift that influences the ways designers work:

*As participant designers, we focus on changing ourselves and the way we do things in order to change the world. With this new perspective, we will be able to tackle extremely important problems that don't fit neatly into current academic systems: instead of designing other people's systems, we will redesign our way of thinking and working and impact the world by impacting ourselves (2016, para 28).*

The participant perspective acknowledges that designers are part of the world that we want to influence. This view sits in sharp contrast to the narrower perspective where designers focus on ‘the user’. Kevin Slavin claims that: “This is the inversion of User Centric Design. Rather than placing the human at the center of the work, the systems that surround us – systems we depend on – take the appropriate center stage in their complexity, mystery, in their unpredictability” (2016, para. 36). Participant designers are learning to work in transformative ways by

*engaging with the complex adaptive systems that surround us, by revealing instead of obscuring, by building friction instead of hiding it, and by making clear that every one of us (designers included) are nothing more than participants in systems that have no center to begin with. These are designers of systems that participate – with us and with one another – systems that invite participation instead of demanding interaction.*

*We can build software to eat the world, or software to feed it. And if we are going to feed it, it will require a different approach to design, one which optimizes for a different type of growth, and one that draws upon – and rewards – the humility of the designers who participate within it (Slavin 2016, para. 40 & 41).*

The ‘type’ growth that Slavin refers to here should be qualitative, regenerative growth (in shared prosperity) – with simultaneous *de-growth* in what is currently counted as economic growth – but has devastating ecologically and social consequences (known abstractly and over-simplistically as ‘economic externalities’). Challenging the nature of growth is an essential part of developing sustainable future ways of living.

### *Nature's Patterns and Processes*

Nature's patterns and processes provide time-tested models for the design of sustainable ways of living. Ecological theorist Fritjof Capra describes six “principles of organization, common to all living systems, that ecosystems have evolved to sustain the web of life” (2003, 201). The Center of Ecological Literacy lists six processes and patterns in ecological systems:

**Networks:** “All living things in an ecosystem are interconnected through networks of relationship.”

**Nested Systems:** “Nature is made up of systems that are nested within systems. Each individual system is an integrated whole and—at the same time—part of larger systems.”

**Cycles:** “Members of an ecological community depend on the exchange of resources in continual cycles.”

**Flows:** “Each organism needs a continual flow of energy to stay alive. The constant flow of energy from the sun to Earth sustains life and drives most ecological cycles.”

**Development:** “All life—from individual organisms to species to ecosystems—changes over time. Individuals develop and learn, species adapt and evolve, and organisms in ecosystems coevolve.”

**Dynamic Balance:** “Ecological communities act as feedback loops, so that the community maintains a relatively steady state that also has continual fluctuations. This dynamic balance provides resiliency in the face of ecosystem change” (2016).

Patterns in nature are also the building block of biomimicry (see Chapter 25). Design that works with nature's patterns and processes is regenerative for humans and non-human nature alike. Nature's patterns and processes framework can be applied at all levels of systems that humans design – including political and economic systems.

### **Ecological Literacy and the Political Economy of Design**

In the context of a deeply unsustainable culture, ecological literacy offers a more comprehensive critique than the abused concepts of ‘sustainability’ and ‘sustainable development’. Sustainability has been associated with development since the 1987 United

Nations Brundtland Commission report *Our Common Future*. Meaning ‘ecological care’ and ‘development’ simultaneously the term has been described as conflicted. Critics claim that the concept ensures the “conservation of development, not for the conservation of nature” (Sachs 1999, 34). This contradiction has noted from the beginning:

With sustainable development there are no limits to growth. Greens and environmentalists who today still use this concept display ecological illiteracy. There is a basic contradiction between the finiteness of the Earth, with natural self-regulating systems operating within limits, and the expansionary nature of industrial capitalist society. The language of sustainable development helps mask this fundamental contradiction, so that industrial expansion on a global scale can temporarily continue (Orton 1989, unpaginated).

Increasing levels of consumption with ever more people wanting more resource intensive stuff cannot happen indefinitely. Ecological literacy acknowledges thresholds and builds capacity to address problems where shallow approaches to sustainability fail. While the Earth’s generative capacities can be sometimes be remediated, there are also finite resources and planetary boundaries that must be taken into account.

Ecological literacy informs the debate on sustainability by emphasizing the contextual and collective nature of sustaining civilization over time. Sustainability is not the feature of one product, but is the condition of an entire culture relative to its gross impact on ecological systems. The per capita ecological footprint of consumption is 4.9 global hectare (gha) in the United Kingdom and 8.2 gha in the United States (Global Footprint Network, 2016). These nations collectively use respectively over 3 and 5 times the sustainable levels of resources. Cumulatively these two nations have ways of living that are deeply unsustainable. Pollution and climate change already have very real consequences (especially for the poor who bear the brunt of environmental harms). There will be even more dramatic consequences for future generations. While some individuals personally use fewer resources and create less pollution, it is the gross impact of the system that matters. For this reason sustainability is a political problem. It is about structural choices (that determine how much greenhouse gases are released and the types of development that is enabled) – and not simply a matter of individual consumer choices. The designer concerned with creating sustainable ways of living needs to think not only about the ecological circumstances relevant to a particular design problem she is addressing – but how she participates in a political context that is changing to meet environmental challenges. Environmental problems are also political problems so the political economy of design matters. Economic priorities have a determining role in the degree to which design can address ecological problems. Designers concerned with sustainability need to consider why it is that ecological sustainability is so difficult in the current political context.

### **Some Clarification on Ecological Entanglement**

While design increasingly engages with ecological entanglements, certain ways of thinking continue to enable continued harmful, unsustainable design and development. MIT Press *Journal of Design and Science* (January 2016), published an article with a section titled ‘The End of the Artificial’ where Joichi Ito claims that “unlike the past where there was a clearer separation between those things that represented the artificial and those that represented the organic, the cultural and the natural, it appears that nature and the artificial are merging” (2016, para. 20). In the same journal, Danny Hillis states:

We humans are changing. We have become so intertwined with what we have created that we are no longer separate from it. We have outgrown the distinction between the natural and the artificial. We are what we make... We are at the dawn of the Age of Entanglement (2016, para.1).

It is true that plastic debris is clogging up the guts of marine animals, greenhouse gases in the upper atmosphere are destabilising the climate system and there are endless examples of similar entanglements. The artificial and the organic are definitely interacting in countless ways on all scales across the Earth – but the ‘end of the artificial’ concept has more to do the legacy of epistemological error and the particular type of political economy that emerged from this error than the so-called merging of the ecological and the artificial. Contrary to the

ideas presented in this journal, the entanglement must not be theorised as the coalescing of the natural and the artificial.

The ways that we talk about nature influences how we understand and value it. If the artificial things that humans have designed and constructed over the past century are of the same order as natural patterns and processes that have made it possible for humans to flourish over millennia – this influences the ways we understand and value natural processes. And not in ways that are helpful. The ecological sphere has evolved over millions of years to enable life-sustaining conditions on this planet. In stark contrast to the ecological, the artificial has not endured the test of time. It has not evolved to work in harmony with the ecological. In many places it disables or disrupts the dynamic balance ecosystems need to sustain or regenerate their processes. The climate system is the most dramatic example of this severe disruption. The artificial includes toxic elements and destructive technologies that threaten not only the most complex and exquisite ecosystems and animals on the planet but civilisation itself.

Nature is of a different order than the artificial because it is the *context* of the artificial. Just because it is now possible to ‘edit’ nature (genetic engineering, synthetic biology, geo-engineering) does not mean the organic and the artificial are the same, or that they have equivalent value. We might redesign nature into what appears to the most cavalier amongst us as a ‘better’ place, to suit human needs and desires – but we cannot predict with certainty the consequences of the most dramatic interventions. (This is what is described as the ‘instrumentalisation’ of human-nature relations: where natural processes are controlled, exploited). On the other hand, nature has experimented for millions of years to refine the evolutionary moment that we find ourselves in now, one that we are quickly degrading. Since humans have already caused irreparable damage to the climate system, to biodiversity and to a vast array of ecosystems and species, now is not the time to build new theory that will further dismiss ecological concerns.

In a context that already denies the primacy of the ecological, the claim that the ecological and the artificial are merging is a convenient and ‘useful’ assumption. It is a claim that facilitates the interests that profit from new technologies and associated market growth. Meanwhile, the denigration and dismissal of the ecological context is not an easy assumption to break considering the powerful interests that are served by certain types of industrial development and the historical circumstances that have led to epistemological error and ecologically destructive types of development. The flattening of the natural and the artificial is an error of order and value. The ignoring of the severity of the consequences of industry emerges from this mind set. This is part of the epistemological error that must be challenged. The error is simultaneously in ways of thinking, in design and in the political economy.

Design is a social practice that reflects the assumptions of designers as well as priorities embedded into the political economy. There are toxins and greenhouse gases that are entangled with ‘the natural’ in deeply damaging way. Ecological theory provides a basis for making distinctions between good and bad entanglements. Knowing the difference between life-sustaining and life-destroying entanglements is essential for designers to move beyond the ecologically disastrous errors of modernity.

## **Conclusion**

Ecological rationality, ethics, ontologies and epistemologies challenge conceptions of nature as ripe for abuse. Ecological thought rejects modernist rationality that “depends on what it destroys for its survival” (Plumwood 2002, 236). It should be evident that “no rational society rewards members to undermine its existence” (Orr 1992, 6) but clearly those who exploit natural and human ‘resources’ are rewarded financially in the current economic

context. Ecological thought offers a more coherent paradigm as a basis for sustainable transformations. The participant designer understands herself as embedded within and interdependent with her ecological context. Yet effective design solutions do not simply emerge from this understanding. They become possible through her capacities to analyze and identify the interests that are systemically de-prioritized in this particular context along the concepts that legitimize environmental and social harms and injustices. The participant designer must understand why the political economy matters for regenerative design to enable change on a scale necessary to address society's most severe problems.

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