Technē Logos and the (Neg)anthropocene

The first annual conference of the European Culture and Technology Laboratory.

Noel Fitzpatrick
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EUt+ Academic Press

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Preface

The European Culture and Technology Lab (ECT Lab+) is part of the European University of Technology (EUt+) which commenced in 2020 and is funded by the European Universities Initiative. The EUt+ brings together eight universities, Cyprus University of Technology, Darmstadt University of Applied Sciences, Riga Technical University, Technological University Dublin, Technical University of Sofia, Universidad Politécnica de Cartagena, Université de technologie de Troyes, Universitatea Tehnică din Cluj-Napoca in eight countries Bulgaria, Cyprus, France, Germany, Ireland, Latvia, Romania and Spain, and across eight languages: Bulgarian, English, French, German, Greek, Latvian, Romanian and Spanish. The ECT Lab+ was formally set up in Cluj-Napoca Romania in February 2020 as the first pan-European Research Institute to focus on questions of technology and society. The ECT Lab+ poses questions about the relation between culture and technology, the emerging environments (or milieux) of technology which are cultural, cosmological, technical, social, economic, and political. The emerging environment could be considered as a study of evolution, a history of technical organs, this we can term a general organology. The ECT Lab+ brings together researchers who are interested in the impacts of technology on society, these impacts can be both positive and negative; this we can term a pharmacology. Following on from the recent material turn in philosophy of technology, the ECT Lab+ conceives of technology as part and parcel of the process and practices of becoming human in the world. Hence the title of the ECT Lab+ reflects the positioning of technology within a culture, acknowledging that technology is not built in a vacuum but in and for society. The second aspect of the cultural environment of technology stems from the philosophical positioning of technics, technē and technology within their cultural locality or milieu. The ECT Lab+, therefore, encourages research which recognises the localised and situated knowledge contexts of technological innovation. The ECT Lab+ acts as a metastable structure, which is akin to supersaturation, a crystallising that can occur in relation around certain thematics, for example Technological Foresight and responsibility or epistemology, ethics and artificial intelligence. The ECT Lab+ takes into account the instability of the milieu (locality) and allows for the undecidability, contingency or indeterminacy of the cultural environment of technology or technological tendencies.

Introduction

The ECT Lab+ held its first annual conference in December 2021 and this publication is a collection of papers and keynotes that were given over the three days of the conference. It is always a risk to announce the first annual conference as this implies a promise that the conference will be repeated every year. The format of the conference reflected the context of the COVID 19 pandemic, where in November and December 2021 further restrictions were introduced in Ireland as there was a spike in cases, or a new wave of cases and TU Dublin was meant to host the first conference. With the changes in public health recommendations the original format of having a hybrid conference with delegates present in Dublin had to be changed to a fully online format. The ECT Lab+ first annual conference, therefore, took place in what we have come to term an integrated format, integrating different contexts and localities into an online format. Whilst the phenomenological experience of presence needs to be acknowledged, the switch to online or hybrid conferences throughout the pandemic has led to increased collaboration within the ECT Lab+. However, we cannot be naïve about the political economic stakes at play, what Naomi Klein has referred to as the Screen New Deal (Klein, 2020), reflecting the under investment in public health and education which enables the sudden switch to screens only. We are thankful to Ali Warner who helped us bring together this integrated format for the ECT Lab+ conference.

The thematic of the conference was the *Technē Logos and the (Neg)anthropocene*, inspired by the work of the French Philosopher Bernard Stiegler and the Digital Studies Network where questions of the impacts of technology and society have been central for the last 15 years. The conference was also in one way a homage to Bernard Stiegler and his work, a form of recognition of his huge influence and his premature passing in 2020. His last collective publication *Bifurcate: There Is No Alternative* was published in English in December 2021, and at the close of the conference we launched the Bloomsbury publication *Aesthetics, Digital Studies and Bernard Stiegler*. The thematic of the conference reflected on the relation between technology, technics, technē and their consequences on the environment, here understood as forms of ecologies, individual ecology, collective ecology and planetary ecology. This thematic continues to be central in the research of the ECT Lab+ and the second conference will continue by posing the question of care.

In order to understand what is meant by the two terms 'Neganthropocene' and 'Technē' it is necessary to take a detour through the later publications of Bernard Stiegler and the Internation Collective.[1] In the book *Bifurcate: There Is No Alternative* the collective set out a series of propositions in order to combat the immediate consequences of climate change. If, with Deleuze, we accept that philosophy is about the building of concepts and their genealogy, then we need to set out here what the concepts are and how they have evolved. There are two concepts which are of import here, firstly, the concept of the Anthropos in the Anthropocene and secondly, the concept of entropy in the Anthropocene. It is in the later publications of Bernard Stiegler that the term Neganthropocene is developed (Fitzpatrick, 2020). In contrast to Levi Strauss' Anthropology, Stiegler proposes a Neganthropocene as a counter proposition to the Anthropocene or a counter action for climate change.

Firstly, the genealogy of the term 'Anthropocene' dates from a paper by Nobel Chemistry Laureate Paul Crutzen at the International Geosphere–Biosphere Programme's Global Change at Cuernavaca in Mexico in February 2000. There he says 'we have now entered the Anthropocene', using the term coined by biologist Eugene Stroermer in the *Global Change Newsletter* of 2000. Crutzen later published an article 'Geology of Mankind' in 2002 in *Nature*; this article points to the current epoch as one where the traces, effects of human beings on the planet are having devasting effects, irremediable consequences, where population, pollution and human waste are impacting on the very viability of the planet earth itself. The Anthropocene points to this new geological era where the anthropic, the processes and practices of the Anthropos are directly impacting the very geological structure of the planet. In 2019 the Anthropocene Working Group of the International Commission on Stratigraphy voted to recommend that the Anthropocene be treated as a formal chrono-stratigraphic unit within the Geological Time Scale. The term 'Anthropogenic forcing' was used in the 2008 COP 14 report which points to the human impact on the planet. The Anthropocene is the new era where the planet earth has been negatively impacted by the presence of human activity. The debates about the exact dates of this new era should be left to the discipline of geology that operates on time scales which are beyond the human; however there is a correlation between the development of human activity and climate change. The debate could be summarised as follows: on the one hand, it is suggested that the Anthropocene really starts with mass industrialisation in the industrial revolution from the 1840s onwards, and on the other hand, that it starts with the period referred to as the grand acceleration from the 1950s onwards and the mass adaptation of a consumerist model of late capitalism. Nonetheless, there can be no doubt – whether we date the Anthropocene from the 1840s of from the 1950s – that there is a direct correlation between technological progress and environmental change or challenges. The question then is how to counter act this anthropogenic forcing which is having such devasting effects; how to counter act or negate the human practices and processes which are affecting the planet.

However, conceptually, in order to counteract or negate the process which has caused the Anthropocene we need to establish a relation between the advent of the Anthropocene with forms of anthropos, or human activity. Indeed, there is direct relation between human activity and energy usage, energy from fossil fuels, energy from biological processes, and energy from information processes. The key term is that of entropy; entropy in climate changes becomes a form of energy calculation which takes into account the human activity on the planet. Energy usage has become a key point in debates about the Anthropocene and has come into sharp focus with the Russian invasion of Ukraine where energy supply has become a pawn in military strategy. Therefore, how to regulate access to key fossil fuel energy supplies has become an important geopolitical strategy for European countries. These questions of energy flow and demand are in fact questions of entropy. The history of the concept of entropy is a complex one, and one which has been taken up in a number of disciplines – physics, biology and information theory, and more recently social studies. Here, instead of speaking of the Anthropocene, we could

1 The Internation Collective emerged from the work carried out with the Serpentine Gallery London on the Future of Work in 2019. The collective published 'internation.world' and then on the 20 January 2020 presented a memorandum of understanding to the United Nations in Geneva. This was launched at a press conference.

speak of the Entropocene (Stiegler, 2021); there is an embedded relation between the development of entropic processes and climate change, and more efficient energy usage is at the core of the different concepts of entropy. Historically, it is important to note the development of the second law of thermodynamics which established the concept of entropy in physics by Carnot and Clausius. It is interesting to return to the origin of the term entropy; Clausius was trying to find a term that would express the form of energy that was present in the exchange of heat in an engine. Entropy was a term that he pointed to that had a Greek origin, *entropia*, in ancient Greek work (*ergon*) and transformation (*trope*), entropy is an equivalent to the transformation of energy. Entropy at its origins in physics refers to the distribution of heat or energy which is always movement. In this sense entropic processes are processes where the heat is distributed.

It is worth noting that it is the physicist Schrödinger who, in a series of lectures entitled 'What is Life?' given in Dublin 1948, translates the term entropy from physics to questions of biology or questions of the living.

Towards the end of the lecture he refers to counter-entropy, a force which enables me to hinder the ultimate entropic process of becoming a necromass. The entropic process of the body is ultimately a distribution of energy, so maintaining the living body is a form of counter entropic process. Then later in the 1950s, the notion of entropy is used in relation to the distribution of probability of information within Claude Shannon's work with Bell labs. The efficient usage of energy within a system (steam engine) is translated by Shannon into the efficient usage of information within a messaging system. Shannon's use of entropy had wide reaching consequences in the development of transistors and early computing. The second term of the title is *Technē*. This enables the mobilisation of the original Greek meaning of technē which includes all forms of technics, whether they be artistic, artisanal or professional. These are hidden meanings of technics and technologies, that all forms of mediation in the world take place

through technics, and technology is not simply a tool but also a co-constitution or co-evolution which enables the human to become human through the non-human. Technē points to an alternative technology as tool and includes an understanding of technics and technologies as part of the very process of the becoming human – technology as social systems as well as technical systems.

The period of time which is being referred to as the Anthropocene includes these different forms of entropic processes, whether in computational processes and artificial intelligence, technospheric systems, destruction of biodiversity, destruction of technodiversity and destruction of noodiversity. The challenge for us and technologies of the 21st century is to pose ways and means for alternatives to the dominant economic model where technological progress has now reached its limits in terms of an extractivist logic, where Nature including human nature (understood here as the ability to give attention) is no longer simply a resource (a form of standing reserve) from which financial value can be extracted. The Negation of the Anthropocene comes to the fore when we think of how to get beyond the Anthropocene. This is not reducible to questions of resilience but becomes a way of thinking through the alternatives, alternative technologies with other forms of innovation and other forms of economic models, and this is what ECT Lab+ conferences are attempting to do.

In our first keynote, 'For a Technodiversity in the Anthropocene', philosopher of technology Yuk Hui begins by asking what is technics. He traces contemporary understanding of technics, through Gilbert Simondon, as being more than simply technological with its focus on machines but an expanded process that encompasses aesthetic, religious, and philosophical thinking. Through a contrasted account of Asian and Western histories of technology he demonstrates the flaws in concepts of the universality of technology; flaws that can be remedied, he suggests, through his proposition of Cosmotechnics and its recognition that technics, in its essence, is cosmologically situated. In conclusion he suggests that the value of Cosmotechnics in the Anthropocene is that it allows us to think of the future of technology beyond cybernetics at this critical moment for technology and geopolitics, offering a re-opening of the question concerning technology as one of the decolonisation of the history of technology.

In 'Challenges for Science Policy in the Anthropocene', our second keynote, historian of technology Carl Mitcham addresses the challenges facing science policy in the Anthropocene. Science policy is a body of discourse designed to analyse, rationalise, and/or provide guidance for the science–politics interaction, including scientific and political responses to global climate change and other dimensions of the Anthropocene. He examines the case of the United States where science policy is locked in a political struggle between *anthropocenic ressentiment*, a populist scepticism on regulation, mixed with climate change denial and counter rationalism. This anthropocentric nihilism is contrasted with the long-standing tradition of science policy in the US which stems from Vannevar Bush's post war policy document *Science: the Endless Frontier* which built on wartime scientific public research to maintain US strategic and economic scientific advantages, an approach that set the tone for generations of public science policy. However, it is argued that this strategy helped to build a pragmatic scientific elite that through failure to communicate and foster inclusivity through popular science education has contributed to the growth of anti-science scepticism in American public life that is allied to an erosion in democratic principles. Echoing Lenin, he concludes by asking what is to be done, with this call to action tempered by the acknowledgment that, while science policy must play a role, there are no quick fixes.

In 'Entropies, Ecologies, Economies in the 'Entropocene' Era: Towards an 'Anti-entropic Growth' philosopher Anne Alombert looks to Bernard Stiegler's later formulation of the anthropocene as *entropocene*, that is a process of increased entropy at multiple levels; thermodynamical, biological, and informational. Building on the work of Stiegler and Nicholas Georgescu-Roegen she outlines the need for an anti-entropic growth that comes from the conservation, cultivation, and care of not only material resources but psychic, social and libidinal resources.

Genevieve Melville continues the neganthropic theme in 'Bifurcating Gender: Knowledge and Neganthropy in Queer and Trans Futures', to address shortcomings in Stiegler's thinking on gender through the proposal of a framework for thinking gender neganthropologically. The author questions a perceived foreclosure of gender in Stiegler's 2014 Pharmakon.fr seminars, that excludes queer and trans practices of transforming the body. However, she suggests a new way forward through a neganthropology of gender, building on resonances between contemporary queer theory and Stiegler's neganthropy, where a *bifurcation of gender* allows local forces to self-determine and self-regulate on the basis of their own cultivated knowledges. That it is through taking *care* seriously, and through experimentation with technologies of gender and sexuality, that a neganthropology of gender can continue to facilitate the local diversification of forms of life.

In 'Pattern Recognition and the Grammatization of Vision', Hugh McCabe locates the origins of contemporary computer vision in research conducted by Kovásznay and Joseph at the National Bureau of Standards in the United States in the 1950s. He argues that it is this early cybernetic inflected machine vision research that established machine vision as an informational or data problem; a problem that was solved through pattern recognition techniques.

This approach persists in contemporary AI's neural networks that underpin computer vision with their reliance on pattern recognition from image databases such as ImageNet. This, it is argued, leads to a grammatisation of vision (after Stiegler), built on a flawed assumption of the correspondence between cognition and computation that leads to computer vision applications that consolidate and replicate bias. These contemporary problems within AI can only be addressed, it is argued, by fully understanding their historical origins.

Silviya Serafimova continues the theme of AI in 'Challenging AI's Simulacra of Ethical Deliberation: Some Problems of Ethicopolitics of Algorithms' where she argues that in order to advance debates about ethical algorithms it is essential to consider the central role of techno imaginaries – that is the collectively held, institutionally stabilised, and publicly performed visions of desirable futures – in considering the possibilities of moral AI algorithms. These techno imaginaries are instrumental in the formation of twin macro and micro hyperrealities, which are characterised by the megatrends of the fourth industrial revolution and the automation and replication of flawed human morality respectively. This, it is claimed, results in strong and weak AI scenarios that effect a simulacrum of ethical deliberation, leading to the conclusion that human and machine learning ethical vulnerabilities are in fact inseparable.

Artists Jenny Pickett and Julien Ottavi's 'Ctenocene: A Network Topology' offers a perspective derived from artistic research and practice, with a case study of the development of their artwork of the same name, a participatory artwork offering a speculative sonic account of networked communication in jellyfish populations. As super-adaptors jellyfish thrive on the chaos humans create from ocean warming to reduced sea oxygen levels caused by pollution, with jellyfish population migrations acting as climate change warning signs and disrupting human activities as they do. With jellyfish modular synths and networked performances, the artists imagine a post Anthropocene gelatinous future where jellyfish resist human control in speculative scenarios that reflect that, indeed, another world is possible.

In our next paper, 'Environmental Education and the Technosphere', arts educators Glenn Loughran and John O'Connor, continue the perspective of environmentally aware practice with a case study of an experimental virtual pedagogical environment as part of a Masters degree programme *Art and the Environment* in rural West Cork, Ireland. Conducted during COVID-19 lockdowns, as the university shifted to online teaching, the Virtual Archipelagic programme connected students in island communities through the virtual embodiment of VR technologies. The paper details the practical aspects of the undertaking, outlining the potential pitfalls and the successes where the connection of virtual embodiment surpassed that available in traditional educational virtual learning environments. The case study is contextualised within a theoretical framework of archipelagic studies set against a well-developed critique of technological platforms with their unsustainable carbon footprint and reliance on the surveillant data-extractivist practices.

In our final paper 'Climate Change for a Change in Architectural Education: Evaluating the Curricula', the authors (Ţigănaş, Opincariu, Pop, and Voinea) offer a case study of architectural education to evaluate how climate change mitigation can be incorporated into curricula to ensure a sustainable future in architectural education. The paper details the research design and the methodology needed to analyse curricula in the Faculty of Architecture and Urbanism in the Technical University Cluj-Napoca. The case study is set against the realities of climate crisis and the contribution of the built environment to global warming, with a recognition of the urgency of embedding sustainable practices into curricula for future generations of architects. Building on international best practice the authors identify four key vectors necessary for the dissemination of sustainable practices and their inculcation into pedagogical processes. The paper concludes with a detailed account of the practical application of these principals into the programmes of the Faculty, an account that recognises that attention to the contextual specificity of pedagogical programmes is necessary if these approaches are to move beyond the experimental stage.

References

Anthropocene Working Group (2019) 'Results of Binding Vote by AWG Released 21st May 2019'. Subcommission on Quaternary Stratigraphy, the International Commission on Stratigraphy. http://quaternary.stratigraphy.org/working-groups/anthropocene.

Bush, Vannevar, with a companion essay by Rush D. Holt (2021) Science, the Endless Frontier. Princeton University Press. https://doi.org/10.2307/j.ctv15r5879.

Klein, Naomi (2020) 'Screen New Deal'. The Intercept, 8 May 2020. https://theintercept.com/2020/05/08/andrew-cuomo-eric-schmidt-coronavirus-tech-shock-doctrine.

Crutzen, P.J. (2002) 'Geology of Mankind'. *Nature*, 415, 23.

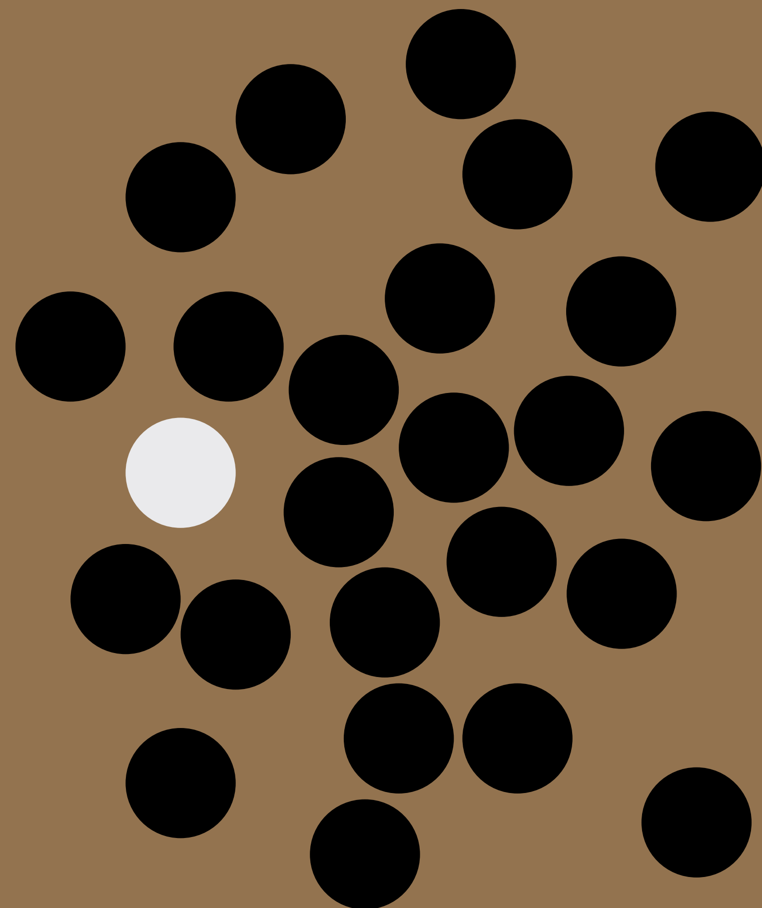
Crutzen, P.J. and E.F. Stoermer (2000) 'The 'Anthropocene''. *Global Change Newsletter*, 41, 17.

Fitzpatrick, Noel (ed.) (2021) *Aesthetics, Digital Studies and Bernard Stiegler*. New York: Bloomsbury.

Schrödinger, E. (1992) What is Life?: With Mind and Matter and Autobiographical Sketches. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139644129

Stiegler, Bernard et al. (2021) *Bifurcate: There Is No Alternative*. London: Open Humanities Press.

Part 1
Keynotes



Chapter 1

For a Technodiversity in the Anthropocene

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On the Concept of Technics

What is technics? Jacques Ellul begins *La technique ou l'enjeu du siècle* (1954) with a critique of the conventional understanding of technics, which for him is far away from being able to understand the complexity and the dynamic of technics; namely, technics has been considered as equivalent to machines:

> What is called the history of technique usually amounts to no more than a history of the machine; this very formulation is an example of the habit of intellectuals of regarding forms of the present as identical with those of the past.[2]

Ellul showed how this equivalence has been implicitly and explicitly maintained among his contemporaries, including by the respectful historian of technology Lewis Mumford.[3] The mis-identification of technics and machine led to a very narrow notion of technics. However, if technics is irreducible to machines, then what does it include, and how do we describe it? Ellul claims at some points that the primitive society '*was free of technics*.'[4] It is difficult if not impossible to think of a society free of technics, and here we may also confuse the relation between magic and technics, namely, that there is only magic but not technics in the primitive society:

> In so-called primitive societies, the whole of life was indeed enclosed in a network of *magical techniques*. It is their multiplicity that lends them the qualities of rigidity and mechanization. Magic, as we have seen, may even be the origin of techniques; but the primary characteristic of these societies was not a technical but a religious preoccupation.[5]

2 Jacques Ellul, *The Technological Society* (New York: Vintage, 1964), 42.
3 *Ibid*., 79
4 'Society was free of technique. And even on the level of the individual, technique occupied a place much more circumscribed than we generally believe.' Ibid., 65.
5 *Ibid*., 64. Italics are mine.

Ellul's seemingly odd view resonated with Gilbert Simondon, who became a key figure in Ellul's *The Technological System* and in which Ellul takes Simondon further, from the latter's analysis of technical objects in terms of technical element, technical individual, and technical ensemble, to an autonomous technological system. This distinction between magic and technics may not come directly from Simondon, but they were writing in the same epoch. In *On the Mode of Existence of Technical Objects* (1958)[6] Simondon proposes a speculative history of technology, which he calls the genesis of technicity. At the beginning is the magic phase, in which there is no distinction between subject and object, while ground and figure (terms taken from *Gestalt* psychology) are already separated. The convergence between ground and figure is maintained by key points, namely, the sacred geographical points and special dates such as festivals. For Simondon, the term genesis is what he calls individuation, which he elaborated in *L'individuation à la lumière des notions de forme et d'information*.[7] According to this theory, individuation is triggered when a system is oversaturated, when the tensions or incompatibility within the system have reached a threshold, and consequently a restructuration takes place. When the magic phase is saturated, its restructuration is presented as a bifurcation into technics (practice) and religion (theory), and each part in the second stage further bifurcates into a theoretical part and a practical part. For example, religion bifurcates into ethics (theory) and dogma (practice). This does not mean that Ellul agreed completely with Simondon's theory of the genesis of technicity, as he contested the nature of the key points in *Théologie et Technique*.[8] His description of magic as pre-technics seems to have implicitly reserved the term technics for a post-magic rationality, or *techno-logos*.

The post-magical rationality, which is technics, according to Ellul, seems to have started in the East and traveled from the Near East to Greece and then continued into the Roman era. For Ellul, in Greece and Rome technics remained Oriental; it was not until the decline of the Christian West in the fourteenth century that the anti-technological tendency was reversed, and then modern science and technology emerged. After the eighteenth century, technology ceased to be the application of scientific discoveries; instead, technology gained an autonomy that was far beyond machines and beyond the sheer application of sciences. Ellul reminds his readers that Western scholars have mistaken the East as inclining

6 Gilbert Simondon, *On the Mode of Existence of Technical Objects* (Minneapolis: University of Minnesota Press, 2017).
7 See Gilbert Simondon, *L'individuation à la lumière des notions de forme de d'information* (Grenoble: Éditions Jérôme Millon, 2005).
8 See Jacques Ellul, *Théologie et Technique* (Geneva: Labor et Fides, 2014), 183–185. Ellul claimed that these sacred points are posteriori, namely, sacredness is given by the human.

towards mysticism and regression (one can find this, for example, in Pierre Teilhard de Chardin). Instead, Ellul shows that 'technics is essentially Oriental':

> This predominance of technique in the East points up an error which is found throughout Western thought: that the Oriental mind is turned toward the mystical and has no interest in concrete action, whereas the Western mind is oriented toward 'know-how' and action, and hence toward technique.[9]

Interestingly, this account of technics is similar to Hegel's theorization of the *Weltgeist*. That is to say, like the *Weltgeist*, technics travelled from the East to the West, and it is realized as an autonomous and self-conscious form in the State. However, since technics' departure to the West from the East, what happened in the East became insignificant. It will be significant again only after it is modernized and synchronized by the West. Retrospectively, perhaps the *Weltgeist* is like salmon,[10] which go back to the stream where they were born, to spawn and die there. So technics, like the *Weltgeist*, travelled back to the East and flourished there after colonization and modernization; and now in Western medias, China is no longer blamed only for being a world factory but is reproached also for its rapid development of artificial intelligence that is putting Western democracy and values in danger.

But what does it mean exactly that technics exceeds machines? We may refer to what Simondon says in the third part of *On the Mode of Existence of Technical Objects*, where he argues that the genesis of technicity should not be reduced to the evolution of technical objects. Instead, it should be understood as a genetic process in which technical thinking interacts dynamically with aesthetic, religious, and philosophical thinking. That is to say, technological thinking is not an independent thinking but rather one that is motivated and at the same time conditioned by other thinking. What Simondon does in *On the Mode of Existence of Technical Objects* is very significant, even though one can reproach him by saying that he leaves the impression that the primitive society is pre-technics – something that might be inspired by Sir James Fraser's *The Golden Bough*.[11] But this does not mean that the magic phase is devoid of technics – it means only that in the magic phase the ground and figure are not separated. That is to say, technics still has a dominant function in the mediation between the internality of the subject and the externality

9 Ellul, *The Technological Society*, 27–28.

10 See Moritz Rudolph, *Der Weltgeist als Lachs* (Berlin: Matthes & Seitz, 2021), in which the author made a witty claim that if Hegel was right that the *Weltgeist* travelled from the despotic Orient to Greece, then to Rome, and lastly to Germany, now it travels back to the East like a salmon.

11 See Yuk Hui, *Recursivity and Contingency* (London: Rowman and Littlefield International, 2019), 233 fn71.

of the environment. Thus it was preoccupied with religious meaning, rather than with rationality. This might be how we can understand those seemingly odd passages in *The Technological Society* mentioned above. Simondon's thesis on the genesis of technicity is fundamental for us to understand the diversity of technology, since he states that a technological thought is dependent on its relation to other thoughts, namely, on its *locality*. The notion of locality is important but also delicate, since in our time locality, negatively defined in opposition to globality, can also mean conservativism, traditionalism, and even proto-fascism, such as found in the discourse of the National Front in France and the AfD in Germany. Without approaching the question of locality, however, perhaps we will not be able to fully understand the question of technology. Locality does not mean a logical operator – that which is opposed to the non-local – but rather cosmology. I suggest that technics is cosmologically situated in locality, and precisely because of this we can account for the different trajectories of technological development.

This way of understanding technics appears unfamiliar, however, because we have been told that science and technology are universal. In the current technological and philosophical education, there is not even space to have such a doubt. According to the conventional understanding, one admits that other civilizations also developed their technologies; however, these technologies differ only in terms of functional aesthetics (for example, the particular length and decoration of spoon handles) and levels of technicality, and despite these differences, they could be understood in principle as the same kind of technology. Non-European thoughts, therefore, have been considered solely as ethics or religions that regulate the use of these technologies. Therefore today we find everywhere discussions on Daoist ethics of technology, Confucian ethics of technology, Indigenous ethics of technology, etc. To what extent is technology universal? If we could find different technologies in different cultures, then shouldn't it imply that there have been multiple technological thoughts? Here, when we follow up our previous discussion with Ellul, we want to ask, what happened to the East after technology travelled to the West?

On the Antinomy of the Universality of Technology

It seems that one has more courage to challenge the universality of the concept of nature than the concept of technics. For example, in the so called 'ontological turn' in anthropology, associated with anthropologists like Philippe Descola and Eduardo Viveiros de Castro, the anthropologists questioned whether the concept of nature that we are using now is mainly a product of European modernity. There are different natures, as one can find in ethnographies. Nature as it is understood today in the globalized world refers to the non-manmade environment surrounding us. It is a modern construction based on the opposition between nature and culture, which Descola calls 'naturalism.'

Nature is here considered to be the opposite of culture and at the same time an object to be mastered by culture or the 'spirit.' However, this naturalism is not a default but rather a fault.

If the anthropologists are able to argue for multiple natures, or multiple ontologies as response to the anthropocentrism of the Anthropocene, is it possible, and isn't it even more effective, to argue for multiple technologies, namely, to relativize the concept of technics from the conventional understanding as a universal *techno-logos*? *The Question Concerning Technology in China: An Essay in Cosmotechnics* (2016) consists in this effort. The answer is deemed to be a difficult one, but even raising such a question is not easy at all. Perhaps we can try to articulate the difficulties by looking into how a discourse on the universality of technology is already uncritically assumed in some schools of thought, for example, philosophy, anthropology, and history of technology.

Let us start with philosophy of technology. Readers of Heidegger know that in his 1949 Bremen lecture titled *Gestell*, later published in 1953 as *Die Frage nach der Technik*, Heidegger makes a distinction between what the Greeks called *technē*, and *moderne Technik*. If *technē*, understood as *poiesis*, bringing forth [*Hervorbringen*], bears a mode of unconcealment of Being [*Sein*], then one no longer finds in modern technology poiesis. Rather, it has its essence as Gestell, namely an enframing of all beings as standing reserve [*Bestand*], resources to be exploited. Modern technology, for Heidegger, arrived after modern science, taking on its significance after the Industrial Revolution. Heidegger's analysis is well recognized in Continental philosophy, and the distinction he made between the Greek *technē* and modern technology also resonates with the Romantics, whose thought persisted among conservative thinkers in Germany. Heidegger's analysis travelled far beyond Germany; it is also well endorsed in the East. The experience based on the opposition between *technē* and modern

technology is identified as the conflict between tradition and the modern, and resonates in cultures that are experiencing great transformation due to modernization. If we follow Heidegger's analysis, however, we might want to ask, how can we situate technics in the East? It is definitely not modern technology, but is it Greek *technē*?

On the other hand, Heidegger's interpretation of *technē* as the unconcealment of Being already points to an understanding of technics beyond its utilitarian and anthropological definition. Did the Chinese and the Japanese, for example, also have such an understanding of their technics, namely, in relation to the unconcealment of Being? Kitaro Nishida, the founder of the Kyoto School, once made a rather straightforward but profound observation that for the West, Being occupies the central question in philosophy, while for the East, it is the question of Nothing. It is doubtful that this distinction could be applied to the East at large; at least we can say that in Chinese thought it is not Being but Dao that is the highest inquiry of philosophy. What then is *dao*? We are told at the beginning of the *Dao de jing* that *dao* cannot be explained by language,[12] while it is also not mysterious since it exists everywhere, in feces and in gold.[13] Dao, like Being, is beyond the objective description of language, and for this reason it is spiritual and irreducible to materiality but also conditions all pursuits of knowledge.[14] If technology, as well as the concept of technology, must be understood historically, not only factually and chronologically but also spiritually – in the sense of what Hans Blumenberg calls a *Geistesgeschichte der Technik* – then it is immediately evident that there are many histories of technologies in different cultures and civilizations.[15]

In the anthropology of technology, the invention and use of tools (often covered by the terms *labor* or *praxis*) has been understood as the determining process behind hominization, notably in the work of Leroi-Gourhan. He interpreted technics as an extension of organs and an externalization of memory. In this interpretation, technology is anthropologically universal. This is not wrong insofar as such externalization and extension are considered as proceeding from what Leroi-Gourhan called a 'technical tendency.' But we still have to explain what he called 'technical

12 Lao Tzu, *Tao Te Ching*, trans. D.C. Lau (Hong Kong: Chinese University of Hong Kong, 2001). The text starts with, 'The dao that can be said is not the eternal dao.'

13 Zhuangzi, *The Complete Works of Zhuangzi*, trans. B. Watson (New York: Columbia University Press, 2012), 182. For a closer discussion, see Yuk Hui, *The Question Concerning Technology in China. An Essay in Cosmmotechnics* (Falmouth: Urbanomic, 2016/2019), 67–68.

14 I have tried to elaborate on the relation between Being and Dao in my latest book; see Yuk Hui, *Art and Cosmotechnics* (Minneapolis: University of Minnesota Press, 2021).

15 Hans Blumenberg, *Geistesgeschichte der Technik* (Frankfurt: Suhrkamp, 2009).

facts,'[16] which are different from region to region and from culture to culture. While a technical tendency is necessary, technical facts are accidental: as Leroi-Gourhan writes, they result from the 'encounter of the tendency and thousands of coincidences of the milieu.'[17] While the invention of the wheel is a technical tendency, whether wheels will have spokes is a matter of technical fact.

But is a technical fact merely accidental, caused by the material condition? We would like to ask, what is embedded in these technical facts apart from a casual reduction to cultural difference, or even sometimes to contingency? In the history of technology, the biochemist and sinologist Joseph Needham raised a haunting question by asking why modern science and technology were not developed in China and India. At the same time, in his multiple volumes of *Science and Civilization in China* Needham shows the large amount of rather advanced scientific and technological development in China *before* the sixteenth century. Echoing Needham's inquiry, there have been significant inquiries on comparing technological development in different regions of the world in order to show that, for example, one particular region is more advanced in papermaking or metallurgy than another. However, this is a distortion of Needham's question, which in fact suggests that one cannot compare Chinese science and technology directly with those of the West since they are based on different forms of thinking.[18] In this sense, how can one re-articulate these differences? It is through discussions and negotiations with the philosophy of technology, anthropology of technology, and history of technology that I believe we can arrive at an even richer concept of technology, which I call cosmotechnics. The prefix *cosmo-* suggests that technology is motivated and conditioned by cosmology, and technology mediates between the cosmic and the moral of the human world. I took China as an example of such an investigation. Instead of simply rejecting technology as being universal, I suggest that we understand what is at stake with the following antinomy.

> Thesis: Technology is an anthropological universal, understood as an exteriorization of memory and the liberation of organs, as some anthropologists and philosophers of technology have formulated it.
>
> Antithesis: Technology is not anthropologically universal; it is enabled and constrained by particular cosmologies, which go beyond mere functionality or utility. Therefore, there is no one single technology, but rather multiple cosmotechnics.

16 André Leroi-Gourhan, Milieu et Technique (Paris: Albin Michel, 1973), 336–40; André Leroi-Gourhan, *L'homme et la matière* (Paris: Albin Michel, 1973), 27–35.

17 Leroi-Gourhan, *L'homme et la matière*, 27.

18 See Joseph Needham, *Science and Civilization in China. Vol. 2, History of Scientific Thought* (Cambridge: Cambridge University Press, 1991).

We know that for an antinomy, when the thesis and antithesis are examined separately, each of them stands on its own; but when they are brought together one sees immediately a contradiction. Technics is universal insofar as it is a material support, like what Leroi-Gourhan called externalization; but beyond that there are tremendous differences in different technics that are not merely contingent.[19] I gave a preliminary definition of *cosmotechnics* as unification between the cosmic order and the moral order through technical activities. The meaning of the cosmos and the moral have to be understood according to their locality. This also means that technology should be *re-situated* in a broader reality, which enables it and also constrains it, like what Simondon said regarding the genesis of technicity. In *The Question Concerning Technology in China: An Essay in Cosmotechnics*, against easy oppositions between the West and the East, for example, one being mechanical and polemical, the other organic and harmonious, I suggest formulating a technological thought in China according to the historical dynamics and relations between two major philosophical categories, *dao* and *qi* (literally, 'utensils', to be distinguished from the word of the same pronunciation which is familiar to western readers, meaning breath, vital energy). These two categories, I argue, are fundamental to the reconstruction of a technological thought in China. It is not only because, as stated earlier, it is not the question of Being but of Dao that occupies the central role in Chinese thought, but also because there has been an ongoing discourse about the unification between *dao* and *qi* in the history of Chinese thought. The discourses about the relation between the two are dynamic throughout history, meaning that there have been countless reflections and theorizations on their relations, from Confucius and Laozi to the early twentieth century. Finally, we see how the discourse is rendered ineffective during the process of modernization, that is to say, since China's defeat by Britain in the Opium Wars, which forced China to open to modernization and global capitalism.[20] The discourse on *dao* and *qi* was replaced by the dialectics of nature, an orthodox Marxist philosophy of science.

Let us take a step back. If Heidegger, the thinker of Being, was able to see the great secret [*Geheimnis*] in modern technology, namely, the possibility of the unconcealment of Being in the form of challenging [*Herausforderung*], it is because Being still has its role in the modern world, as a possibility and task of philosophy. However, Being is not *dao*, and Heidegger's interpretation of

19 In relation to this, one may even find an affirmation in Derrida's *De la grammatologie* (1967), in which Derrida compared Western alphabetic writing and Chinese pictorial writing, claiming that the former is based on the concept of substance and the latter on relation. For a detailed analysis, see Yuk Hui, 'Writing and Cosmotechnics.' *Derrida Today* 13, no. 1 (2020): 17–32.

20 For a detailed analysis, see Hui, *The Question Concerning Technology in China*, part one.

technology grounded in the history of Western philosophy might not provide the right path for thinking beyond the evening land [*Abendland*]. This awareness may come to us only as *après coup*, just as philosophy is always a latecomer. In the second half of the nineteenth century, the Chinese were very eager to take the Western technology as Chinese *qi* and hoped to integrate it into the *qi-dao* discourse, but they failed, because the relation of *qi-dao* at that time became a dualism. The British historian Arnold Toynbee once raised an interesting point in his 1952 Reith Lectures for the BBC: why did the Chinese and Japanese refuse the Europeans in the sixteenth century but allow them to enter the countries in the nineteenth century? His answer was that in the sixteenth century the Europeans wanted to export both religion and technology to Asia, while in the nineteenth century they understood that it is more effective to just export technology without Christianity. The Asian countries easily accepted that technology was something inessential and instrumental; they were the 'users' who could decide how to use it. Toynbee continued by saying:

> Technology operates on the surface of life, and therefore it seems practicable to adopt a foreign technology without putting oneself in danger of ceasing to be able to call one's soul one's own. This notion that, in adopting a foreign technology, one is incurring only a limited liability may, of course, be a miscalculation.[21]

We can interpret what Toynbee said in two ways. First, that the opposition of Asian thought and Western instrument, and the belief that the former can master the latter, are proved to be mistakes, since it is dualist in nature; second, that technology in itself is nothing neutral, but it carries particular forms of knowledge and practice that its users are obliged to comply with. Without taking into consideration this understanding of technology (which Max Weber might call rationalization), one takes a rather dualist approach, by undermining technology as something merely instrumental. This miscalculation, a fault, has become a necessity in the twentieth century.

Technodiversity in the Anthropocene

What could be the value of introducing the concept of cosmotechnics in the time when we have entered into the so-called Anthropocene in which the technical activities dominate the earth? We live in an epoch of cybernetic systems, which become more and more organic, as Ellul rightly described in *The Technological System*. In *Recursivity and Contingency*, I attempted to reconstruct a philosophical history of cybernetics by outlining the historical relation between mechanism and organism, from Kant to cybernetics, in order to show that we have entered a new

21 Arnold Toynbee, *The World and the West* (Oxford: Oxford University Press, 1953), 67.

condition of philosophizing after Kant.[22] The earth in the time of F.W.J. Schelling and later James Hutton was described as a super organism, and since the late twentieth century it has been regarded as a gigantic cybernetic system capable of homeostasis under the name of Gaia. If we take up the inquiry of the future of technology, we might ask how to think technology beyond cybernetics – which, according to Heidegger, indicates the end of Western philosophy and metaphysics. The concept of cosmotechnics also has the aim of addressing the future of technology. I proposed an agenda on technodiversity (or a multiplicity of cosmotechnics) in *Recursivity and Contingency* (2019) as a way to think beyond a cybernetic reductionism.

> In the past century, modern technologies covered the surface of the earth, constituting a converging noosphere in Pierre Teilhard de Chardin's sense.

In fact, Teilhard's noosphere might provide us a conceptual tool to understand the Anthropocene, especially when we think that it is based on the discussion with Vladimir Vernadsky's biosphere. Since the nineteenth century on, the formation of the noosphere has been largely accelerated by technological competition, which in turn also defines geopolitics. This 'technological consciousness' persisted throughout the twentieth century and was marked by the atomic bomb, space exploration, and now artificial intelligence. The technological achievements of the East seem to have reversed the unilateral movement from the West to the East. This is also the source of the neo-reactionary sentiment that we see today in the West,[23] since it continues Spengler's curse of the 'Decline of the West,' now affirmed by ideological slogans such as 'Decline of the West and Rise of the East.'

Taking a step further, we may want to reposition this discourse of the Anthropocene as a critical moment to reflect on the future of technology and geopolitics. This critical assessment

22 I argued that Kant's 1790 *Critique of Judgment* imposed an organic condition of philosophizing; see Yuk Hui, *Recursivity and Contingency* (London: Rowman and Littlefield International, 2019). For a more concise explanation of Kant's relation to cybernetics, see Yuk Hui, 'Philosophy after Automation?' *Philosophy Today* 65, no. 2 (2021): 217–33.

23 Yuk Hui, 'On the Unhappy Consciousness of Neoreactionaries.' *E-flux*, no. 81 (2017), https://www.e-flux.com/journal/81/125815/on-the-unhappy-consciousness-of-neoreactionaries/.

demands the *reopening* of the question of technology. Reopening means, first, enlarging the concept of technology by pluralizing it, and second, by doing so we open new imaginations, new methodologies, and new possibilities for thinking the future. We can suspect that there has been misunderstanding and ignorance of technology in the past centuries, since technology has been regarded as merely instrumental and inessential, but more significantly, as homogenous and universal. This universality of technology prioritizes a particular history of technology, which is fundamentally modern. I attempt to show that the way technology has been perceived in philosophy, anthropology, and the history of technology is debatable, and it is *imperative* now for us to gain a different understanding of technology and to reflect on its other futures.

We could also say that this attempt to reopen the question of technology is fundamentally a project of decolonization; however, it is not a project left only to non-Europeans. Indeed, it is a project that is essential and imperative for Europeans also. Modernization brought forward two temporal dimensions: on the one hand, a simultaneity, characterized by the synchronization and homogenization of knowledge through technological means; on the other hand, consequently, the development of knowledge according to an internal necessity, namely, progress. Modernization *qua* globalization is a process of synchronization that converges different historical times to a single global axis of time and prioritizes specific kinds of knowledge as a major productive force. It is also in this sense that we understand why Heidegger claims in 'The End of Philosophy and the Task of Thinking' (1964) that

> the end of philosophy proves to be the triumph of the manipulable arrangement of a scientific-technological world and of the social order proper to this world. The end of philosophy means: the beginning of the world-civilization based upon Western European thinking.[24]

The end of philosophy is marked by cybernetics. Moreover, it implies that the world civilization and geopolitics are dominated by Western European thinking. If there is a future for philosophy again, it will have to become a 'post-European philosophy.'[25]

This re-opening cannot avoid confronting the concept of technology with the one we have today, much as anthropologists of the 'ontological turn' want to do with the concept of nature. Cosmotechnics implies not only the varieties of technologies in different geographical regions in human history, but also different forms of thinking and a different complex set of relations between the human and the non-human. Departing from these anthropological and philosophical investigations, we have to further

24 Martin Heidegger, 'The End of Philosophy and the Task of Thinking,' in *On Time and Being*, trans. Joan Stambaugh (Harper & Row, 1972), 59.

25 See Hui, Art and *Cosmotechnics*.

interrogate what this technodiversity could mean for us today. Apart from simply preserving it as obsolete pre-modern and non-modern knowledge, will we be inspired to reframe the enframing of modern technology? Without a direct confrontation with the concept of technology itself, we can hardly maintain alterities and diversities (which I formulate as biodiversity, noodiversity, and technodiversity[26]). This is perhaps also the condition under which we can think about a post-European philosophy. We will need a technological thinking which is capable of firstly rendering the gigantic technological force contingent and making it necessary again for searching a path beyond the Anthropocene.

26 For the analysis of these three diversities, please see Yuk Hui, 'For a Planetary Thinking,' in *E-flux*, no.114, ed. Bruno Latour and Martin Guinard, https://www.e-flux.com/journal/114/366703/for-a-planetary-thinking/.

Chapter 2

Challenges for Science Policy in the Anthropocene

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> The other danger which arises from this alliance between science and politics is that the crises affecting political thinking also become the crises of scientific thought. Out of this complex we will concentrate on only one fact which, however, became significant for the contemporary situation. Politics is conflict and tends increasingly to become a life-and-death struggle.
>
> (Mannheim, [1929] 1936, p. 34)

1 Introduction

Science policy is that amorphous body of discourse designed to analyze, rationalize, and/or provide guidance for the science–politics interaction, including scientific and political responses to global climate change and other dimensions of the Anthropocene. Standard science policy work distinguishes two types: science for policy, that is, the use of science in governmental decision making; versus policy for science, that is, state funding for or promoting of science. One prime example of the first is the Intergovernmental Panel on Climate Change (IPCC), created in 1988 to provide policy relevant science to inform political decision making about climate change. An example of the second is the discussions that take place within governments about how much investments to make in science. Of course in practice these two can overlap a great deal. Note also that there are few examples of intergovernmental (in the sense of international or global) policy for science other than those among science policy scholars.

The Anthropocene presents challenges to both types of science policy but more prominently to the first, as Benard Stiegler's concept of the Neganthropocene illustrates (Stiegler, 2020). Stiegler questions any celebration of the Anthropocene by calling attention to the ways it is actually negating or threatening the existence of ο άνθρωπος, the human. To put Stiegler's argument

in science policy terms, the world is today manifestly failing to act on scientific knowledge provided by IPCC reports (issued once every five or so years) and to address the problems created by the capitalist-developmental capture of science, engineering, and technology. Instead, we have entered not only a new and newly recognized geo-global age of human engagement with the stability of the Earth, but a related political instability.

The political is characterized by a life and death struggle between ecomodernist faith in an engineering ability to manage the new environmental–political order and ecopessimist skepticism. Dividing friend and foe on both sides are contests of denial and anger at the unintended outcomes of nationalist driven science and engineering often emerging into an inchoate but powerful resentment against science broadly construed. In the United States this existential partisanship can be sensed, for example, in religious fundamentalist rejections of Darwinian evolution versus efforts to promote STEM literacy, in corporate economistic criticisms of research on species diversity and toxicological studies of pollution versus criticisms of neoliberal depredations of natural and social environments, in cultural conservative fears of biomedical engineering threats to human dignity versus celebrations of diversity enhancing hybridization. All this tends to feed into a sovereign social belligerence over the nexus of capitalism, developmentalism, nationalism, science, and engineering – often simplified into an effective tug-of-war over how best to integrate science into the state.

In the United States today one finds significant public skepticism about the benefits of regulatory governance, climate change denialism, and vaccine conspiracy theorizing that can be lumped together as 'anthropocenic *ressentiment*': 'Anthropocenic' both because of how the suite of phenomena emerge in the shadow of the Anthropocene and because it is such an element of the 'human, all too human' scene. *Ressentiment* drawing on Nietzsche's analysis of how personal resentment becomes cultural power when the bourgeois masses, subjected to the rule of experts, ask themselves (to adapt a passage from *The Genealogy of Morals*): 'These experts are simply a self-interested class, and those who least resemble them, namely us – should we not be considered superior after all?' Those who find themselves too weak to understand, to rationally criticize, or to heroically rebel against a situation they feel illegitimate, in frustration and powerlessness easily lash out with a sense of grievance and paranoia, attacking notions of expertise, elitism, message as well as messenger, as stupid, or conspiracies against liberty – and assert a counter-rationality of their own. Anthropocenic ressentiment is another name for what Stiegler terms Anthropocenic nihilism.

2 From Policy for Science to Science for Policy

To throw into relief the challenge of Anthropocenic nihilism and *ressentiment*, let me consider the question of science policy in its broader dimensions while focusing on the American context. Primacy of the American context is justified by the simple fact that the United States has, for more than a century and a half, been the leading state funder of science and engineering. It also has one of the most clearly formulated political philosophical rationales for doing so, thus establishing a model influential well beyond its borders. The model was most clearly articulated at the end of World War II in a report by Vannevar Bush, the scientist-engineer who served as the first presidential science adviser. (Again illustrating the leading role of American scientific-political establishment, all other advanced countries have followed by establishing their own executive science policy advisory offices.)

Bush's *Science: The Endless Frontier* (1945) primarily articulated a policy for science: that is, what became known as a social contract that would leave science alone and give it unfettered state support, in return for knowledge that the government and private industry could then exploit as they saw fit. Bush's claim was that (1) science functioned best when it was granted the autonomy to determine its own priorities and methods, and (2) that it provided knowledge that would enhance national security, improve healthcare, and be available for economic exploitation.

In response to critics of this scientific elitism, defenders of science have subsequently proposed enhancing science for policy: that is, an expanded social contract in which scientists explicitly orient their research so as to produce knowledge more immediately useful for decision making by politicians and for the scientific tutoring of the non-scientific public. Scientists need to consciously consult the public and even invite public participation in their work; they should dedicate themselves not just to research in the lab and peer reviewed publication but to the public communication of their work.

3 Elite Mediation and Democratic Pushback

Although Bush strongly believed science was good for democracy because of how it could be utilized for defense, health, and economic welfare, his view was severely qualified by a long-standing distrust of democracy. In an important essay on 'Democracy and the Medical Profession,' Bush argued that the public benefit of medical research is dependent on an elite medical profession that mediates between science and the public. Contemporary defenders, by contrast, argue for a public that is not so much a patient as actively engaged in the production of science, what has sometimes been called participatory research and citizen science – which involves scientists themselves engaging more directly and deeply with non-scientists and the public.

Scientists must help counter the impression that science is for scientists alone. Above all, scientists must help the public understand that the success of science comes from evidence-based thinking and that evidence and evidence-based thinking are available to all. Scientists should promote public scientific literacy, which may be difficult to teach but is at least as important to national welfare as the material benefits on which Bush focused. We need the broad infusion and application of the scientific method to public affairs and personal decision making.

Unfortunately, there is good evidence – historical as well as social scientific and political – of serious limits to such infusion. Many people simply do not want to lead evidence-based lives, at least not based in what scientists consider evidence. What are much stronger influences in many lives is continuity with the ways they were raised and the past (tradition), religious beliefs (and authority), power (economic and political), and even intuition (or personal revelation). As Aristotle argued, the first name of the good is that which is our own: our families, our languages and cultures, our countries. Early on, people develop customs and expectations that are psychologically difficult to alter or abandon and as such are prone to the protectionism of conspiracy theorizing and *ressentiment*.

Indeed, scientists themselves often have difficulty practicing what sociologist of science Robert Merton called 'organized skepticism' (Merton, 1942) and criticize others for conspiring against them in forms of *ressentiment* manqué. All four of Merton's social norms of science – including communalism, universalism, and disinterestedness – depend on institutional socialization that doesn't always take. The continuing presence of scientific fraud and misconduct are further witness to the problems.

Abraham Lincoln once remarked that democracy was saved from demagoguery by the fact that although you can fool all of the people some of the time and some of the people all of the time, you can never fool all of the people all of the time. But the success of Donald Trump and other populist politicians has quantified these numbers and shown that those who can be fooled all of the time represent 30–40%. In a world dependent on science, to have 30–40% of anthropogenic climate change denial and anti-vaccination conspiracy mongering is not all that reassuring.

4 'The Fixation of Belief'

The point at issue here can be restated with reference to one of the founding texts of American pragmatism, C.S. Peirce's short essay on 'The Fixation of Belief' (1877). Peirce distinguished between 'the sensation of doubting and that of believing,' noting that 'doubt is an uneasy and dissatisfied state from which we struggle to free ourselves and pass into a state of belief,' and that beliefs are what 'guide our desires and shape our actions.'

He then distinguished four methods for fixating or stabilizing beliefs. First is the method of tenacity, which simply rejects cognitive challenges to any existing belief. There is obviously a lot of this going on in climate denialism and related refusals to acknowledge anthropogenic environmental mutation.

Since individuals find it difficult to practice this method by thinking alone, there is a natural turn to the method of authority or tradition, a kind of social tenacity. This second method too can become problematic, insofar as people become aware of and are willing to compare different authorities or traditions. But it is usually only a few individuals from a group that will be destabilized by such knowledge. Instead most people are more likely to double down and decide that other authorities and traditions are mistaken, misled, or misleading. They are not like us. This charge can be directed especially at scientists who would teach things that conflict with established beliefs or ways of life. Research studies bearing on this phenomenon are legion; among the more recent is a set of articles in the *Annals of American Academy of Political and Social Sciences* pointing up how this is not limited to the non-scientific public (Suhay and Druckman, 2015).

Among cognitive elites, however, there emerges a third movement from opinion justified by authority to fixated belief: what Peirce terms an a priori method that strives to construct coherence among beliefs. Such is a process more appropriate to mathematicians than to empirical researchers. It is also not widely practiced by the masses.

Most people are content to follow American poet Walt Whitman when he declares, 'Do I contradict myself? Very well, I contradict myself.'

Peirce, along with many philosophers, rejects poetry, but has to admit that while pure a priori reasoning 'is far more intellectual and respectable from the point of view of reason' than either of the first two, it nevertheless has the feel of a certain arbitrariness. Isn't there more to belief than coherence?

Isn't it possible that coherence could also obtain among a set of false beliefs? Thus among those who desire that their beliefs be determined by something more than reason alone there develops the scientific method. Although only explicitly formulated by philosophers and scientists, it is a method that has vernacular forms used by everyone at some level in their lives. When further applied systematically, this scientific method 'has had the most wonderful triumphs in the way of settling opinion.'

Yet as Peirce's hierarchy of methods also reveals, the scientific method is one that is practiced only among the few. The many in any society, seeking relief from doubt, have and are more likely to rely on individualist bull-headed tenacity or trust in some authority. Peirce fails to mention the ways brute force and violence can also fixate belief or that it can be engineered through propaganda. Finally, Peirce fails to acknowledge that the glue of all social groups larger than the family or tribe (with their biological bases and genetic ties) are dependent on some commonly fixated beliefs that are not to be doubted — many of which are regularly challenged by science as myths or superstitions, most obviously perhaps by the social sciences of history and cultural anthropology.

5 Social Glue

What Pierce effectively proposed — and what his more political philosophical heir John Dewey defended at length — is that all people in a democracy should become scientists, or at least scientists manqués. According to Dewey's educational ideal, everyone should learn to cultivate the scientific way of thinking as the good life, making science their own, and this can serve as a secular, rational social glue. By contrast, Bush rejected such a goal and never conceived of science as able to become a broadly democratic practice.

On the basis of common experiential knowledge, Bush would seem to have the stronger case. Indeed, this appears to be implicitly confirmed by the numerous problems encountered by efforts at mass public science education in the United States, especially since the end of World War II. Today in American universities students are much more likely to gravitate toward studies and careers in business administration (#1 in 2021), accounting (#2), and marketing than in math (not even listed in the top 25), science, or engineering.

Although Enlightenment belief in the benefits of science was a major influence in the founding of the American regime, the founders themselves admitted that the viability of the new political order was not a sure thing. The *Federalist Papers* referred to the new regime as an 'experiment.' We might also note that the opening of the *Declaration of Independence* appeals not to evidence but to fixated belief: 'We hold these truths to be self-evident.'

They didn't argue for, so much as simply assert, 'That all men are created equal.' The *United States Constitution* in turn established an elitist, representative structure in conscious acknowledgement of the dangers of mass democracy. They took what may well have been the ultimate risk, however, in proposing to replace the traditional glue of religion with secular patriotism (civil religion) and science. While the American government is constitutionally prohibited from favoring any religion, it has increasingly and explicitly committed itself to promoting science — the form of belief fixation promoted by American philosophers but eschewed by large numbers of citizens. One result has been a significant anti-science reaction among the non-scientific public.

What most people practice most of the time is not science but what social psychologists call 'motivated reasoning.' They begin with a belief already fixated and then search for reasons to support it. In the words of one social psychologist, the reasoning process is often 'more like a lawyer defending a client than a judge or scientist seeking the truth' (Haidt, 2001).

Although the scientific method may be able to serve as a glue for a scientific community, it is doubtful that it can do the same for a mass public. Moreover, by creating a cosmopolitan community of scientists that transcends national science, science creates what some non-scientists experience as 'fifth column' in their midst. There is an strong tendency on the part of scientists to feel like they have more in common with fellow scientists in other countries than with some of their non-scientist (and anti-science) fellow-citizens.

6 Alienation

The political problem, however, is not just an innate resistance among non-scientists to scientific, evidence-based thinking. As science infuses into public life — as indeed it has done (witness the growing references to Anthropocene in popular media), just not as a template for daily life, as Peirce and Dewey desired — it destabilizes a social order. When economist Joseph Schumpeter described capitalist innovation as 'creative destruction' that runs the danger of being rejected by the masses whose lives it continuously upends, even as it increases aggregate wealth, he might well have been describing science (Schumpeter, 1942).

Scientists are socialized to accept and affirm the constant churn of conceptual change, but even within the scientific community this can strain social norms. The persistence of scientific misconduct is one testimony of the degree to which internal to science there is a fragility that remains a political issue, an issue the political dimensions of which neither Bush nor contemporary defenders of a reformed science policy explicitly address.

Moreover, to imagine that resistance to science can be overcome within the public at large by scientists making more of an effort to communicate their findings fails to appreciate the degree to which scientific findings themselves have become increasingly counter-intuitive and unable to be confirmed by non-scientists, even when they try to do so by applying some vernacular version of the scientific method.

It is not just the gap between the rich and the poor that has been widening in a society in which capitalist engineering is able ever more effectively to exploit the resources produced by basic research. There is a growing gap between scientific expertise and perceptual experience, from toxic chemicals, emergent viruses and invisible nanoparticles, through nuclear mass destruction and climate change catastrophe that are beyond imagination, to quantum entanglement that cannot even be thought. What is emerging is not an Anthropocene but a Neganthropocene.

7 What Is To Be Done?

How to operationalize some form of a policy for science and coordinate science for policy that would address all the political problems associated with science, engineering, and technology in our increasingly engineered world is not easy. Faith in standard received science policies is as difficult to practice organized skepticism on as any scientific paradigm.

What is to be done? It's not clear. Although Stiegler's work substantially deepens our knowledge of the disruptive, Neganthropic dimensions of life in the early twenty-first century, especially of how new communications technologies are re-engineering social relationships across multiple dimensions. Stiegler sometimes appears to manifest a kind of second order *ressentiment*: against the large-scale political failures to effectively address the existential issues staring us in the face. So one small step we might try to take, a philosophical step, would be to practice some level of detached appreciation of the fix we are in, to fixate on more calmly understanding the difficulties and dangers we are in. A model might be the way philosophers, tied fast to a railroad track with a train barreling down, would not look away or fantasize about some potential innovative McGyver-like escape, but simply want to watch and reflect on how they got into this mess. The philosophical life is not the same as the engineering life. It is actually closer to the scientific life, the life in science that can on occasion and, admittedly, to no more than a limited extent, accept the littleness of our anthropology.

To say the same thing in another way: There is something to be said simply for calmly avoiding false hope, for recognizing and accepting limits while working in small ways to moderate negative outcomes and to adapt. It does not help living in the hope that somehow we can avoid our eventual corruption and death. To accept the inevitability of physical death does not mean I will stop brushing my teeth. There is a space between then and now. To draw on another French philosopher, ‘One must imagine Sisyphus happy.’

References

Bush, Vannevar. (1945) *Science: The Endless Frontier*. Washington, DC: United States Government Printing Office.

Haidt, Jonathan. (2001) ‘The Emotional Dog and Its Rational Tail: A Social Intuitionist Approach to Moral Judgment,’ *Psychological Review*, vol. 108, no. 4, pp. 814–834.

Mannheim, Karl. ([1929] 1936) *Ideology and Utopia*, trans. L. Wirth and E. Shils, London: Routledge & Kegan Paul.

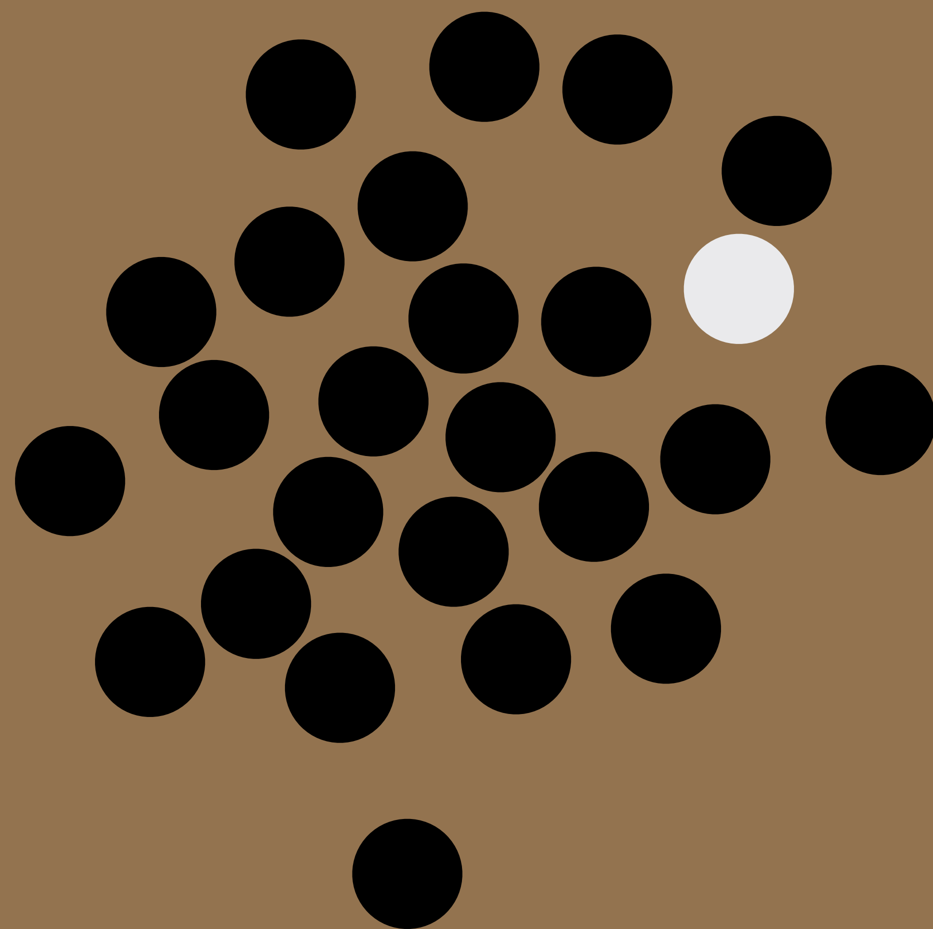
Merton, Robert. (1942) ‘Science and Technology in Democratic Order,’ *Journal of Legal and Political Sociology*, 1, pp. 11–126.

Peirce, Charles Sanders. (1877) ‘Fixation of Belief,’ *Popular Science Monthly*, vol. 12 (November), pp. 1–15.

Schumpeter, Joseph. (1962) *Capitalism, Socialism and Democracy*, New York: Harper & Row.

Suhay, Elizabeth, and James N. Druckman. (2015) ‘The Politics of Science: Political Values and the Production, Communication, and Reception of Scientific Knowledge,’ *Annals of the American Academy of Political and Social Science*, vol. 658, no. 1 (March), pp. 6–306.

Part 2
Papers



Chapter 3

Entropies, Ecologies, Economies in the 'Entropocene' Era
Towards an 'Anti-entropic Growth'?

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Abstract

In his latest works, Bernard Stiegler describes the Anthropocene as an Entropocene, that is, as a process of increasing entropy at different levels (thermodynamic level, biological level and informational or psycho-social level). This proposition invites us to rethink the contemporary ecological crisis as a triple problem of environmental ecology, mental ecology and social ecology, as proposed by Félix Guattari at the end of the twentieth century. In order to answer to this entropic ecological crisis, a double energetic transition seems necessary, which requires the conservation, cultivation and care of physical, chemical and mineral resources, but also the conservation, cultivation and care of psychic, social and libidinal resources. In order to conceive such a transition towards an 'anti-entropic growth', this article attempts to articulate the works of Nicholas Georgescu-Roegen and Bernard Stiegler, who respectively insisted on the finite and fragile dimension of natural energies and libidinal energies, and who tried to rethink the role of nature and desire in the economic process, in order to intensify and value biodiversity and noodiversity.

Keywords: entropy; economy; ecology; neganthropy; Anthropocene; Stiegler; Guattari; Georgescu-Roegen

Introduction

In a book published in 1989 and entitled *Les trois écologies* (The Three Ecologies), the French philosopher Félix Guattari suggests that the ecological question should be rethought in systemic terms: according to Guattari, 'ecological disturbances of the environment' should be considered as 'the visible part of a deeper and more profound problem relating to the ways of living and being in society on this planet' (Guattari, 1989). What he called 'environmental ecology' had to be considered in one piece with what he called 'social ecology' and 'mental ecology': 'it is not fair to separate the action on the psyche, the socius and the environment' (Guattari, 1989: 32). It is striking to note that just as Guattari insisted on the need to distinguish and connect three types of ecologies (environmental, mental and social), another French philosopher, Bernard Stiegler, in his work on the Anthropocene crisis, insisted on the necessity to distinguish and connect three types of entropies: at the thermodynamic level, at the biological level, and at the informational or psychic and social level. Indeed, according to Stiegler, 'the various disturbances which characterise the current stage of the Anthropocene era all consist of an increase in the rates of thermodynamic entropy, as dissipation of energy, biological entropy, as reduction of biodiversity, and informational entropy, as reduction of knowledge to data and informational calculations – and, correlatively, as loss of credit' (Stiegler, 2020: 28). According to the reflections of Guattari and Stiegler, the contemporary ecological crisis can thus be considered as a triple problem of environmental ecology, mental ecology and social ecology, in which the entropisation of biological organisations, the entropisation of social organisations and the entropisation of psychic organisations all combine together.

One fundamental reason for this is that the industrial, technological and mediatic devices characteristic of the last stage of the Anthropocene favour a loss of organisation, diversity, of singularity and novelty, and do so at the environmental level as well as at the psycho-social level: through the dispersion of mineral resources, the disorganisation of ecosystems and the elimination of biodiversity on the 'environmental' side, through the disruption of traditional institutions and the destruction of local social practices by digital platforms on the 'social' side, and, finally, through the exhaustion of psychic energies, the dissemination of attention and the destruction of protentional capacities, on the 'mental' side. While natural ecosystems are threatened by industrial infrastructures, which exploit mineral resources in the service of a globalised consumerist economy, psychic and social ecosystems are threatened by digital devices, which exploit libidinal resources, in the service of computational capitalism and the attention economy.

First, I will explain why the current Anthropocene crisis can be understood as an 'Entropocene' (Stiegler, 2020 and Stiegler, 2018b), in the three ecological dimensions described by Guattari (Guattari, 1989). Then, I will try to show that going beyond such a situation requires a double energetic transition, based on the conservation (that is, on economising) and care of physical and mineral energies on one hand, and on the conservation and care of psychic and libidinal energies on the other hand. In order to conceive such a transition, I will lean on the works of Nicholas Georgescu-Roegen and Bernard Stiegler, who respectively acknowledged the finite and fragile dimension of both natural energies and libidinal energies, and who tried to rethink the role of nature and desire in the economic process, in order to intensify and to value biodiversity and noodiversity.

1 The Anthropocene as an Entropocene: The Entropic Ecological Crisis

The current stage of the Anthropocene corresponds to digital capitalism and the data economy, which have replaced and combined with Fordist capitalism and the consumerist economy. The destructive character of this development gives rise to a situation of disorientation and loss of credit that Stiegler describes as amounting to an 'absence of epoch' (Stiegler, 2018a), which is to say, a loss of the conditions for epochal formation. It is a situation that seems to be characterised by an increase in entropy rates at the level of ecosystems and biological organisations, at the level of individuals and psychic organisations, and at the level of societies and social organisations.

1.1 Entropy: Degradation of Energy, Disorganisation, Disorder, Inertia

In its classical sense in thermodynamic physics, entropy designates a 'measure of the unusable energy in a system': the increase in the entropy of a thermodynamic system therefore corresponds to a degradation or a dissipation of energy, which evolves from a usable or free state (energy over which man can exercise almost complete control) to an unusable or bound state (energy which man absolutely cannot use) (Georgescu-Roegen, 2006). The transformation of the system does not correspond to the consumption of energy strictly speaking, but rather to a change of state of the energy: for example, 'when a piece of coal is burned, its chemical energy neither decreases nor increases', 'but its initial free energy has dissipated so much in the form of heat, smoke and ash, that man can no longer use it' (Georgescu-Roegen, 2006: 68). So the energy is conserved, but in a degraded form. This degradation of energy corresponds to the passage from a certain ordered structure (an improbable microscopic configuration) to a

state of dispersion and disorder (a more probable configuration). Georgescu-Roegen offers the following analogy to illustrate this difference: 'free [usable] energy implies a certain ordered structure comparable to that of a store where all the meats are on one counter, the vegetables on another, etc.', while 'bound energy [not usable] is energy scattered in disorder, like the same store after being hit by a tornado' (Georgescu-Roegen, 2006: 69). This is the reason why entropy is also defined as a measure of disorder. In a thermodynamic sense, the production of entropy can therefore be defined as 'a tendency towards disorganisation, destructuration and disorder' (Alombert and Kzrykawski, 2021), which corresponds to a dissipation and degradation of energy (energy passes from a usable state to an unusable state and from an improbable configuration to a more probable configuration). Thus, in a broad sense, beyond thermodynamics, an entropic process is 'a process in which a system tends to exhaust its dynamic potentials, as well as its capacity for conservation or renewal' (Alombert and Kzrykawski, 2021) by dissipating its energy and gradually coming to a state of inertia.

1.2 Environmental Entropy: Dispersion of Resources, Disorganisation of Ecosystems and Reduction of Biodiversity

In the field of environmental ecology, Maël Montévil's research in theoretical biology (Montévil, 2019 and Montévil, 2021) suggests that the scarcity of energy resources, the destruction of ecosystems and the reduction of biodiversity characteristic of the Anthropocene, can be understood as entropic phenomena: the production of artefacts generates a dispersion of mineral or energy resources, while climatic disturbances caused by anthropogenic forcings produce a 'desynchronisation' between populations (plants and animals), a disorganisation of ecosystems and a loss of biological singularities. In 1950, Norbert Wiener, one of the founders of cybernetics, had described living organisms (many of which are today threatened) as 'islands of decreasing entropy in a world where the general entropy does not cease increasing' (Wiener, 2014: 68): indeed, as the physicist Erwin Schrödinger showed a few years earlier, through their organisation, their diversification and their historicity, living organisms accumulate energy and use it in unpredictable ways, thus participating in the struggle against entropy which characterises the overall becoming of the physical universe (Schrödinger, 1992). The extinction of species, the reduction of biodiversity or the destruction of ecosystems thus corresponds to an acceleration of the entropic tendency. And as many Anthropocene experts have pointed out, these ecosystemic disruptions will soon have repercussions in human societies (or are already doing so), in the form of natural disasters, health crises, or economic and political conflicts: this is the reason for which, according to scientists, collective action is now necessary to maintain the Earth system in a habitable state, which supposes 'a profound reorientation of human values, behaviors, institutions, economies and technologies' (Steffen et al., 2018). Nevertheless, such a reorientation seems difficult to conceive in the current context, because in the field of social ecology, too, entropy seems to be increasing.

1.3 Social Entropy: Disruption of Institutions, Destructuring of Societies and Reduction of Cultural Diversity

Indeed, the sociologist Wolfgang Streeck describes the current crisis of the capitalist system as 'the age of social entropy' (Streeck, 2017): he maintains that the end of capitalism will in all likelihood not lead to a new political order or to a new economic and social organisation, but will instead be (and already is) characterised by a disintegration of the system under the effect of its internal contradictions (decline in growth, decline of democracy, accumulation of inequalities and debts, commodification of labor, land and money, systemic disorders, corruption, widespread demoralisation, etc.). Far from leading to an alternative system, this period of disorder engenders what he calls 'post-social' and 'sub-institutionalized' societies, characterised by unstable and unreliable structures, which no longer constitute places of solidarity and no longer provide individuals with the necessary resources and existential norms. Individuals are subjected to all kind of disturbances and accidents, condemned to develop individual strategies of adaptation and survival, unable to organise collectively in order to conceive and produce a different future. No doubt digital disruption, which contributes to weakening social systems (family, academic, linguistic, legal) is not innocent in this entropic becoming of social structures, bypassed by permanent technological innovation which ignores local regulations (Morozov, 2015) and which leaves no time for traditional organisations to renew themselves.

1.4 Psychic Entropy: Dissemination of Attention, Disorganisation of the Self and Loss of Noodiversity

At the very least, it seems, from the point of view of mental ecology or of the ecology of the mind, that digital technologies serving the data economy play a fundamental role in the production of psychic entropy. Indeed, Katherine Hayles' research (Hayles, 2007) has shown that the transition from printed and literal writing to electronic and digital writing corresponds to a transition from a socialisation of the capacity for deep attention (concentration on a single object for a long time) to societies and individuals characterised by hyper-attention (dissemination of attention in several tasks simultaneously). Likewise, Jonathan Crary's research (Crary, 2013) has shown that by constantly stimulating subjects, digital environments and 'persuasive' interfaces in the service of data economy are gradually destroying the capacities for concentration, patience, imagination and projection. According to psychologist Mihaly Csikszentmihalyi, this state of psychic disorder in which the subject's attention is constantly entertained and absorbed in objects or tasks that he or she has not themselves chosen to undertake can be described as 'psychic entropy', which corresponds to a 'disorganisation of the self' (Csikszentmihalyi, 1990): the subject becomes unable to invest his or her libidinal energy in long-term activities and projects. Their libidinal energy then becomes unusable and inoperative, because it is dispersed and disseminated, instead of being concentrated on any desired object. Conversely, optimal states of experience (characterised by deep joy or satisfaction) most often occur when the subject manages to accomplish something new at the cost of an effort of concentration during which he or she manages to direct all of his or her energy towards a single object or activity. After such an effort, which can be individual or collective, individuals feel both enriched and unified, cohesive and coherent with respect to themselves and the world around them, able to engage in creative and collective activities and to produce novelty and diversity – what Stiegler calls 'neganthropy' (Stiegler, 2018b).

2 Towards the Neganthropocene: Rethinking Economic Growth and Energetic Transition

According to Stiegler, the increasing rates of entropy observed at the levels of environmental, mental and social ecologies mean that the economy must engage in a fight against the different types of entropy: for Stiegler, economics should therefore be reconceived as 'collective action against entropy' (Stiegler, 2020: 37). Such a claim implies the need to redefine the concept of economic growth itself: indeed, according to Stiegler, the question is not to seek degrowth, but to rethink the meaning of growth itself, and the indicators that allow it to be measured. From the perspective of what Stiegler calls the Neganthropocene (Stiegler, 2018a and Alombert, 2016), that is to say, the new epoch which is supposed to come after and go beyond the Anthropocene, the aim is still to grow, but to grow in a different way – according to other values and measured by other indicators.

2.1 Towards an Anti-entropic Growth?

Indeed, GDP (gross domestic product), which today constitutes the main indicator of growth to which governments and economists pay attention, 'only takes into account the market value of what is exchanged' at the national level (Ekeland, 2021: 26), without taking into account the environmental, psychological and social consequences of these exchanges, which are always local. On the contrary, Stiegler maintains that real economic growth is not characterised by the maximisation of financial profits and exchange value, but by the intensification of anti-entropic activities, that is, activities capable 'of renewing exploited resources, preserving biodiversity and producing social and cultural diversity' (Stiegler, 2020: 134). In the context of the Entropocene, understood as the entropic crisis of the three ecologies, it therefore seems necessary to rethink economic growth on other scientific foundations, and to fight for an 'anti-entropic' growth, based on the protection and cultivation of natural ecosystems, but also of social institutions and psychic or noetic faculties.

Therefore, according to Stiegler, an anti-entropic economy should be based on 'new indicators, capable of taking into account anti-entropic activities' (Stiegler, 2020: 134), activities that preserve and cultivate natural or psycho-social resources. It is for this reason that Stiegler insists on the need to conceive and experiment with other types of economic indicators, in order not only to calculate the production of financial profits but also and above all to measure and evaluate the production of collective knowledge: in short, indicators that do not only measure the exchange value of products, as GDP does, but also take into account the practical value of knowledge. One model for this conception of economic indicators is provided by Amartya Sen's idea of a Human Development Index (HDI), designed to take human aspects into account, such as the capabilities of the inhabitants, which are also necessary for economic resilience and social development (Sen, 1985).

2.2 The Anti-anthropic Value of Knowledge

According to Stiegler, the capabilities possessed by inhabitants of a locality are based on the practice of various types of knowledge (practical, technical, theoretical – knowledge of how to do and make things, of ways of living, theoretical knowledge). All these types of knowledge constitute practices of care, which can be described as anti-entropic activities (which preserve and cultivate natural or psycho-social resources and natural or psycho-social environments). Indeed, the various types of knowledge always constitute ways for subjects to take care of their environments: to take care of their natural or technical environments, by taking care of their daily living environment through know-how or technical knowledge; to take care of their social environment, by connecting to each other through arts of living, social skills or social knowledge; and to take care of their mental or symbolic environment, by concentrating and cultivating their psychic energies through conceptual or theoretical knowledge. Understood in this way, the different types of knowledge seem to constitute activities through which people fight against the entropic tendencies specific to the different ecological fields, by promoting the cultivation and renewal of environmental, psychic and social 'resources'.

> The practice of knowledge therefore has an economic value, which Stiegler describes as 'practical' or 'neganthropic' value, which he distinguishes from use value or exchange value.

The value of knowledge cannot be conceived as use value, because knowledge does not exhaust itself while being practised: it is not destructible and cannot be consumed like material products. But knowledge cannot be thought according to exchange value either, because the value of a form of knowledge (practical, technical or theoretical) does not increase according to its scarcity: on the contrary, the more a knowledge is shared, the richer it gets, and the more its value increases. The more knowledge you share, the more knowledge you have: knowledge is the only thing that you can share without losing it, precisely because it is not a thing that can be exchanged on a market, but an anti-anthropic activity, which is essential to the preservation and transformation of societies.

2.3 The Role of Nature and of Desire in the Economic Process

If practical, technical and theoretical knowledge are so necessary, it is because they allow people to take care of natural and psycho-social resources, which are finite and fragile. Just as Georgescu-Roegen argues that the neoclassical model of economics ignores the role of nature in the economic process and does not take into account the finitude of natural resources, so Stiegler maintains that the digital consumerist economy ignores the role of desire in the economic process and does not take into account the destructible character of psychic or libidinal resources, which do not develop spontaneously, but which must be cultivated, and which, conversely, can be captured by all kinds of artifacts that can manipulate and destroy them. Digital consumerist capitalism captures users' attentions thanks to personalised advertisements and persuasive technologies based on the massive collection of data and designed to control behaviors and steer them towards compulsive or addictive consumption. But these consumerist behaviors can also become dangerous, because they are based on the exploitation of individual drives: they short-cut the process of sublimation and socialisation, through which the satisfaction of individual drives is deferred through collective projects or activities, in which people invest their libidinal energies and cultivate objects of desire (which can be persons, such as children or friends, but also artistic or scientific activities, political projects, works of arts, etc.). So, the anti-entropic economy is interested not only in the effects of industrialisation on natural environments or ecosystems, caused by the exploitation of raw materials by production industries, but also in the effects of industrialisation on individual minds and collective lifestyles, caused by the exploitation of attentions by cultural industries.

2.4 The Exhaustion of Material and Libidinal Resources: A New Energetic Transition

Indeed, according to Stiegler, by reducing desires to drives, digital consumerist capitalism ends up depleting libidinal energies, generating all kinds of frustrations, leading to all the compensatory behaviors of hyperconsumption which further aggravate 'the entropic nature of the economic process' described by Georgescu-Roegen, through the production of more waste or more pollution. According to Stiegler, 'we ingest more and more sugar and fat, we eject and produce more and more carbon dioxide because we are caught in this symbolic misery, for which we try to compensate by acquiring things and engaging in activities that cause us to consume a lot of materials, and materials which, consumed under such conditions, produce a great deal of toxins' (Stiegler, 2006: 94). Thus, the necessity to save or to economise natural resources (chemical, physical or mineral energies) is intrinsically linked with the necessity to save and economise psycho-social resources and libidinal energies. Just as Georgescu-Roegen insisted on the need to stop exploiting the stock of fossil fuels and to base economy and industry on renewable energy flows (such as solar or wind), Stiegler insists on the need to stop exploiting the drives of consumers and to base economy and industry on the renewal of libidinal energy: just as the exploitation of coal and petroleum forces us today to find renewable energies, so too 'we must find a renewable energy of the libido' (Stiegler, 2006: 88). According to Stiegler, only such a 'revival of desire' will be able to transform individual and collective behaviors, by making them 'more aware of, more attentive to and more careful with what surrounds them' (Stiegler, 2006: 94), through which such behaviour becomes, therefore, more promising for the future.

Conclusion

Even if, as Georgescu-Roegen (2006) puts it, there is no industry without waste because everything that is produced is consumed and everything ends up decomposing (the economic process that is characteristic of human societies contributes to the overall entropic tendency), through the practice of knowledge or collective and creative activities, human groups can nevertheless constitute 'islands of decreasing entropy in a world where general entropy continues to increase' (Wiener, 2014: 68). An anti-entropic economy aims at developing and promoting such 'islands of decreasing entropies', which constitute what Guattari called 'existential territories' (Guattari, 1989: 50) or what Stiegler called 'anti-anthropic localities' (Stiegler, 2020), that is to say, activities within which individuals socialise their drives, project collective desires, invest their libidinal energies into local and singular activities, and in this way take care of themselves and their environments, through the practice of every kind of knowledge. The function of the contributory income promoted by Stiegler (2015) is precisely to remunerate and valorise such activities, in order to exit from a consumerist and entropic economic model that depletes psychic energies by producing addictive consumption and destroying ecosystems, and to open a contributory and anti-entropic economic model, which intensifies and increases the practice of local knowledge, and through that intensifies biodiversity and noodiversity.

References

The quotations taken from the original French texts are translated into English by the author.

Alombert, A. (2016) La question du Néguanthropocène chez Bernard Stiegler. *La Deleuziana* 4. URL: http://www.ladeleuziana.org/2016/12/30/4-geopower/

Alombert, A. and Krzykawski, M. (2021) Vocabulaire de l'Internation. *Appareil.* URL: http://journals.openedition.org/appareil/3752

Csikszentmihalyi, M. (1990) Flow: *The Psychology of Optimal Experience*. London: Harper Perennial.

Crary, J. (2013) *24/7 Late Capitalism and the Ends of Sleep*, trans. as *24/7 Le capitalisme à l'assaut du sommeil*. Paris: La découverte, 2014.

Ekeland, I. (2021) Du bon usage des modèles mathématiques. *Annales des Mines – Responsabilité et environnement*, 101 (1): 25–28.

Georgescu-Roegen, N. (2006) La loi de l'entropie et le problème économique. *La décroissance: entropie, écologie, économie*. Paris: Ellébore-Sang de la terre.

Guattari, F. (1989) *Les trois écologies* (*The Three Ecologies*). Paris: Galilée.

Hayles, N. K. (2007) Hyper and Deep Attention: The Generational Divide in Cognitive Modes. *Profession*: 187–199. URL: https://www.jstor.org/stable/25595866

Montévil, M. (2019) Entropies and the Anthropocene Crisis. *AI & Society: Knowledge, Culture and Communication*, Springer Verlag. URL: https://hal.archives-ouvertes.fr/hal-02398756/

Montévil, M. (2021) Sciences et entropocène. *Ecorev' – Revue critique d'écologie politique*, 50 (1): 109–125.

Morozov, E. (2015) Résister à l'ubérisation du monde. *Le Monde Diplomatique*. URL: https://www.monde-diplomatique.fr/2015/09/MOROZOV/53676

Schrödinger, E. (1992) *What Is Life?* Cambridge: Cambridge University Press.

Sen, A. (1985) *Commodities and Capabilities*. Oxford: Elsevier Science Publishers.

Steffen, W. et al. (2018) Trajectories of the Earth System in the Anthropocene. *PNAS*, 115 (33): 8252–8259. URL: https://www.pnas.org/content/115/33/8252

Stiegler, B. (2006) De l'économie libidinale à l'écologie de l'esprit. *Multitudes*, 1 (24): 85–95. URL: https://www.cairn.info/revue-multitudes-2006-1-page-85.htm

Stiegler, B. (2015) *La Société Automatique*, Paris: Fayard.

Stiegler, B. (2018a) *Qu'appelle-t-on panser ? Au-delà de l'Entropocène*. Paris: Les liens qui libèrent.

Stiegler, B. (2018b) *The Neguanthropocene*. Open Humanity Press.

Stiegler, B. (2020) *Bifurquer*. Paris: Les liens qui libèrent.

Streeck, W. (2017) *How Will Capitalism End? Essays on a Failing System*. London and New York: Verso.

Wiener, N. (2014) *Cybernétique et société. L'usage humain des êtres humains*. Paris: Seuil.

Chapter 4

Bifurcating Gender Knowledge and Neganthropy in Queer and Trans Futures

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Abstract

Contemporary theories of queer and trans liberation widely embrace the liberatory potential of experimental transformation. While 'natural' categories of sex and gender are aligned with fixed and immutable essences, through experimentation, one can compose with artifice and prosthesis, slipping through the cracks of nature/culture and human/machine binaries. Where natural essence thus stands in for an outdated past and cloying present, experimentation with transformative techniques figures a free future. How much of this discourse can be retained when our thinking of the future is forced to tarry with *entropy*, and with the irreversible expenditure of finite resources? Are we still able to champion the subversion of stable forms in the face of automated identity-formation and the atomisation of identity classes in metadata? If entropy limits the efficacy of experimentation, what can we say of the future of our queer and trans communities, their borders, and the ways in which they are, from now on, able to pass down their knowledge(s) and customs? I argue that Bernard Stiegler's work on entropy, anthropy and neganthropy provides a set of tools for approaching these questions. For Stiegler, the subversion of order often leads not to liberation, but instead to the careless consumption of energy and a global increase in human-spurred entropy (anthropy). Stiegler suggested his own form of futural politics in the localised deferral of this anthropy through *bifurcation*. Wresting careful control over the local environment from global process that simply expropriate its energy, bifurcatory decision-making allows for local forces to self-determine and self-regulate on the basis of their own cultivated knowledges.

Stiegler nevertheless aligned medical intervention in the domain of reproduction with entropy, the loss of knowledge, and with *degeneracy*. It is likely that gender affirming care, and queer or trans healthcare in general, would not have escaped his critical ire in this regard. In this paper, I read Stiegler with *and against* Paul Preciado, as perhaps his closest contemporary within the tradition of so-called 'queer theory', in order to think a new way forward for the 'neganthropology' of gender. How can we take Stiegler's critique of disorder, and of entropy, seriously, and put it to use without condemning trans(formative) healthcare as necessarily entropic, proletarianising, or *degenerate*? A new bifurcation of gender is necessary, to move beyond experimental romanticism and Stiegler's revived discourse of degeneracy.

Keywords: gender construction; gender affirming care; entropy; pharmacology

Introduction

How can sex, gender, and sexuality be approached from within, or at least alongside, Bernard Stiegler's thinking of *neganthropology*? I suggest that despite a relative silence on these questions, Stiegler does provide – with pharmacology and the logic of *adoption* – a framework for thinking gender in a manner that is properly *neganthropological*. Nevertheless, I feel it necessary to insist that Stiegler himself failed to think gender in this way, and I intend in what follows to interrogate this failure by posing the question of what might make a '*bifurcation of gender*' possible and desirable. In doing so, I aim to build upon Stiegler, pushing his thought in the direction of a careful thinking of gender, primarily by demonstrating where his work resonates with certain strains of contemporary queer and trans thought, and where these forms of thinking clash *unproductively*.

I begin by setting out the basic tenets of Stiegler's neganthropology. I do this by presenting his 2014 seminar series dedicated to a critique of scientific anthropology as a call for *prescriptive (neg)anthropology*. I then contrast Stiegler's thinking briefly with Paul Preciado's *Testo Junkie*. Despite its brevity, this reading should allow us to reach gender neganthropologically, or at least to begin to think of gender as a matter of *neganthropology*, and therefore to point future research in the direction of a theory of gender that would be sensitive to the *urgency* Stiegler imparts to our thinking with the problem of entropy. As I demonstrate, however, thinking gender neganthropologically is far from a simple task. The brief gesture toward *degeneracy* [*la dégénéresence*] in the limited 'theory' of gender that exists in Stiegler's own voice brought him strikingly close to an avowal of eugenics: the introduction of Preciado into this text is therefore not only a matter of comparative reading or vague interdisciplinarity but is also intended to serve in some regard as a corrective to this *least careful*, and potentially *catastrophic*, aspect of Stiegler's speculation.

I A New Critique of Anthropology

In one course of Stiegler's annual *pharmakon.fr* seminars (Stiegler, 2014), he proposed a 'new critique of anthropology'. Stiegler thematised, primarily, the discipline's inability to think *pharmacologically* about technology. He claimed that scientific anthropology *à la* Maurice Godélier lacks an analysis of technology as not only essential to the constitution and development of humanity, but also as irreducibly both toxic and therapeutic, in need of constant re-evaluation and continuously updated legal and social regulation. Just as the *pharmakon* that is writing, for the Socrates of the *Phaedrus*, aids memory yet reduces and replaces its power, technologies present themselves for Stiegler as therapeutic enhancements that embellish our powers to think, act, and desire, yet are also always prone to *replace* these powers, if not to efface them entirely. The discourse concerned with this double tendency of our technologies, their ambivalent character as *pharmaka*, Stiegler calls *pharmacology*. Pharmacology is not just a question of describing the toxic and remedial effects of technologies, however, it should instead be concerned with *managing* these effects. Pharmacology should for Stiegler cultivate the good and curb the bad. Each stage of this necessary management is staked on a form of decision that Stiegler calls *bifurcation*, such that '*the pharmakon is always that in relation to which a bifurcation must operate*' (Stiegler, 2018: 198). The meaning of this bifurcation in any given scenario depends on how the toxic and therapeutic tendencies of a given technology present themselves, but generally to bifurcate, in Stiegler's sense of the term, means to decide in favour of the cultivation of positive, therapeutic effects. To bifurcate, to enact a bifurcation, is to forge a path from within the present manifestation of the toxicity of our technologies toward a future that is in some sense more sustainable, more diverse, and more *liveable*.

A critical point in Stiegler's understanding of pharmacology, however, is that the bad, toxic, or poisonous effects of technological development are not only qualitative, but quantitative insofar as they can be expressed in terms of the wasteful expenditure of energy, and therefore as *entropic* – or as specifically human, '*anthropic*.' The bifurcation toward a more sustainable and liveable future is always one that responds directly to this increase in entropy and anthropy that our technologies, as pharmaka, facilitate. The bifurcation required to defer entropy is not simply a process of deliberation in which we manage to 'decide against entropy', however. The situation in which technologies present themselves in line with two tendencies at once, one entropic or anthropic, the other therapeutic or in some sense amenable to the deferral of anthropy that Stiegler describes as '*Neganthropy*', requires a certain kind of strategic decision-making that does not pretend to do away with the irreducibility of the ambivalence of technology. As Stiegler writes in *The Neganthropocene*: 'To the anthropic tendency we must not oppose but impose a neganthropological tendency, by quasi-causally inhabiting the anthropic tendency and in doing so reversing it, that is, localizing it, through a neganthropic bifurcation' (2018: 202). Insofar as entropy represents the global, irreversible expenditure of energy, it leads toward an end state of absolute homogeneity, a universal stasis in which there is, strictly speaking, only unstructured waste. Neganthropy, in deferring this, is aligned with *locality, diversity,* and *structure*.

Stiegler claimed that scientific anthropology could only succeed in thinking the transformation of social relations – and specifically kinship, which in Maurice Godélier is tied to gender – in terms of relations internal to, and between, ethnic groups and their effacement before 'occidental ethnocentrism.' For Stiegler we are currently facing joint processes of synchronisation and standardisation, implemented by technoscientific industries on behalf of a 'purely and simply computational capitalism' (Stiegler, 2019: 38). As Stiegler sees it, the *purely computational* aspect of capitalism today renders any appeal to a localised and coherent *ethnicity* almost meaningless. The analysis provided by scientific anthropology therefore cannot suffice, as its emphasis on the primacy of kinship and ethnicity misses the need for programs designed to orient technological development towards the sustainability of the social, the biological, and the environmental, and away from the totalising influence of this technoscientific capitalism that is no longer localisable, even to an amorphous 'occident'.

The central mistake that results in this anthropological blindness, Stiegler claims, is that of thinking it possible to separate the development of, and interaction between, social and ethnic groups, from the development and deployment of techniques and technologies. The *weakness* [*faiblesse*] of scientific or structuralist anthropology is in this regard tied to its failure to think of the brain as first and foremost the organ that incorporates technologies, such that the historical development of the human – of human intelligence such that it can come to form ethnicities and civilisations – is in fact the development of the brain *as this power of incorporation* (Stiegler, 2014: Séance 03, 0:25:30–0:26:00).

Precisely because the brain is the organ for incorporating technologies, and because these technologies are always both toxic and therapeutic, leading to an increase in entropy in the

absence of regulation, the history of interactions between social groupings must for Stiegler be thought against the backdrop of the development of technologies that are always being incorporated in various ways by each group, managed and sometimes *mis*-managed, with empowering and sometimes *dis*-empowering effects. What anthropology should therefore become, integrating pharmacology and the theory of entropy, is in fact *Neganthropology*: a field that can address *and combat* the massive increase in entropy (and so anthropy) effected by the delegation of the management of technologies to markets and industries divorced completely from the sustainability of the social and the organisation of the living. The need for a *neganthropic bifurcation* is therefore pressing in Stiegler's account because our present state of affairs leaves unchecked the toxic effects of our technologies, which, as *pharmaka*, need to be constantly checked and *re-checked* lest they completely overwhelm, replace, and automate our ways of living and forms of knowledge of how to live.

The alternative to this 'careless' automation and marketisation of our ambivalent technologies can be described in terms of a 'careful' organisation of the living.

As an *organisation*, Stiegler insists, this alternative must be structured around *Negentropy* – and as non-inhuman, *Neganthropy* – as the localised deferral of the homogenisation wrought by the increase of entropy and anthropy. For Stiegler, only this kind of organisational project can avoid the environmental and political catastrophe(s) looming on the technological horizon of our systematically careless epoch. Passing beyond the effort to merely describe today's *Anthropos*, in order to facilitate bifurcation away from disaster, Neganthropology must be explicitly prescriptive: it should define the programs which stave off the worst consequences of technological development and dis-organisation by cultivating negentropy and neganthropy, safeguarding the various, heterogenous ways in which life is organised, this in the name of the future of the *diversity* of the living, which for Stiegler can flourish only within environments that are relatively stable. Neganthropology can only succeed in making appropriately realistic and *liveable* prescriptions, however, if it comprehends the logic of the pharmakon, acknowledging toxicity even within therapeutic programs and possibilities for therapy even from within situations which appear eminently toxic.

From the perspective of a queer or trans person living today, what is most striking in this transformative critique of anthropology is the way in which Stiegler integrates 'the question of gender' (his phrasing). In the second of the *pharmakon.fr* seminars – dated April 29, 2014 – Stiegler says that if we take his critique of Anthropology seriously, we must realise that: '*on ne peut pas aborder la question du genre autrement qu'en posant un* *problème pharmacologique*' (30:27–30:38).[27] Just as the pharmakon always calls for a decision, as a *question*, gender is something that demands a response. In other words, a decision should be made regarding and responding to the openness of gender, and this requirement arises for Stiegler in the context of introducing a prescriptive pharmacology into the scientific anthropology of Godélier and his contemporaries. Insofar as it is necessary to come to a 'gender decision' in response to the pharmacological character of our technologies, we should understand the 'question of gender' as the demand for a *bifurcation of gender*. The bifurcation of gender ought to move us toward a sustainable future for the *Anthropos* that is always already technical, and thus always already in need of programs for managing the increase in entropy for which this technicity renders it culpable. The *diversity* of the living is therefore at stake in the question of gender, threatened by a technoscientific homogenisation, and should for Stiegler be safeguarded through a neganthropic bifurcation. It is intuitive to include diversity of gender in the diversity of life under threat, gender being one way among others that people differ in living out their lives. Therefore, it is intuitive to suppose that within Stiegler's program, diversity of gender ought to be safeguarded and affirmed by neganthropology through means that are *prescriptive*.

This theoretical route already represents a radical departure from the orientation of a great deal of theory aligned with contemporary queer and trans politics – which is to say contemporary progressive politics of sex, gender and sexuality. Common today in queer and trans political discourse is an emphasis placed on the freedom to desire beyond the constructs imposed upon us by medical, legal and political institutions. De-regulating desire is therefore often a primary goal, in the sense of stripping away arbitrary restrictions imposed in the name of some supposedly 'natural' way of organising the living. Prescriptions, therefore, and generally the idea of prescriptivism, are commonly disavowed in favour of a general embrace of autonomous, intentionally subversive experimentation. Epistemologically, this should also be understood in the context of a shift in attitudes toward forms of theory that favour the descriptive and even the auto-biographical or auto-theoretical to the semi-prescriptive or normative discourses of (now-outdated, historical) biology, psychology, and anthropology of gender.

Given this difference in perspectives, I feel compelled to pose a question that can potentially provoke several alarmed and alarming responses: How much 'liberatory' queer and trans discourse can survive the posing of the question of gender and sexuality in pharmacological terms, in terms of a prescriptive

27 'We cannot approach the question of gender other than by posing a pharmacological problem.'[Translation my own.]

anthropology that is also a *neganthropology*? In other words, when entropy and organisation are the key terms through which we think impending political catastrophe and its deferral, what becomes of *liberation*? The inverse question unavoidably haunts any attempt to respond to questions such as these. In return, that is: how much of the pharmacology and (neg)anthropology prescribed or endorsed by Stiegler can be retained without sacrificing what, in the fight for our safety and freedom as queer and trans people living today, is worthy in-itself of being sustained and affirmed into the future *precisely as biological, technical and noetic diversity?*

II Prescriptive Diversity

Paul Preciado serves as an interesting starting point for approaching this network of problems, given that he is a thinker within what we might reductively still call 'queer theory' or 'trans studies' who is nevertheless sensitive to the already technical situation in which our supposedly natural designations of sex, gender, and sexuality arise. This is to say nothing here of his own interpretation of pharmacology after Derrida, or his own development of a *philosophical* analysis of originary prosthesis (Preciado, 2018). Preciado's vision for liberation, at least as it is expressed in the 2010s, comprises a sort of piracy, or even a *copyleft gender politics*. At stake in much of *Testo Junkie* (Preciado, 2013) is, as a result, the free experimentation with transformative substances – primarily hormone replacement therapies, though these are far from his only points of reference – in which one is not prescribed doses to which one must adhere, and so in which knowledge of use and bodily transformation are not delegated outside the user. The properly curative or therapeutic aspect of the substance is, for its part, nurtured in the embrace of the open-endedness of its effects. One is experimenting with *testo-gel*, to use Preciado's example, in communication with others that may be doing the same, anticipating some of its effects, but affirming both the undecidable ambivalence *and* the determinately 'masculinising' changes in equal measure – 'no norm', he states, 'merely a diversity of viable monstrosities' (Preciado, 2013: 397).

Two key tenets of the political project in which this experimentation is situated are the separation of transformational technologies from a restrictive medical gatekeeping on one hand and their public distribution freed from privatised pharmaceutical industries on the other.[28] Without the latter step, private industry would in all likelihood benefit immensely from the former process of de-medicalisation and would thus likely reduce trans healthcare to

28 'We have the right to demand collective and 'common' ownership of the biocodes of gender, sex, and race. We must wrest them, from private hands, from technocrats and from the pharmaco-porn complex. Such a process of resistance and redistribution could be called *technosomatic communism*' (Preciado, 2013: 352).

a commodity market. Yet, public distribution of these technologies without an end to hyper-medicalisation would remove a number of economic barriers to medical transition without addressing the loss of knowledge and agency that even publicly funded medical gatekeeping involves. Both strands of Preciado's politics must therefore go hand in hand. This is to say, Preciado presents an idea of gender politics that centres experimentation, but this emphasis on personal, experimental agency is not disengaged from questions of automation, privatisation, and *proletariansiation* (to borrow Stiegler's term for the systematic loss of knowledge effected by the delegation of practices to automating processes).

It is worth reiterating that the technologies and substances involved in these experimental processes are *pharmaka*. They are addicting, they give way to toxicity in the absence of care, and vague strategies of experimentation do not in themselves guarantee that one stays 'in control' of the relationship between user and substance. It can remain an open question for my purposes to what degree the fantasy of ever being in control of – or truly exerting control over – the pharmakon can be more than fantasy. It should nevertheless be understood that the pirate politics at play in Preciado's use of *testo-gel* is avowedly a risky one, and that these risks are not assuaged, necessarily, by Preciado's playful knowledge of them – hence his self-proclaimed status as a *(Testo) Junkie*.

This said, in queer politics 'after' Preciado, it is reasonable to say that the role of a theory of the ambivalent technicality of the human and the need for prescriptive measures are related yet still fundamentally *separate* issues. The top-down management of the interplay between the organisation of life and its associated technologies through the prescription of therapeutic programs would clash directly with the goal of freeing sex and gender from medical diagnostic models and processes of social marginalisation staked on norms whose legitimacy is supposed to come precisely from prior historical, anthropological and medical expertise or 'deliberation'. These models, the gatekeeping they facilitate, and the industries they prop up, seem in fact perfectly compatible with the kind of deliberative decision-making processes that ground Stiegler's emphasis on prescription, notably insofar as the function of our institutions (medical and otherwise) is usually tied directly, for Stiegler, to the propagation, (re)production, and (re)transmission of knowledge. In contrast, *knowledges*, both theoretical and practical, are in Preciado to be won *collectively* and as *common*: insofar as power over the formation and distribution of knowledges is the central political stake, their production and ownership *cannot* be justifiably prescribed in advance.

This discourse in Preciado is taking place *prior*, in a sense, to the introduction of the question of entropy, or at least prior to

Stiegler's injection of political *urgency* into the question of entropy. Stiegler's pharmakon is not simply toxic in the sense that one can become addicted or personally face negative side-effects. As noted above, the toxicity Stiegler described is tied to a tendency that is itself measurably entropic, that moves those who embrace the ambivalent technologies in the direction of a general exhaustion of future possibilities and the homogenisation of forms of life into waste. Once addicted to *testo-gel*, a Stieglerian response to Preciado might claim, one is delegating the development of the body in relation to gender and sex to an external system that can never be suitably re-integrated. As a result, knowledge about the ongoing transition process is not granted the user-turned-consumer of the hormone supplement, who remains alienated and proletarian, and is thereby deprived of full knowledge of their own gender and body, streamlined into the same 'future of gender' as every other consumer of the same substance.

For this hypothetical Stiegler, instead of *adopting* the technology that is the hormone supplement, incorporating and developing alongside it, one is *adapting* to it, and conforming to *its* set of futural possibilities.[29] As he wrote in *What Makes Life Worth Living* (Stiegler, 2013), 'To adapt is to proletarianize, that is, to deprive of knowledge those who must submit to that to which they are adapting themselves' (130). It is this loss of knowledge that adaptation *always* is for Stiegler, that makes possible the standardisation and homogenisation that threatens today's *Anthropos*. As a result, this adaptation is also what makes a *neganthropology* that can safeguard diversity in forms of biological, psychological and technical life necessary. The need to prescribe in the interests of the protection of forms of knowledge required for new kinds of diversification, that is, arises at least partially in response to the kind of adaptation represented by experimentation with hormone supplements.

In this context, the question of gender is no longer simply the question of the use or abuse of specific technologies that relate to, or affect, gender, or of the approach through which one broaches the pharmacological situation opened by, for example, the scientific description of hormones as sexed or *sexing*. Instead, the question is that of *deciding* where adoption is truly possible and legislating so that it wins out over the forms of adaptation that would lead to proletarianisation, entropy, and homogenisation. This is to say, the *bifurcation* necessary in relation to gender turns out to be for Stiegler a decision made between those technologies that *can be adopted* and those to which *one*

29 For more on the distinction between adoption and adaptation in Stiegler, see Hui (2019): 'to adopt is to affirm what accidently arrived and integrate it into the whole. Adoption is different from adaptation but it is not opposed to it, as if they were two incompatible processes' (Hui, 2019: 143).

can only adapt. It seems then that the necessary prescription for Stiegler is one that intervenes in the development and distribution of technologies transformative in relation to sex and gender in order to prevent the dissolution of the social organisation to which these categories are essential. Though he did not explicitly include transitional technologies such as hormone supplements in his analysis, Stiegler made this need for decisive legislation clear in his remarks on surrogacy [*'la gestation pour autrui'*], and by extension medical technologies impinging on the relationship between sex, gender, sexuality and reproduction, which he condemned almost categorically: '*des actes médicaux… des actes de reproduction, actes sexuels, actes de gestation, actes d'accouchement – je peux déléguer ça à quelqu'un, c'est une prolétarisation'* (1:27:18–1:27:27).[30]

III Degeneracy

Stiegler's disavowal of transformative medical intervention gives us an answer to my primary question that is unsettling: what can be retained from discourses of queer and trans liberation is their acknowledgement – where this is in fact present, and it is not present everywhere – that when we speak of gender and sexuality we do so always from within a situation that requires managing the toxic and therapeutic sides of the technologies with which we compose. What cannot be retained, however, is any sense of experimental or epistemological *autonomy*: to experiment with hormone therapies, to alter one's body and its means of reproducing (or having sex, and these are for Stiegler perhaps confused), and also, *to play*; these matters seem to be reducible, in Stiegler's thought, to forms of entropic and knowledge-destroying adaptation. Experimentation simply *delegates* gender, sex, and sexuality to still-toxic technologies, it cannot suitably facilitate the bifurcation toward a neganthropic future. When, as in Preciado, we claim to be preserving and establishing *our own knowledges* through communal, experimental practice, we seem for Stiegler to actually be giving in to proletarianisation.

For this reason, we might worry that for Stiegler there may be no properly queer or trans knowledge of the plasticity of gender and sex outside of medical institutions imbued with the authority to decide, on behalf of queer and trans people, what is acceptably therapeutic, and what is simply adaptive. If the experimental practices of queer and trans people themselves are necessarily proletarian, knowledgeless, and entropic, then the neganthropic bifurcation necessary to avoid social and environmental collapse, for Stiegler, seems to turn out to require legislating emancipatory experimental practices out of existence. This would indeed be a *worry* insofar as medical institutions and right-wing governments

30 'medical acts… reproductive acts, sexual acts, acts of gestation, acts of childbirth – I can delegate this to somebody [else], this is proletarianisation' [Translation my own.]

alike have historically maintained this position themselves, wielding it to their great profit and power (this, it should go without saying, at our great expense and harm). It would be necessary, in order to fully flesh out this analysis, to combine it with a broader critique of privatisation, and of political economy at large. Within this latter endeavour the appropriate distinctions could be made between currently failing medical institutions threatened by catastrophic privatisation, and medical institutions *to-come* that could perhaps facilitate transformational reproductive and gender-affirming care in a way that Stiegler would not deem entropic. Given that Stiegler himself (at least in these seminars) expressed disdain for the practices of medical delegation and not their deployment only within private care, however, this would involve going far beyond the word of his oral text, a step too far for my purposes here. Compounding this, unfortunately, Stiegler's *pharmakon.fr* seminars see him express a sentiment that is somewhat more sinister than simply distrust in the face of externalisations of knowledge that may or may not be entropic, and whose status *as entropic* may or may not result from privatisation alone.

Toward the end of his first seminar, he says the following:

> La dégénérescence est ce qui est provoqué par ce que je décrirais comme une dés-intégration commune aux faites anthropotechniques qui caractérise notre époque… L'affirmation d'aujourd'hui, c'est que la dés-intégration technologique actuelle expose au risque d'une dégénérescence. Et ce que j'appelle la dégénérescence, c'est la perte de fécondité. C'est la perte de fécondité tel qu'un déséquilibre générique… je dis bien générique, je ne dis pas génétique… Le nazisme, qui a eu un discours sur la dégénérescence, c'était un discours sur la dégénérescence génétique…
>
> (Stiegler, 2014: 1:22:18–1:23:25)[31]

31 'Degeneracy is what is provoked by what I call a common dis-integration of the anthropo-technical facts that characterise our epoch… Today's affirmation is that the current technological dis-integration exposes the risk of degeneracy. And what I call degeneracy, it's the loss of fecundity. It's the loss of fecundity such that a generic disequilibrium… and I really am saying generic, I am not saying genetic… Nazism, which had a discourse on degeneracy, it was a discourse on genetic degeneracy…' [Translation my own.]

On one hand, this passage represents an extension of the general theory of bifurcation and organisation described above. Technological development, improperly regulated and oriented, can lead to the disintegration of social, political, and vital structures, and so can facilitate the homogenisation of forms of life (a loss of 'fecundity' in forms of living, or of 'generic' diversity). On the other hand, this is an unavoidably moralistic condemnation of the side of the pharmakon that is toxic, entropic, and with which practices that fail to become properly *neganthropic* compose. Insofar as he has thought it appropriate to claim in advance that the delegation of medical processes is in-itself proletarianising and adaptive, moreover, this is a condemnation of delegated medical transformation as objectively and measurably *negative, privative, and degenerate*.

The distinction Stiegler draws is incredibly important in this regard, if not for the reasons he likely had in mind while speaking. He is distinguishing his critique of *generic* or *formal degeneracy* [*'la dégénérescence générique'*] from an affirmation of eugenics, the fascistic notion of *genetic degeneracy* [*la dégénérescence génétique*]. This distinction, precisely insofar as it comes down to the difference of *just one letter*, is important not because it prevents his prescriptivism from falling into eugenics, but rather because it allows us to see what might be going wrong in Stiegler's thinking of prescriptive neganthropology. It should be uncontroversial to say that the 'genetic' component of supremacist notions of purity and filth is far from their only ethically and politically unsavoury characteristic. Just as, historically, the loss of faith in a genetic inscription of homosexuality does not amount to an end to homophobia, the shift in qualifier from genetic to generic should not satisfy us that a discourse of *degeneracy* is not still *just that:* a discourse that proclaims *there is degeneracy, 'that [form, practice, process] is degenerate'*.

This demands careful attention, and a full interrogation of the ethico-political implications of this aspect of Stiegler's thought lies well beyond the scope of this paper. I would like only to highlight it here to suggest that Stiegler's neganthopology goes awry when it builds this condemnation-in-advance into the supposedly quantifying discourse of entropy and its deferral through localisation. Pharmacology, the management of the *irreducibly* ambivalent character of our technologies, is incompatible in principle with the designation of certain practices as necessary disintegrative, proletarianising and degenerate. This internal tension seems to suggest that within Stiegler's vision of a neganthropic future, there is diversity, as local heterogeneity, but it is a diversity which seems to be prescribed in such a way that various possibilities for diversity among ways of living are ruled out, and it seems unfortunately that many queer and trans practices of

transforming the body and experimenting with technological means of styling the body are among these latter exclusions.

Conclusion

There is doubtless another bifurcation possible – another decision on gender and sexuality that treats the pharmacological aspect of *all* transitional technologies carefully and does not fall into exclusionary moralism. Extending its care from surrogacy to metoidioplasty, this other bifurcation would amount to a decision to prescribe in the name of the heterogeneity of the many sexes and genders and sexualities with which our contemporary technologies are interposed. Such a thing might still be possible through Stiegler, even if this would require holding him to his word, *despite his word*, that the pharmakon *always* has the potential to facilitate therapy, that nowhere are we *only* facing entropy without the possibility of its local deferral in neganthropy. This requires taking *care* seriously in the context of so-called transitional technologies, and seeking to formulate therapeutic programs which do not simply re-enclose knowledges on the side of prescriptive medical, legal and political institutions, but instead provide the space – likely by intruding on any process of *privatisation* of these technologies that would subsume them under an aesthetics of marketing or a marketing of aesthetics – in which experimentation with technologies of gender and sexuality can continue to facilitate the local diversification of forms of life into the future.

In this regard, even if aspects of Preciado's political vision appear in the face of entropy as naïve or romantic affirmations of undecidability, his staunch refusal to enclose knowledge and agency within prescriptive institutions is perhaps more faithful to the guiding insight of Stiegler's neganthropology. If the pharmakon demands a bifurcation, it nevertheless demands that the decision is not made too far in advance, from ground that is too high or from a perspective agency that would reduce its ambivalence to a matter of deciding 'against toxicity, entropy, and *degeneracy*'. The hardest task remains, after this intervention, that of carefully charting a path towards the cultivation of local knowledges, including those borne from queer and trans experimentality, without falling into romanticism or repackaged naturalism, if not something worse. In further research dedicated to gender and neganthroplogy, this must remain in view.

References

Hui, Y. (2019) *Recursivity and Contingency*. London: Rowman and Littlefield.

Preciado, P. (2013) *Testo Junkie*. Translated by B. Benderson. New York: Feminist Press.

Preciado, P. (2018) *Countersexual Manifesto*. Translated by K.G. Dunn. New York: Columbia.

Stiegler, B. (2013) *What Makes Life Worth Living: On Pharmacology*. Translated by D. Ross. Cambridge, MA: Polity Press.

Stiegler, B. (2014) *Séminaire Pharmakon Édition 2014: Nouvelle critique de l'anthropologie – Rêves, cinémas, cerveaux*. Available at: https://iri-ressources.org/collections/season-44.html

Stiegler, B. (2018) *The Neganthropocene*. Translated by D. Ross. London: Open Humanities Press.

Stiegler, B. (2019) The Age of Disruption, Translated by D. Ross. Cambridge: Polity Press.

Chapter 5

Challenging AI's Simulacra of Ethical Deliberation Some Problems of Ethicopolitics of Algorithms

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Abstract

The rapid advancement of AI technologies inevitably expands the scope of ethical questions about the impact of such technologies. That is why I argue that the crucial role of sociotechnical imaginaries for the debates about moral AI can be traced back to the way in which they create what I call macro-hyper-reality (encouraged by the introduction of the so-called fourth industrial revolution (4IR)) and micro-hyper-reality (induced by the replication of imperfect human morality in the field of machine ethics). Tackling the impact of the latter type of hyper-reality, I examine why the so-called simulacrum of ethical deliberation in Powers' sense triggers some paradoxical at first sight similarities between what I call weak and strong moral AI scenarios. Specifically, the analysis is focused upon the origin of some crucial concerns about both scenarios. The latter address the way in which the so-called ethical intelligent agents are unable to reach the complexity of human moral motivation and moral behavior, as well as the very important human capacity of taking moral responsibility by themselves. Consequently, the practical threats of AI simulacra of ethical deliberation are refracted through the lens of what Amoore calls cloud ethics. The introduction of the ethics in question contributes to revealing how the aforementioned

simulacra are underlined by three types of mutually related mistakes in the process of computation. These mistakes include what Gordon calls *rookie mistakes* (concerning engineers' lack of knowledge about some relevant ethical principles), *moral mistakes* (regarding problems of general moral disagreement) and purely *computational errors*.

Keywords: AI simulacra of ethical deliberation; weak and strong moral AI scenarios; cloud ethics; rookie mistakes; moral mistakes

Introduction

Key Concepts and Clarifications

Analysing the implications of sociotechnical imaginaries[32] for the debates about moral AI, I would point out two types of hyper-realities they create – macro-hyper-reality encouraged by the introduction of the so-called fourth industrial revolution (4IR) and micro-hyper-reality induced by the replication of imperfect human morality in the field of machine ethics.

Specifically, 4IR is associated with the empowerment of the so-called technological megatrends such as AI, robotics, the Internet of Things (IoT), autonomous vehicles (AVs), 3D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing (Schwab, 2016: 19–27; Vicente & Dias-Trindade, 2021: 2). For the purposes of unpacking the role of the sociotechnical imaginaries for the discussions about moral AI, one should go back to the suggestion of the members of the World Economic Forum (WEF) that '4IR represents what Sheila Jasanoff would term a sociotechnical imaginary' (Philbeck & Davis in Vicente & Dias-Trindade, 2021: 2). Assuming that 'the WEF sociotechnical imaginary for a 4IR' (Vicente & Dias-Trindade, 2021: 4) displays a 'techno-optimist sentiment or orientation towards the future that not only echoes other contemporary imaginaries, but also amplifies the revolutionary potential of technology' (Schiølin in Vicente & Dias-Trindade, 2021: 4), I argue that it is its probabilistic character that triggers the issue of the so-called future essentialism (Schiølin, 2020: 542). Consequently, one of the most disturbing outcomes of the latter is that it can reduce the democratic options by encouraging 'the transformation of a corporate, highly elitist vision of the future into policymaking and public reason on a national level' (Schiølin, 2020: 542). In addition, the probabilistic character of this sociotechnical imaginary also strengthens the general concerns about moral AI. The assumption is that 4IR may constitute an immoral or an irrelevant to morality pseudo-

32 Regarding the understanding of sociotechnical imaginaries, I refer to Jasanoff's definition that the latter are 'collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology' (Jasanoff, 2015: 4).

reality (macro-hyper-reality) whose impact upon human beings is completely unpredictable in moral terms.

Judging by the aforementioned specifications, I outline two main reasons for the recognition of 4IR as a macro-hyper-reality which necessitates the introduction of different scenarios of moral AI. First, the pervasive power ascribed to AI may lead to the conflation of decisions to ethical decisions as a trigger for the attribution of moral agency to machines.[33] Second, future essentialism can be examined as rooted in the understanding of WEF sociotechnical imaginary as one homogenous imaginary. However, the latter does not meet the definition of sociotechnical imaginaries as co-existing simultaneously and with different actors who compete for imposing their own imaginaries as dominating (Jasanoff, 2015). In turn, killing pluralism brought about by these imaginaries in favor of one macro-hyper-reality raises the threat of arguing for strong moral AI scenarios. Specifically, the probabilistic character of WEF sociotechnical imaginary revives the concern that even if AGI (Artificial General Intelligence) is a speculative concept, the macro-hyper-reality kickstarted by the 4IR strengthens the discussions about AGM (Artificial General Morality) which this new pseudo-reality may bring to light.

Regarding micro-hyper-reality, I argue that it implies the recognition of different types of the so-called moral machines (Wallach & Allen, 2010), as well as encouraging their development into more elaborated artificial moral agents. The attempts range from building machines (robots) which can discern right from wrong (Wallach & Allen, 2010), when producing artificial moral agents (AMAs) as implicit ethical agents,[34] to speculating with the prospects for artificial autonomous moral agents (AAMAs) as explicit ethical agents.[35] In turn, the distinction between implicit and explicit ethical agents raises the discussion about the possibilities of building autonomous moral machines which can demonstrate moral (self-)development, as well as cultivating human-level responsibility.[36] The issue is whether different types of machines can be not only autonomous, but also sufficiently moral in their autonomy.

On the other hand, setting the requirement of human-level morality triggers the concerns about one of the most illuminative embodiments of what I called micro-hyper-reality – the simulacrum

33 I am deeply grateful to the anonymous Reviewer 1 for bringing the matter to my attention.
34 These machines have 'been programmed to behave ethically' by following some ethical principles, as embodied by their designer (Moor, 2006: 19–20).
35 These are machines that are 'able to calculate the best action in ethical dilemmas using ethical principles' by themselves (Anderson &Anderson, 2007: 15).
36 For the role of responsibility in avoiding potential harms see Tigard, 2021.

of ethical deliberation exhibited by machines (Powers, 2006: 46).[37] If all the latter achieve is such a simulacrum, it 'could be that a great many humans do no better' (Powers, 2006: 46). The major challenge is whether or not moral machines can correctly identify moral dilemmas,[38] predict and reduce to a minimum the negative outcomes of a decision-making process, as well as selecting these dilemmas which can enrich machine-learning context so that they 'can shed some light on philosophical work in ethics'[39] (see LaCroix, 2022).

Consequently, the continuity of the aforementioned processes necessitates the examination of the moral context in which implicit and explicit ethical agents can reach (or not) a graduated human-level morality. The goal of machine ethics 'to create a machine that *itself* follows an ideal ethical principle or set of principles' (Anderson & Anderson, 2007: 15) is no longer considered as ultimate, since it addresses the status of implicit ethical agents alone. Being influenced by today's sociotechnical transformations, researchers are more interested in discussing whether 'machines could at best be engineered to provide a shallow simulacrum of ethics' (Sparrow, 2021: 685).

Elaborating upon the issue whether or not the use of moral machines can encourage simulacra of ethical deliberation raises the question of what the scenarios of moral AI should look like. Specifically, the moral difference regarding explicit and implicit agents' problem-solving potential, as refracted through the lens of their potential for moral(self-)development and the way of taking responsibility, underlines the introduction of two different types of moral AI scenarios.

I argue that the distinction between the so-called strong AI scenarios (due to which a human-level of cognition should be reached) and weak AI scenarios (operating by using preprogrammed algorithms) (Savulescu & Maslen, 2015: 84; Klincewicz, 2016) can be extrapolated into what I would call

37 Assuming Baudrillard's conception of simulacrum as something 'never exchanged for the real, but exchanged for itself, in an uninterpreted circuit without reference or circumference' (Baudrillard, 1994: 6), Powers outlines the risk of making machines moral by analogy with humans who are imperfect moral agents (Powers, 2006: 46).

38 As an illuminative example of machines, whose use initially concerns the process of identification and solution of moral dilemmas, I point out that of autonomous vehicles (AVs) (see Awad et al., 2018; LaCroix, 2022; Serafimova, 2022a). For the role of sociotechnical imaginaries for AVs see Martin, 2021.

39 The clarification that the pendulum swings back to the field of philosophy has apparent practical implications. This is due to the fact that leaving moral dilemmas unsolved hinders AMA's commercialization. For the debate about the moratorium of the commercialization of AMAs see Van Wynsberghe & Robbins, 2019 and Chomanski, 2020.

strong 'moral' AI scenarios (looking for an explicit ethical agent)[40] and weak 'moral' AI scenarios (designing an implicit ethical agent) (Serafimova, 2020).[41] Judging by their definitions, one may assume that these 'moral' scenarios generate more differences than similarities. However, the major similarity has a purely moral rather than technological origin. The reason is that complexity of human moral motivation cannot be programmed into any machine whatsoever nor can one find ethical principles which are valid once and for all.

That is why strong and weak moral AI scenarios can be described as inducing simulacra of ethical deliberation, as well as demonstrating why instead of improving human moral reasoning, they raise some additional moral concerns. For the purposes of shedding light upon the latter, I examine why the scenarios in question are underlined by the conflation of the so-called *rookie mistakes*, viz. mistakes resulting from the lack of relevant ethical knowledge on the programmers' (and researchers') part, *moral mistakes* regarding 'areas of peer disagreement in ethics, where no easy solutions are currently available' (Gordon, 2020: 141) and purely *computational errors*.

Furthermore, the conflation itself has crucial moral implications, as embedded into the concern about human vulnerability to AI systems. It triggers 'at least two kinds of ethical issues' (Liao, 2020: 2): first, what is the impact of these AIs upon humans and second, how humans should treat these AIs (Liao, 2020: 2). In turn, tackling the aforementioned issues requires one to analyse the predictability of some long-term effects of imposing

40 The necessity of discussing strong moral AI scenarios can be defined as provoked by dangerous scientific hybris of believing that technological advancing can successfully make room for our future with machines as cyber-humans (Barfield, 2015). Barfield explores the example of Professor Steve Mann, 'one of the first human-machine 'cyborgs'' (Barfield, 2015:IX) who was assaulted at a restaurant in Paris (2012) due 'to his appearance and technical capabilities as a cyborg' (Barfield, 2015:IX). Barfield argues that since Mann has a natural personhood status, it could give him the right to initiate a civil lawsuit (Barfield, 2015:IX). However, in so far as 'artificially intelligent machines have not yet reached a level of cognitive development to argue for personhood status...they currently lack individual rights and the ability to defend their interests' (Barfield, 2015:IX). In addition, I would say that the idea of obtaining legal rights should be examined as closely tied with that of moral rights. The reason is that Mann might not be able to practically defend his rights, but this does not solve the dilemma in deciding whether or not human beings have the moral right to do this on his behalf for his own sake. That is why I point out that it is human hybris of ascribing human-level morality to machines that necessitates humans to take a stance on the potential failure of strong moral AI scenarios in practical terms. I am grateful to the anonymous Reviewer 2 for their suggestion to rethink how strong AI affects the debate on robots' rights and real harms.

41 Another interpretation of strong and weak moral AI scenarios can be found in what Bauer coins minimum and maximum payout of ethical questions within machine ethics. While the minimum payout promotes discussions about ethics in general (Anderson, Anderson & Amen, 2004; Anderson & Anderson, 2011), the maximum payout is that 'AMAs could be better ethical decision-makers than us (Anderson, Anderson & Armen, 2004; Grau, 2006) and, therefore, perform right actions more often than we do now' (Bauer, 2020: 263).

AIs such as that of harming people, as well as grounding some suggestions for the near-term AIs such as that of distinguishing between 'vulnerabilities in machine learning' (ethical dilemmas arising from the limitations of the current machine-learning systems) and 'human vulnerabilities' (ethical dilemmas that derive from the better way of functioning of machine learning systems compared to humans) (Liao, 2020: 3). Regarding the latter type of vulnerabilities, I would add that human vulnerabilities also include these which concern the 'worse' functioning of machine learning systems in moral terms (i.e., worse functioning affecting the process of computation of moral motivation, moral feelings, biases etc.).

For the purposes of exemplifying the way in which the two types of vulnerabilities are embedded in simulacra of ethical deliberation, I examine the conflation of rookie mistakes, moral mistakes and computational errors in the scope of the so-called cloud ethics (Amoore, 2020). Could ethics itself be defined as irreducible to a specific ethical paradigm. The choice of such an approach can be recognized as a methodological advantage in the sense that cloud ethics does not prescribe a given set of ethical rules which 'merely locate the permissions and prohibitions' of the use of algorithms (Amoore, 2020: 7). Otherwise, it would have been nothing but one among many first-order normative theories with a limited field of application.

Furthermore, I argue that the methodological advantage of introducing cloud ethics is that it provides a meta-ethical framework of integrating moral agents and algorithms in a dialectical manner, since both of them have a status of ethicopolitical entities. Specifically, cloud ethics is determined as dealing with ethicopolitics of algorithms which 'involves investigations of how they learn to recognize and to act, how they extract assumptions from data relations, and how they learn what ought to be from relations with other humans and algorithms' (Amoore, 2020: 8). On the other hand, such a meta-ethical framework strengthens the concerns about vulnerabilities in machine learning and human vulnerabilities, as I show in the following sections. The major reason is that the ethicopolitical status of algorithms can be recognized merely by analogy with that of human agents, which increases the risks of building simulacra of ethical deliberation.

Powers' Simulacra of Ethical Deliberation: Theoretical Framework

Before exemplifying some practical moral concerns about the simulacra of ethical deliberation in the field of cloud ethics, I briefly discuss a few theoretical reasons for their justification. According to Powers, the gist of the simulacra of ethical deliberation is that neither humans nor machines can do better. This means that moral machines can do nothing but replicate human imperfect morality. Thus, instead of grounding a better moral reality, they can enchant a given type of immoralism or moral absolutism as the one and only moral reality.

Therefore, if one wants to provide a genealogical analysis of why machines' ethical deliberation takes place under the guise of simulacra, one should tackle it as a question of morality rather than machine ethics. In other words, if one wants to understand why neither humans nor machines can do better, one should first clarify that machines cannot do better because humans cannot do so either.

What could be said before analysing the two examples of weak and one example of strong moral AI scenarios given below is that the last two examples are underlined by different types of moral mistakes concerning areas of general moral disagreement. Specifically, such mistakes can be described as resulting from the complexity of human moral motivation and moral behavior. In other words, it is the complexity in question that determines why moral mistakes can contribute not only to building immoral machines, but also to showing *why* these machines cannot be moral at all.

Regarding the weak moral AI scenarios, I argue that the moral concerns about programming an implicit ethical agent to behave ethically are displayed in the following cases. First, one may inadvertently program moral machines with unethical behavior strongly believing that the latter is ethical. Consequently, the origin of this problem can be traced back to the so-called rookie mistakes which are made due to engineers' lack of awareness of the most relevant principles for moral machines (Gordon, 2020: 141). In psychological terms, it is natural to believe that one may easily identify the origin of such mistakes by providing the engineers with the relevant ethical knowledge (Gordon, 2020: 141). However, revealing the role of unconscious biases[42] behind the rookie mistakes does not solve the problem by default. The reason is that engineers can be provided with the relevant knowledge, but deny its application when it contradicts their own moral principles. Therefore, the programming of immoral machines, when one strongly believes that they are moral, can be described as a result of moral mistakes regarding areas of general moral disagreement. The mistakes in question are triggered by engineers' conscious

42 For the different role of biases see Serafimova, 2020a: 114–115.

biases of what machine's moral behavior should look like. That is why the simulacrum of ethical deliberation built by immoral machines is justified due to the tacit argument that machines cannot do better because people who build them cannot do so either.

Second, one may deliberately program moral machines with unethical behavior, when being guided by immoral intentions of gaining more power and better control. In this case, I argue that a simulacrum of ethical deliberation is underlined by the assumption that machines cannot do better because people do not want them to do so. Elaborating upon the debate in the language of rookie and moral mistakes, I draw the conclusion that such machines are built by engineers who deliberately do not want to correct their own rookie and moral mistakes.

They ground their unwillingness in the speculation with the normative status of moral mistakes concerning general moral disagreement, viz. the engineers impose their moral decisions by speculating with the normative validity of moral pluralism.

Regarding the strong moral AI scenarios, one can expand upon Powers' statement on the simulacra of ethical deliberation by saying that machines cannot do better in moral terms because they cannot achieve even the imperfect level of human morality. This means that explicit ethical agents lack human capacity for moral self-development which makes it so hard, if not impossible, for an AAMA to cultivate an autonomous moral concern on the basis of a self-developing moral reasoning. Practically speaking, moral machines cannot experience moral (self-)development because they cannot make moral mistakes regarding areas of general moral disagreement. Therefore, they cannot learn from their own mistakes, which in turn makes them unable to develop their own moral capacity.

In addition, if one aims to fulfill a strong moral AI scenario in which ethical intelligent agents can reach a human-level of ethical

knowledge, one should be assured that the moral self-update of the AAMAs guarantees that after the update, the moral machines will remain at least as moral as they were before. This, however, is not an easy task, since only human moral self-development can guarantee that moral reasoning guides practical reasoning in situations when some new, morally justifiable decisions are needed.

Elaborating upon the discussion into the field of machine ethics makes the differences between human and machine moral reasoning even more complicated. The missing link in the comparison between human and machine's moral self-development can be found in machine's inability to take responsibility for its own actions, as well as having no potential to be benefitted by its own moral mistakes. That is why machines preprogrammed with the perfect moral algorithms from a computational point of view are less desirable in moral terms than some immoral human beings. The reason is that regardless of the fact that such beings cannot be recognized as moral at this stage of their life, they have the potential to become more moral in the future. In contrast to the moral machines, human beings initially have the potential to internalize the role of the normative expectations regarding their behavior in process terms. Specifically, such people can take responsibility for changing their immoral behavior in the process of their own moral (self-)development. The result of the latter is that in contrast to the moral machines, human beings have the potential to deconstruct the simulacra they build by themselves.

Simulacra of Ethical Deliberation within the Framework of Cloud Ethics: Practical Contribution

For the purposes of analysing the practical implications of moral reasoning, I explore the origin of some simulacra of ethical deliberation within cloud ethics. The simulacra in question are evaluated due to the way in which moral and computational vulnerabilities predetermine the conflation of rookie mistakes, moral mistakes and computational errors.

Examining Amoore's theory that the ethicopolitical narrative is underlined by 'a composite of human-algorithm relations' (Amoore, 2020: 9), one should take into account that these relations are not established between two types of autonomous moral and socio-political agents. It is humans as moral agents who are initially responsible for both human and computational vulnerabilities. That is why when one argues for cloud ethics 'envisaging a plurality of venues for ethical responsibility in which all selves – human and algorithmic – proceed from their illegibility' (Amoore, 2020: 8), one should also keep in mind that algorithmic selves do not fully exhaust the subject of human selves, although the latter can express themselves via the former.

Elaborating upon Amoore's idea that algorithm is a particular type of ethicopolitical entity which is shaped by 'the relational attributes of selves and others' (Amoore, 2020: 7), I would point out that humans and algorithms display different types of ethicopolitical entities. The difference is that while algorithms are coined ethicopolitical beings in the world due to the fact that they 'must already be replete with values, thresholds, assumptions, probability weightings, and bias' (Amoore, 2020: 8),[43] humans constantly *replete themselves* with the aforementioned experiential set of features in the process of interaction.

Based upon these specifications, I try to demonstrate why the risks of simulacra of ethical deliberation in the field of cloud ethics can be examined as driven by the multiple relations between rookie mistakes, moral mistakes and computational errors. That is why the following scenarios are taken into consideration.

First, when rookie mistakes do not lead to moral mistakes in a short-term perspective, but may have negative ethical consequences for the process of computation in the future. In computational terms, the major moral challenge is the enrichment of the generative potential of machine learning algorithms.[44] Specifically, there is a risk that a simulacrum of ethical deliberation in the field of cloud ethics can be triggered by what Amoore cogently coins a problem of bounded rationality. According to the latter, the domination of computational criteria delineates good from evil in algorithmic decisions as one marked by reason versus unreason, rationality versus irrationality (Amoore, 2020: 109).[45]

Amoore exemplifies the idea of bounded rationality by the introduction of the so-called kill switch of a human intervention, viz. the activation of an autonomous weapons system, artificial intelligence for speech, or a video recommendation system for children (Amoore, 2020: 109). The introduction 'marks a threshold of something like madness, understood as a departure

43 The role of biases for machine ethics is determined by the specific use of the algorithms as well, since they 'inevitably make biased decisions' (Mittelstadt et al., 2016: 7). The reason is that algorithms' design and functionality reflect the values of the designers 'and intended uses, if only to the extent that a particular design is preferred as the best or most efficient option' (Mittelstadt et al., 2016: 7). In addition to data bias, algorithm bias and user interaction feedback (Merhabi et al., 2019: 8, Fig. 2), one should also take into consideration the role of agency bias for the ethicopolitics of algorithms. This bias underlines the process in which 'the source is continually edited and rewritten through the algorithm's engagement with the world' (Amoore, 2020: 87).

44 The generative function of algorithms concerns the assumption that they 'do not merely recognize people and things in the sense of identifying—faces, threats, vehicles, animals, languages...', but also 'actively generate recognizability as such' (Amoore, 2020: 69).

45 However, this is only one scenario of simulacrum of ethical deliberation underlined by the relations between rookie and moral mistakes. In addition to the cases when rookie mistakes trigger negative moral consequences here-and-now, the problem of bounded rationality can also result from moral mistakes regarding areas of general moral disagreement. Then, the short- and long-run risks affect the issue that 'immoral' algorithm can be misrecognized as moral due to being rationally verified.

from reasoned logic', when the algorithm 'acts in a way that was somehow not anticipated' (Amoore, 2020: 109). Discussing Amoore's example of the kill switch, one may argue that the major concern is not that the algorithms grounding these systems work in an unpredictable manner, but that AI systems can be misused (deliberately or inadvertently) for some wrong purposes such as killing civilians, providing violent speech and inappropriate video recommendations for children. Bringing the debate back again to the theoretical level of investigation, I outline that if the engineers are unaware that they do not have the relevant ethical knowledge, they can make some rookie mistakes which have long-term moral consequences; specifically, when assuming that verified algorithms cannot be morally bad due to their computational 'rightness'.

Second, there are cases when rookie mistakes *do lead* to moral mistakes which are smoothly incorporated into well-working (from a computational point of view) algorithms. It is the moral complexity of this process that necessitates the establishment of the vast field of data mining for discrimination discovery. Refracting the debate through the lens of cloud ethics, I argue that the gist of discrimination discovery can be interpreted as underlined by the understanding that algorithms constantly give accounts of themselves (Amoore, 2020: 19) in the process of constant development of human accountability.

Third, there are cases when rookie and moral mistakes *do not lead* to computational errors by default. As an illuminative example in this respect, I would point out the complicated process of moral reasoning for autonomous vehicles (AVs). Amoore discusses the impact of the $556,650 research grant (provided by the US National Science Foundation) which is devoted to the elaboration of decision-making algorithms for AVs (Amoore, 2020: 118). According to her, the research is an explicit illustration of 'encoded ethics, in which codes of conduct are sought to modify and restrain the harmful effects of algorithmic decisions' (Amoore, 2020: 118). Considering the fact that this is a comprehensive topic in itself,[46] I briefly discuss Gurney's suggestion that the driver may 'select the ethics of her car' prior to using it in practice (Gurney, 2016: 254) as an exemplification of AV embedded ethics.[47] The analysis demonstrates why even if embedded ethics succeeds in reducing the aforementioned effects, this ethics does not make AVs moral at all.

Specifically, the choice of embedded ethics in Gurney's case raises the following moral concerns. First, when choosing the ethics of their car in advance, the driver cannot guarantee that the choice is moral by default. For instance, one may choose

46 For a broader analysis of the different projects of AVs as moral machines see Serafimova, 2022 and Serafimova, 2022a.

47 For a detailed version of the argument see Serafimova, 2022.

to apply moral principles which are good for one, but not for the well-being of the rest. Second, the driver may program the AV with ethics which they consider as good for themselves, but it may turn out that this ethics benefits the survival probabilities of the rest. While in the first case I argue for selfishness underlining the choice of ethics, which can be determined either as a deliberate selfish decision on the driver's part or as a result of poor estimation, in the second one, the ethical choice results from a poor estimation alone, unless the driver shows a suicidal behavior.

Fourth, there are cases when rookie and moral mistakes *do lead* to computational errors. The concerns about this scenario can be explained by the problems triggered by what Amoore coins ethicopolitical load of undecidability (Amoore, 2020: 164). It is the weight of undecidability that is never eradicated entirely by the algorithm's output (Amoore, 2020: 164). If those who should 'feel the weight' of their decisions do not do that for one reason or another (e.g., they cannot or do not want to weigh what is the risk for them, as well as for their relationships with other people (Amoore, 2020: 164)), they might question the validity of the whole calculus by generating wrong or insufficient safety algorithms.

On the other hand, elaborating upon the double-bind implications of collective responsibility regarding ethicopolitical load of undecidability, I argue that the more disturbing issue is the speculation with the understanding and internalization of 'weight' as encouraging the so-called politics of verticality (Amoore, 2020: 46). In this context, one faces moral rather than rookie mistakes which break the balance between human and algorithmic accountability.

For instance, if the authorities deliberately choose wrong or irrelevant ethical principles for the sake of building cognitive patterns of identifying their enemies in public gatherings, the use and development of some AI models (such as agent-based modelling of civil-violence or revolution) (Lemos, Coelho & Lopes, 2013) or machine learning programs (such as relying on 'pattern recognition and sentiment analysis to identify political protests, civil unrest, and 'atypical' gatherings or events') (Amoore, 2020: 46) may become uncontrollable. Theoretically speaking, the politics of verticality can be described as necessitated by deliberate moral mistakes which rely upon the perfection of computational process so that the misuse and overuse of AI systems serve one distorted vision of ethicopolitics.

Conclusion

The crucial role of sociotechnical imaginaries for the debates about moral AI can be traced back to the way in which they create what I call macro-hyper-reality (affected by the introduction of the so-called fourth industrial revolution (4IR)) and micro-hyper-reality (induced by the replication of imperfect human morality in the field of machine ethics). Specifically, I reach the conclusion that the risks of encouraging the design of different scenarios of moral AI are risks of justifying simulacra of ethical deliberation in Power's sense.

Investigating the moral challenges of micro-hyper-reality reveals one paradoxical at first sight similarity between what I call weak and strong moral AI scenarios. In both scenarios, ethical intelligent agents are unable to reach the complexity of human moral motivation and moral behavior, as well as the very important human capacity of taking moral responsibility by themselves, when learning from their own mistakes. Consequently, one of the most disturbing outcomes of this analysis is that pretending to create a perfect moral world (or at least, more perfect than that of humans), moral machines may tacitly produce an immoral hyper-reality in Baudrillard's sense.

Judging by the way in which rookie and moral mistakes affect the process of building different scenarios of moral AI, I reach the conclusion that AI simulacra of ethical deliberation have a purely moral rather than computational origin. While within the weak moral AI scenarios, machines cannot do better because people who program them cannot do so either (or in some cases – because people do not want them to do so), within the strong moral AI scenarios, machines cannot do better because they cannot reach even the imperfect level of human morality due to lacking the human capacity of moral self-development. Therefore, the main concern about AI's lack of moral (self-)development is that moral machines cannot take responsibility for their own actions, as humans do; nor can they learn from their moral mistakes so that they can deal with new moral dilemmas.

Tackling the practical problems triggered by the lack in question, I focus upon the risks of AI simulacra of ethical deliberation in the field of cloud ethics. Specifically, I argue that cloud ethics contributes to revealing how the simulacra of ethical deliberation result from the complex relations between computational errors, rookie mistakes and moral mistakes in Gordon's sense. That is why I explore the following scenarios, as evaluated from computational and moral perspectives.

First, one witnesses some cases when rookie mistakes *do not lead* to moral mistakes here-and-now, but may have unpredictable consequences in the long term which affect their computational embodiments. In this context, the major moral concern derives from the enrichment of the generative potential of machine learning algorithms, as underlined by the misrelation of good to reason and bad to unreason.

Second, there are cases when rookie mistakes *do lead* to moral mistakes which, however, smoothly underline some well-working algorithms such as these encouraging different forms of discrimination.

Third, there are cases when rookie and moral mistakes *do not lead* to computational errors by default. However, they may negatively affect the ethical decision-making by some machines such as AVs. Investigating Amoore's theory of embedded ethics of AVs, I reach the conclusion that even if the ethics in question successfully reduces harmful effects of algorithmic decisions, it does not make autonomous machines moral by default. The reason is that programming AVs with ethical principles concerns areas of general moral disagreement. In addition, one should also take into account that algorithms for morality are not necessarily moral algorithms.

On the other hand, there are cases when rookie and moral mistakes *do lead* to computational errors, which is illustrated by what Amoore calls ethicopolitical load of undecidability. However, I argue that the disturbing case is not the impossibility of 'feeling the weight', as implied by the undecidability in question, but the speculation with the understanding of this 'weight' for the purposes of introducing the so-called politics of verticality in Amoore's sense. Such politics addresses merely the role of deliberate moral mistakes. That is why the major concern about the latter is that they encourage the process of computational perfection so that the collective socio-political control can be increased.

Having examined the aforementioned configurations between rookie mistakes, moral mistakes and computational errors in terms of the vulnerabilities they provoke, I reach the paradoxical at first sight conclusion that human and machine learning vulnerabilities are inseparable due to the fact that humans and algorithms display different types of ethicopolitical entities which are mutually related. Consequently, their mutual relatedness determines the way in which biases behind machine learning algorithms are inseparable from human biased preferences, although the former have their purely computational specificities. That is why if one wants to reveal the origin of the simulacra of ethical deliberation within cloud ethics, one should not only unpack 'the full socio-technical assemblage of algorithms' (Kitchin, | 2017: 25), but also examine the particular moral implications of this assemblage.

References

Amoore, L. (2020) *Cloud Ethics: Algorithms and the Attributes of Ourselves and Others.* Durham, NC: Duke University Press.

Anderson, M. and S.L. Anderson (2007) 'Machine ethics: Creating an ethical intelligent agent'. *AI Magazine* 28(4): 15–26.

Anderson, M., S.L. Anderson and C. Armen (2004) 'Towards machine ethics: Implementing two-action based ethics theories'. *Machine Ethics*. American Association for Artificial Intelligence Fall Symposium, Menlo Park: AAAI Press, pp. 1–7.

Anderson, S.L. and M. Anderson, (2011) 'A prima facie duty approach to machine ethics and its application to elder care'. *Human-Robot Interaction in Elder Care*. American Association for Artificial Intelligence, Menlo Park: AAAI Press, pp. 2–7.

Awad, E., S. Dsouza, R. Kim, J. Schulz, J. Henrich, A. Shariff et al. (2018) 'The moral machine experiment'. *Nature* 563: 59–64.

Barfield, W. (2015) *Cyber-humans. Our Future with Machines.* Cham: Springer.

Baudrillard, J. (1994) *Simulacra and Simulation.* Ann Arbor: The University of Michigan Press.

Bauer, W.A. (2020) 'Virtuous vs. utilitarian artificial moral agents'. *AI & Society* 35(1): 263–271.

Chomanski, B. (2020) 'Should moral machines be banned? A Commentary on van Wynsberghe and Robbins 'Critiquing the reasons for making artificial soral agents''. *Science and Engineering Ethics* 26(6): 3469–3481.

Gordon, J-S. (2020) 'Building moral robots: Ethical pitfalls and challenges'. *Science and Engineering Ethics* 26(1): 141–157.

Grau, C. (2006) 'There is no 'I' in 'robot': Robots and utilitarianism'. *IEEE Intelligent Systems* 21(4): 52–55.

Gurney, J.K. (2016) 'Crashing into the unknown: An examination of crash-optimization algorithms through the two lanes of ethics and law'. *Albany Law Review* 79(1): 183–267.

Jasanoff, S. (2015) 'Future imperfect: science, technology, and the imaginations of modernity'. In S. Jasanoff and S.H. Kim (eds) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago: The University of Chicago Press, 1–33.

Kitchin, R. (2017) 'Thinking critically about and researching algorithms'. *Information, Communication & Society* 20(1): 14–29.

Klincewicz, M. (2016) 'Artificial intelligence as a means to moral enhancement'. *Studies in Logic, Grammar and Rhetoric* 48(61): 171–187.

LaCroix, T. (2022) 'Moral dilemmas for moral machines'. *AI and Ethics*. https://doi.org/10.1007/s43681-022-00134-y

Lemos C., H. Coelho and R.J. Lopes (2013) 'Agent-based modelling of social conflict, civil violence and revolution: State-of-the-art-review and further prospects'. In E. Lorini (ed.) *Proceedings of the Eleventh European Workshop on Multi-agent Systems* (EUMAS 2013). Toulouse: Toulouse University Press, 124–138.

Liao, M. (2020) *Ethics of Artificial Intelligence*. Oxford: Oxford University Press.

Martin, R. (2021) 'AV futures or futures with AVs? Bridging sociotechnical imaginaries and a multi-level perspective of autonomous vehicle visualisations in praxis'. *Humanities and Social Sciences Communications* 8, 68.

Merhabi, N., F. Morstatter, N. Saxena, K. Lerman and A. Galstyan (2019) 'A survey on bias and fairness in machine learning'. *ACM Computing Surveys* (CSUR) 54(6): 1–35.

Mittelstadt, B.D., P. Allo, M. Taddeo, S. Wachter and L. Floridi (2016) 'The ethics of algorithms: Mapping the debate'. *Big Data and Society* 3(2): 1–21.

Moor, J.H. (2006) 'The nature, importance, and difficulty of machine ethics'. *IEEE Intelligent Systems* 21(4): 18–21.

Powers, T.M. (2006) 'Prospects for a Kantian machine'. *IEEE Intelligent Systems* 21(4): 46–51.

Savulescu, J. and H. Maslen (2015) 'Moral enhancement and artificial intelligence. Moral AI?' In J. Romportl, E. Zackova and J. Kelemen (eds) *Beyond Artificial Intelligence. The Disappearing Human–Machine Divide*. Cham: Springer, 79–95.

Schiølin, K.H. (2020) 'Revolutionary dreams: Future essentialism and the sociotechnical imaginary of the fourth industrial revolution in Denmark'. *Social Studies of Science* 50(4): 542–566.

Schwab, K. (2016) *The Fourth Industrial Revolution*. Geneva: World Economic Forum.

Serafimova, S. (2020) 'Whose morality? Which rationality? Challenging artificial intelligence as a remedy for the lack of moral enhancement'. *Humanities and Social Sciences Communications* 7 (119).

Serafimova, S. (2020a) 'How to assign weights to values? Some challenges in justifying artificial explicit ethical agents'. *Balkan Journal of Philosophy* 12(2): 111–118.

Serafimova, S. [2022] 'Perspectives on Moral AI. Some pitfalls of making machines moral'. Sofia: Avangard Prima. Unpublished monograph.

Serafimova, S. [2022a] 'Ethical clashes in the prospects for autonomous vehicles'. In B.D. Grozdanoff, S. Serafimova and Z. Popov (eds) *Rationality and Ethics in Artificial Intelligence*. Cambridge Scholars Publishing. Unpublished chapter.

Sparrow, R. (2021) 'Why machines cannot be moral'. *AI and Society* 36: 685–693.

Tigard, D.W. (2021) 'Artificial moral responsibility: How we can and cannot hold machines responsible'. *Cambridge Quarterly of Healthcare Ethics* 30(3): 435–447.

Van Wynsberghe, A. and S. Robbins (2019) 'Critiquing the reasons for making artificial moral agents'. *Science and Engineering Ethics* 25(3): 719–735.

Vicente, P.N. and S. Dias-Trindade (2021) 'Reframing sociotechnical imaginaries: The case of the Fourth Industrial Revolution'. *Public Understanding of Science* 30(6): 1–16.

Wallach, W. and C. Allen (2010) *Moral Machines: Teaching Robots Right from Wrong*. Oxford: Oxford University Press.

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Chapter 6

Pattern Recognition and the Grammatization of Vision

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Abstract

The uses and abuses of machine vision have received significant attention recently, with particular concerns arising around applications such as facial recognition, drone vision and automated surveillance. While often framed as a specifically contemporary phenomenon, one that achieved its current ubiquity by means of the introduction of the Convolutional Neural Network (CNN) in 2012 (Krizhevsky et al., 2012), its roots can be found in a network of research practices from the 1950s that were oriented around solving the pattern recognition problem. In this paper I examine this research, focussing on one early example of machine vision – the image processing system built by Kovásznay and Joseph (1953) at the National Bureau of Standards. This examination reveals that the early seeing machine emerges by means of a reformulation of information theory that facilitates the treatment of vision in terms of a data communications channel: an example of the communicative objectivity that Orit Halpern identifies as characteristic of the cybernetically influenced 1950s (Halpern, 2020). Following Stiegler, I suggest that this amounts to a grammatization of vision – a process by which perception itself is rendered discrete and reproducible (Ross, 2018). I also find in the early research an anthropomorphic conflation of the human and the machine – an insistence that cognitive processes can be both simulated and interrogated by means of the computational. I argue that this conflation served (and serves) to obscure the fact that the emerging machine vision paradigm was not (and is not) a simulation of human vision, but rather a radically new way of seeing, one made possible by the datafication of the visual register.

Keywords: machine vision; seeing machines; pattern recognition; media archaeology; information theory

Introduction

Concerns around the usage of machine vision loom large in the contemporary technological imaginary. Among the applications that are rightfully drawing the attention of critical AI researchers are facial recognition (Raji et al., 2020; Stark, 2019), drone vision (Stahl, 2013), and various forms of automated surveillance (McCosker & Wilken, 2020; Andrejevic, 2019). Issues around ethics, bias, and abuse of power have come to the fore (Birhane & Prabhu, 2021; Keyes, 2018), as well as more prosaic concerns around the problems that arise when the capabilities of the technology fail to live up the exaggerated claims that are often made for it (Brown & Laurier, 2017). Allied to this is a more general unease about the problematic world we are venturing into when machines start to stake claims on the supposedly human territory of vision (Azar et al., 2021). Trevor Paglen's reference to the 'seeing machine' is apposite: a 'seeing machine' for Paglen is an 'expansive definition of photography... intended to encompass the myriad ways that not only humans use technology to 'see' the world, but the ways machines see the world for other machines' (Paglen, 2014). This indicates the extent to which the contemporary seeing machine begins to escape the domain of the human, becoming less of a tool for us to see, and more, by means of autonomous, automatic, and algorithmic operation, something that might see on its own account.

At stake here of course is the question of what it means to see, and the related one of whether it is appropriate to suggest that a machine vision system is capable of doing so. Human perception is fundamental to how we navigate our way through the world, and to how our subjective experience is formed, with the visual register constituting a key modality of this. However the complexities of these processes are such that our understanding of their workings is still relatively limited.[48] As a result, machine vision tends to set itself more modest and more tightly circumscribed goals: how to identify particular types of objects; how to recognise specific instances of things and so on. On a similar note, the processes underlying human perception are cognitive while the processes underlying machine vision are computational, but our understanding of how cognition relates to perception is also a subject of much debate, and therefore any proposal that the computational processes driving machine vision are doing something similar to the cognitive ones that drive perception must be treated with caution. My intention here is not to attempt to answer questions about how cognition and perception conspire to produce what we call seeing

48 For example, serious differences exist among psychology researchers as to the extent to which our visual processes rely on knowledge about the nature and purpose of the objects that we encounter. See Wade and Swanston (2013) for an overview of these and other questions in the field of visual perception.

but rather to show how one specific answer to these questions – that vision can be regarded as a form of information processing – came to dominate at a particular point in time, and how this then kick-started the field of machine vision.

Pattern Recognition

While often presented as something specific to the contemporary, the foundations of the seeing machine were firmly in place by the end of the 1950s. By the middle of that decade an intensive research programme was underway, the aim of which was to solve the so-called pattern recognition problem. This was defined by Oliver Selfridge as 'the extraction of the significant features of data from a background of irrelevant detail' (Selfridge, 1955: 91). The sorts of problems they were initially trying to solve were ones like how to automatically recognize the patterns formed by characters in printed text, but they quickly moved on to attempting to recognize simple shapes, and then to speculation about how to automate the sorts of more complicated recognition tasks that our visual systems seem to perform with ease. Some indication of the ambition of these researchers can be gleaned from Russell Kirsch's somewhat impatient remarks at a conference in 1959:

> Pattern recognition research has been, I think, to some extent held back by a lack of proper data... What one needs for successful prosecution of pattern recognition research is large quantities of information in machine form and perhaps automatically generated information.
>
> (Bledsoe et al., 1959: 234)

His comments are notable because while they admit the limitations of what had been achieved so far (automated vision systems only worked in very constrained circumstances), they also demonstrate an exact awareness of how these limitations would eventually be overcome. The sorts of data and 'information in machine form' which Kirsch is bemoaning the lack of is pictorial data and information – in other words, Kirsch is suggesting that if we want to get machines to recognize patterns in images they are going to need a large database of digitised images to practise on. It took a long time for this obstacle to be overcome but it happened in 2009 with the creation of ImageNet at Stanford University (Deng et al., 2009). ImageNet is a giant database of tagged imagery made freely available as training sets for machine vision researchers. It not only cemented machine learning as the standard approach to the computer vision problem, but also facilitated the establishment of the sorts of powerful and generic machine vision technologies that Kirsch and his contemporaries laid the foundations for in the 1950s. Crawford and Paglen (2021) offer a trenchant critique of the practices involved in the construction of

ImageNet and the resultant biases introduced into the AI systems that are trained on it. Considered in this light, Selfridge's definition of pattern recognition in terms of concepts such as 'significance' and 'relevance' becomes somewhat more troubling. How is it determined, what is significant and what is insignificant? Who, or what, decides?[49]

Kirsch's comments also reveal something fundamental to the pattern recognition, and by extension, machine vision programme: an assumption that vision can be regarded as a form of information processing. Strongly influenced by both cybernetics (Wiener, 1961; Ashby, 1956) and the information theory of Claude Shannon (1948), these researchers strove to create automated vision systems that regarded seeing as being a matter of the processing of pictorial data and vision as being something akin to a data communications channel. In order to see how this happened, and how the assumptions upon which it is based continue to trouble the contemporary seeing machine, let us now turn to the National Bureau of Standards, under whose auspices the foundational image processing work of Kovásznay and Joseph was conducted.

The National Bureau of Standards

The National Bureau of Standards (NBS) dates back to 1901 when it was established as the US Government agency responsible for the standardisation of weights and measures.[50] This was done initially by the production of standard references for weights, lengths, densities, colours and any other aspects of the physical world that could be exactly quantified. However, it was not long before such concepts of standardisation were also extended into the realm of the human. For example the practice of measuring women's bodies, with the aim of developing sizing standards for clothing, was underway at the NBS by 1926 (see Figure 6.1). The history of the NBS is therefore a history of standardisation, and as Bowker and Star (2000) remind us, standardisation (and the associated concept of classification) is a key underpinning of modernity itself.

49 See Mendon-Plasek (2021) for a thorough treatment of how the concept of significance was critical to early pattern recognition and AI research.

50 For information about the activities and history of the National Bureau of Standards I draw on Aspray and Gunderloy (1989), Denise Gürer (1996) and Russell Kirsch's own first-hand account (Kirsch, 1998).

Figure 6.1: Women's body measurements being taken to develop a sizing standard for women's ready-to-wear clothing. (National Institute of Standards and Technology Digital Archives, Gaithersburg, MD 20899)

As well as standardisation, the Bureau was also intimately involved in the development of computation. An important part of this work consisted of the commissioning and use of some of the first programmable digital computers in the 1950s, but its involvement in computing per se predates this significantly. The Mathematical Tables Project of 1938 was responsible for the creation of standard mathematical tables that could be used to solve various kinds of scientific and numerical problems (Aspray & Gunderloy, 1989). In addition to constructing these tables, the project also offered a 'computation service' (ibid.: 3) for solving numerical problems for government and industry. Since there were no electronic computers available, all the computations, both those involved in the construction of the tables themselves and their usage in the solving of these numerical problems, were done by hand. Teams of workers, armed with calculators, carried out simple numerical calculations, and were organised carefully into units (Gürer, 1996). Large posters on the walls provided the workers in each group with simple instructions as to how to carry out their assigned operations, and organised carefully, this system enabled the sorts of complex computations needed for the scientific work that the Bureau and their clients were engaged in.

I dwell on this aspect of the Bureau's work in order to emphasise the fact that computation is not, and never has been, the sole preserve of electronic or digital computers. Such practices of organising groups of humans into sophisticated computational systems were in fact common enough that at one point the word computer was routinely employed to refer to 'people who reduced or analysed data using mechanical calculators' (Ceruzzi, 1991: 237). So, in the period before the adoption of the digital programmable computer, the border between computation and thought was not particularly well policed, and if humans were taking on computational tasks that would later be the domain of the machine, it is not surprising that researchers would start to seriously consider what human-associated activities might also be feasible on an electronic or digital computer.

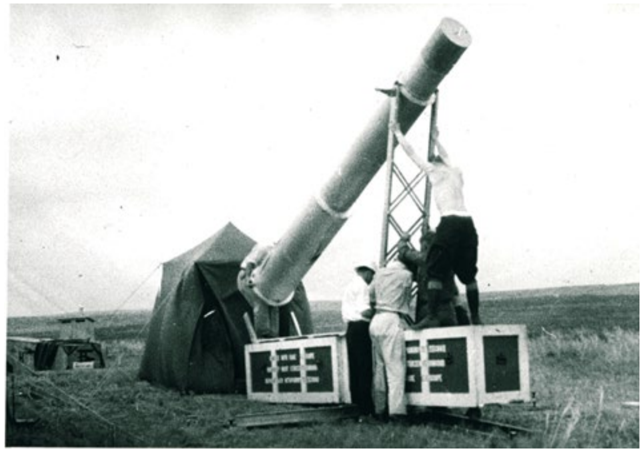

Figure 6.2: The Eclipse Camera of 1936 (National Institute of Standards and Technology Digital Archives, Gaithersburg, MD 20899)

In particular, as Kirsch notes, the National Bureau of Standards had an obvious interest in whether data input was something that could be automated (Kirsch et al., 1957). While this initially involved the encoding of data into standardised physical formats such as punch cards that could then be processed by a machine, researchers at the NBS were also acutely aware of the 'importance of pictorial data', and therefore eager to determine whether 'automatic processing techniques might be applied ... in order to reduce the amount of human intervention required during the input process' (ibid.: 222). Pictorial data implies a broad range of possible forms of input, and for the NBS this resonated with a long-standing interest in machinic vision. In order to assist in the inspection and measurement of the world, numerous devices such as specialised cameras and spectroscopy machines were invented and constructed at the Bureau (Figure 6.2 shows a camera created to photograph a solar eclipse in 1936). But in order to make progress with the automated vision problem, a relatively simple case had to be tackled first. Optical Character Recognition (OCR) is the process of automatically recognising alpha-numeric

characters presented in either hand-written or typed form. It was itself of significant interest at the NBS, but also constituted a special case of the more general problem of how to process any kind of pictorial data. Given that alpha-numeric characters consist of repeating patterns, the processing of this form of data became a question of how to automatically recognise these patterns.

The history of the Bureau as a space of innovation concerned with standardisation, computation and vision, placed it in a unique position to advance this research agenda. As we shall see, this advance, which starts with the work of Kovásznay and Joseph, does not happen because of the availability of the computer, but rather as a result of the insights of information theory that predate this.

Images as Information

Kovásznay's work at the NBS was not concerned with the recognition problem *per se* (character or pattern) but was instead investigating a more fundamental issue: how Shannon's information theory (Shannon, 1948) could be applied to vision. Shannon's insight was that any communications channel acts as a carrier of information, but the richness of the information carried is not dictated by the nature of the information itself, but rather by the characteristics of the channel doing the carrying. Furthermore, this richness can be exactly quantified in terms of an amount of information carried by messages on the channel, which itself is derived from the probability of that particular message being transmitted as opposed to any of the others from the set of all possible messages. This provided not just a means of treating communications channels mathematically, but also a means of conceptualising information in a manner that both unshackles it from semantics and also frees it from association or dependence on any particular material medium. This meant that telegraph messages, phone communications and Morse code signals could all be treated in the same way, and techniques then developed to improve efficiency and reduce error. Kovásznay realised that the same approach can be taken to things not normally thought of as communication channels:

> A black and white continuous picture or a black line drawing can be regarded as a communication channel, i.e. as a carrier of information. Before the advent of modern electrical communications techniques the most common means of transmitting information over great distances was to physically transport a sheet of paper with drawings or symbols on it.
>
> (Kovásznay & Joseph, 1955: 560)

The above remarks concede that pictures have always been used as mechanisms of communication but what is novel here is the notion that they are also amenable to the mathematical approach of information theory. This normally assumes a communication channel that can be conceptualised as a function of one independent variable (time). However a picture can also be treated as a communications channel if we regard it as one that consists of two independent variables, one corresponding to the vertical axis and the other to the horizontal. As the authors explain, the 'optical reflectivity of a paper print for a given angle of illumination' is therefore a 'function of two co-ordinates' and consequently we can avail of the 'techniques and the explicit findings of communication theory' in order to process such pictures (Kovásznay & Joseph, 1955: 560).[51] This talk of 'paper print'(s) and 'optical reflectivity' might seem somewhat incongruous but it is important to understand that Kovásznay's starting point, the image he was looking to process, was a printed or hand-drawn image on paper. A scanning process therefore had to be employed, one that could measure the colour or greyscale value of points on the paper in order to generate the informational content needed. But this is not the now familiar process of creating a digitised version of an analogue picture that can be stored and then subsequently made available for algorithmic processing: Kovásznay was not working with digital computers at all and had to assemble this particular seeing machine out of a somewhat ad hoc assemblage of electronic components.[52]

51 Another assumption is of course being made here. It is debatable whether the processing of two-dimensional pictures is an appropriate characterisation of vision at all. Most computer vision research assumes that it is (or at least that it can be reduced to this), and follows David Marr in this respect (Marr, 1982). An alternative view is offered by James Gibson (Gibson, 1966): one in which vision is something embodied and that operates in a rich three-dimensional environment with a temporal aspect.

52 At the time this work was being done, there were indeed digital computers at the NBS: Kovásznay however, was not using them. This might explain the reason why he is somewhat side-lined with respect to histories of image processing and machine vision. The origin point is usually traced to the moment when these processes start to be implemented on digital computers. For example, Russell Kirsch in a 2002 oral history interview about the SEAC computer, states that it is 'well known that we started the field of image processing in 1957 with a scanner based on a rotating drum lathe type device ... and we demonstrated the first image processing on the SEAC computer' (Kirsch, 2002).

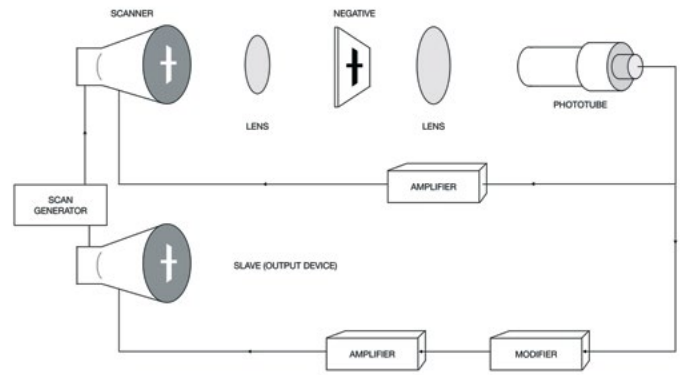

Figure 6.3: Image processing system of Kovásznay and Joseph (schematic recreated from original 1953 paper)

The key one was the flying spot scanner; a device invented for early television which consisted of a Cathode Ray Tube (CRT) whose electron beam could be focused on a semi-transparent image such as a photographic negative. As the beam traverses the image the amount of electrons that pass through is proportional to the density of the image at that point. The transmitted beam is then focused on to a photocell which generates an electric current in response (see Figure 6.3).

So the scanning was an ongoing process, traversing the image continuously in a manner similar to the raster scan of a CRT monitor, and producing not a digital file of any kind but a version of the image rendered in real time as electricity that could then be displayed on an output device such as an oscilloscope. This is not digitisation but it is a form of quantification – and it is also the conversion of something that is spatial into something that is temporal i.e. a signal.

Kovásznay figured out that many of the available mathematical techniques from information theory were applicable when the signal was an image being scanned in this way. For example the amount of information in a signal is proportional to how much it is varying over time and this can be calculated by means of the first derivative (dy/dx), which gives the rate of change of the function. In visual terms parts of the signal with high rates of change are areas moving quickly from dark to bright and vice versa. On the other hand the first derivative will be zero across areas where the signal is not changing at all, i.e. areas that are the same colour. The second derivative of the signal (d2y/dx2) corresponds to the rate of change of the *rate of change*. High values of the second derivative are therefore indicative of parts of the image where there is an acceleration or deceleration of intensity. In other words these areas correspond to edges.

Figure 6.4: Original image (b) Image with contour enhancement applied (c) Image with contour outlining applied. Image processing operations implemented digitally by the author.

Kovásznay could therefore build circuitry which took the electrical signal generated from the photocell, carried out these mathematical operations from the calculus on it, and then passed the modified results on to the output device (this is the 'Modifier' of Figure 6.3). For example, computing the second derivative detects contours of the image and therefore boosting the signal at these points results in the operation of contour enhancement. Similarly picture elements with derivatives close to zero would correspond to areas where the intensity is unchanging. By setting all these picture elements to black in the output image we get the operation of contour outlining (see Figure 6.4). These manipulations are equivalent to the familiar image processing operations of sharpening and edge detection, both of which would later be easily implemented digitally by means of convolution kernels.[53]

But what of pattern recognition? Kovásznay's work is widely cited in the pattern recognition literature but it was not directly concerned with the recognition problem itself. Its significance within this field rests firstly on the demonstration of the usefulness of the notion of treating images as a form of information and secondly the consequent introduction of practical image processing methods such as edge detection that would prove important pieces of the solution to the pattern recognition puzzle. Kovásznay alludes to this when he suggests that his processed images might be 'identified' by comparing them with 'stored ones' and that 'exploration along these lines will inevitably occur, perhaps as a result of stimulation from the present work' (ibid.: 561). He

53 A convolution kernel is a two-dimensional matrix of numbers, otherwise known as a filter, that is applied to every pixel in the input image. This is done by multiplying it by the value in the centre of the kernel, multiplying all the neighbouring pixels by their corresponding values in the kernel, and then replacing the original pixel value by the sum of these multiplications. While Kovásznay had to deal with continuous quantities, the convolution kernel takes advantage of the discrete nature of the digital image, reducing complex operations to simple multiplications and summations. For more details see any standard textbook on digital image processing such as Jain (1989). The convolution kernel also becomes central to the explosion of computer vision technologies via the use of Convolutional Neural Networks (CNNs) from 2012 onwards (Krizhevsky et al., 2012).

concludes by affirming that '(possibly) automatic devices for recognizing patterns or shapes can be constructed' (ibid.: 567). The idea here is that by working with the processed image, which might have all insignificant details removed by reducing it to an outline, we might arrive at a method by which this reduced image can be compared to stored templates, and hence recognised as being, for example, part of some class of shapes (squares, circles etc).

This informational approach to vision introduced by Kovásznay and Joseph does indeed become the entire foundation for machinic seeing: it is implemented on digital computers by Russell Kirsch (also at NBS) a few years later (Kirsch et al., 1957); Selfridge and Dineen outline how we might design machines that learn how to recognize various forms of visual pattens in this way in 1955 (Selfridge, 1955; Dinneen, 1955); and researchers such as Clark and Farley (1955), Pitts and McCullough (1947) and Frank Rosenblatt (1958) have fully conceptualised the idea of neural networks to automate these sorts of tasks by the end of the 1950s. But Kovásznay and others working in the field are not just interested in how information theory provides the foundation for a simulation of vision: they are also interested in what these explorations might reveal about vision itself. In spite of the fact that Kovásznay's research is very much concerned with practical problems of image transmission, communication, and processing, the 1955 paper frames all of this in terms of an investigation into human visual perception. He states that the entire research programme was stimulated by the following question:

> How does one perceive, identify, and recollect pictures? Naturally the solution of the mystery of visual perception is far beyond our objectives. However, the attempts reported here may contribute some insight into particular aspects of the general problem.
>
> (ibid.: 560)

We see here something of a disclaimer in that Kovásznay is holding back from suggesting that this work will fully solve the 'mystery of visual perception', but nevertheless we still get a clear statement that an informational approach to automated image processing can pay dividends with respect to its study. It is important to consider where this idea comes from and its broader implications with respect to how machinic vision systems engage with the world.

The World as Data

Kovásznay cites psychologist Fred Attneave as backup for assumed equivalences between visual perception and the automated image processing he was working on – specifically the idea that 'human visual perception somehow reduces the amount of picture information by outlining the picture before storing it or comparing it with other stored images' (Kovásznay & Joseph, 1955: 560). Some analysis of Attneave's work is instructive as he was typical of the emerging cognitive psychology of the time: a field heavily influenced by the insights of cybernetics and that alerts to the supposed connections and parallels between human cognition and machinic processing.[54] Attneave proposed that our understanding of visual perception can be clarified by recourse to the 'concepts and techniques of information theory' (Attneave, 1954: 183) and that the advantage of information theory is that it provides 'techniques for quantifying situations which have hitherto been difficult or impossible to quantify' (ibid.: 183). He insists that 'the world as we know it is lawful' (ibid.: 183) and that the consistency and regularity of sensory events across both space and time that this entails means that, from an informational point of view, most of our sensory experience is redundant. Perception must therefore operate by ignoring redundant information and concentrating on features with 'high informational content' (ibid.: 185). In order to establish what those features might be, Attneave conducted experiments where volunteers were asked to methodically scan images that were revealed to them on a point by point and line by line basis, and then attempt to predict what was going to appear next. The conclusion is that features within the image with high informational content are indeed lines and edges, and this of course aligns neatly with what the electronic circuitry of Kovásznay's seeing machine was capable of recognizing. Reading accounts of these experiments it is striking the extent to which their methods resonate with the techniques of the human computers at the NBS. While Kovásznay was building electronic machines that he hoped would *see like humans*, Attneave was asking humans to try and *see like computers*, and then drawing general conclusions about visual perception from the results.

Attneave is not claiming that our visual systems work in the basis of a scanning procedure of this nature ('(we) are in no way supposing or assuming, however, that perception normally involves any such scanning process' (ibid.: 184)) but what he is claiming is that the ordered and 'lawful' nature of the world as it is presented to us contains large amounts of redundancy, and our visual systems must be taking advantage of this in order to operate efficiently. Furthermore, this claim is being justified on the basis of an assumed correspondence between cognition and computation, and on the basis of experiments that ask subjects to perform simple tasks in a repetitive manner. The broader point though would be that if we assume that the world consists of information, and also that our interactions with this world are guided by our ability to process this information in a useful manner, then this opens the way to not just drawing conclusions about these interactions based on the insights of information theory, but also computationally simulating processes such as vision on the basis that they are, in fact, equivalent to, or at least analogous to, actual computational processes.

We can see this as an example of what Orit Halpern identifies as the conceptual basis of our 'contemporary perceptual field' – a process of abstracting the world into information and then conceiving of systems as being things that process that information and respond to it in particular ways (Halpern, 2020). Halpern shows how this tendency to treat the world as data, emerging from post-WWII cybernetics, doesn't just influence how particular technologies develop, but also influences those human or societal capacities that those technologies are designed to mirror. In the case of machine vision this would mean that it does not just see the world in a new way, but encourages us to do so as well.[55] Halpern's thesis is that cybernetics creates a new way of seeing – a new approach to perception – that positions us (as seeing subjects) differently to the Enlightenment-era Cartesian disembodied observer. Central to this is the idea that emerges within cybernetics that cognition and perception are the same type of thing – or at least if not the same type of thing, then certainly much more tightly coupled than was previously assumed. This means that rather than the mind being a separate processing facility that interprets signals and sense data relayed to it by the perceptual apparatus that is the body, we instead have a tightly coupled mind–body apparatus where perception and cognition are intertwined processes by means of which the mind is as responsible for perceiving as much as the body is responsible for thinking. A key foundation for this is the work of Lettvin et al. (1959), which showed the extent to which a frog's perceptual apparatus filters out unnecessary data in order to hone in on that which is relevant (quickly moving things often correspond to food for example).[56] This demonstrated how the senses are involved in something that might have previously been regarded as being the exclusive preserve of cognition.[57]

54 See Mitchell Waldrop (2001) for a riveting account of how a cybernetically and computationally influenced form of cognitive psychology challenged the dominant behaviourism across psychology departments of the US in the 1950s.

55 See Uliasz (2020) for a recent exploration of how new forms of human subjectivity are emerging from algorithmic vision.

56 McCullough and Pitts, who collaborated with Lettvin on this work, play a more direct role in the foundations of machine vision by way of their conceptualisation of the neural network and its use for pattern recognition tasks (Pitts & McCulloch, 1947).

57 The idea that perception involves some sort of filtering mechanism is of course also central to the work of Attneave that we have just been discussing. For Attneave, this filtering involves removing redundant information from the input, but for Lettvin et al. the implication is that this goes far beyond filtering and involves much more sophisticated processing that is akin to what we might normally think of as cognition. The issue then becomes whether it is possible to draw a distinction between perception and cognition at all. Attneave himself is alert to this 'troublesome question', asking rhetorically: 'where does perception leave off and inductive reasoning begin?' (Attneave, 1954: 187).

For Halpern, this means that a history of how the world comes to be abstracted into information is a history of both vision *and* reason. If perception and cognition are the same thing, then the way we perceive, and the modes of perception that are available to us, profoundly affects the way that we think.

Under the cybernetic view, vision becomes a practice of processing data, and perceptual systems become feedback-driven mechanisms that guide behaviour based on continual response to this input (Wiener, 1961). In tandem with this we get a corresponding abandonment of conventional notions of meaning and representation. When the frog filters out everything else other than small things that move quickly from its perceptual field, it matters little what the 'everything else' actually represents. In fact, it even matters little that the 'small things that move quickly' represent food – these are simply the patterns that it has evolved to respond to. Similar patterns might be identified by a different perceptual system, in a different context, as something worth responding to for completely different reasons. This clearly resonates with both the information theory of Shannon, concentrating as it does on the possible states a message can be in as opposed to what that message is supposed to represent, and the emerging paradigm of machine vision as a matter of recognizing patterns in input data.

The identification of pattern as the means by which visual systems navigate the world, and the mobilisation of information theory as a means of extracting significant features from which these patterns can be derived, provides the conceptual foundation upon which the seeing machine is built. Attneave's contention that our experience of the world is 'lawful', in other words that there is a consistency and regularity to how it is presented to us, is critical to this project, but whether these 'laws' are in some sense natural, or whether they are arrived at in order to suit the particularities of the technical apparatus under consideration, is a question that is not dwelt upon at any length. We might, for example, consider the neat correspondence between what the second derivative of the calculus gives us when the image becomes information, and what our visual systems are said to rely upon in order to accomplish pattern recognition tasks, to be somewhat *too* neat. One way of understanding what is happening here is via Bernard Stiegler's concept of *grammatization* (Stiegler, 2010). As Daniel Ross explains, this is a 'process by which temporal and structural flows of all kinds are rendered discrete and reproducible through being spatialized' (Ross, 2018:20). For Stiegler, grammatization has deep historical roots: encompassing early representative practices such as cave painting, the invention of radio and cinema, and the programming of the 'manual gestures of the worker ... into the machinery of the industrial revolution' (ibid.: 20). Common to all of this is some sort of encoding of life; an analysis of the world that makes it amenable to recording and reproduction by rendering it into discrete elements (marks, frames, gestures). In the contemporary version of grammatization, discretisation becomes digitisation, making possible the 'grammatization of everything' (ibid.: 20) by means of binary code. The patterns, features and pixels that the information theory approach to vision employs, collectively form a grammar by which the seeing machine does its work, and thereby constitutes a grammatization of vision itself. Crucially, for Stiegler, the form of technics that arises as a result of grammatization is a pharmakon: it is both poison and cure at the same time, and it can both aid and harm us. We can see this paradoxical quality at work in the sorts of machine vision systems that were soon constructed on top of the foundational elements provided by Kovásznay and his peers. The Facial Action Coding System (FACS) was introduced by Paul Ekman in 1978 (Ekman and Friesen, 1978) and quickly became the standard way of encoding the human face for applications such as facial recognition and computer animation. It divides the human face into 71 points, each of which are grouped to form features such as the eyes, the nose, the mouth and so on. This visual grammar of the face can then be employed by facial recognition systems to identify emotions such as happiness and sadness based on the particular patterns of points that supposedly correspond to these emotional states. We might immediately question the reductive nature of this particular grammatization.

Will all faces conform to this standardised model? If not, what happens to the ones that don't?

Conclusions

At stake here is the relationship between machinic seeing and human vision. Kovásznay and Joseph are not psychologists – they are perhaps the most engineering-oriented of the 1950s machine vision researchers – yet even they can't resist speculating about how this model of vision they have constructed might correspond to what our own visual systems do. They frame their work in terms of the general study of visual perception, suggest that the recognition and recollection of patterns is key to this, and relate it to the 'Gestalt problem' in psychology. In short they strongly suggest that this informational approach to the image is not just a convenient way of implementing a particular form of automated seeing but instead is an appropriate way of conceptualising the act of seeing itself. This suggestion becomes even stronger in the work of those researchers who follow them. What we get then is machinic seeing as both a simulation of, and an investigation into, human seeing; an insistence (backed up by both cybernetics and cognitive psychology) that the same processes underlie both. In tandem with this we also get an anthropomorphic conflation of cognition and computation – an insistence that we can think of the computer as a mechanical brain and the brain as a biological computer. I suggest that these deeply problematic assumptions do not just drive the beginnings of the machine vision project but also continue to inform it. The problem that then arises is that this assumed affinity between machine and human vision obscures the extent to which they are actually different. This means that on the one hand the significance of machine vision gets minimised, because of the many ways in which it fails to match up to the human, but on the other hand it is nevertheless deployed as a substitute for the human (often in problematic contexts) by those who are either unaware of these failings to else choose to conveniently ignore them.

In Gilles Deleuze's books on cinema he conceptualises the cine-camera as a perceptual machine – one that provides a radically new way of seeing (Deleuze, 1983, 1985). It seems fruitful to consider machine vision in the same way; not as an imitation of, or substitute for, human vision, but as a radically new and non-human form of vision whose specificities we need to urgently attend to. The reader will no doubt have recognized the image used in Figure 6.4 as being a still from Dreyer's silent film *The Passion Of Joan Of Arc* (1928). Deleuze cites the many close-ups of Maria Falconetti's face as being quintessential examples of what he calls the affection-image (Deleuze, 1983). This is an image that operates at the level of affect, bypassing other forms of cognition. This might be an extreme example of the sorts of things that seem well outside the purview of the informational approach to vision, but at the same time this does not stop contemporary researchers from attempting to automatically determine them (De and Saha, 2015). Whether we would want these systems or not often seems like a moot point, but I suggest that in order to be alert to their problematic uses, their potential failings and their almost inevitable abuses, we need to be alert to the assumptions upon which they are based.

References

Andrejevic, M. (2019) Automating Surveillance. *Surveillance and Society* 17(1/2): 7–13.

Ashby, W.R. (1956) *An Introduction to Cybernetics*. New York: John Wiley & Sons Inc.

Aspray, W. and M. Gunderloy (1989) Early Computing and Numerical Analysis at the National Bureau of Standards. *Annals of the History of Computing* 11(1): 3–12.

Attneave, F. (1954) Some Informational Aspects of Visual Perception. *Psychological Review* 61(3): 183–193.

Azar, M., G. Cox and L. Impett (2021) Introduction: Ways of Machine Seeing. *AI & Society* 36. Springer: 1093–1104.

Birhane, A. and V.U. Prabhu (2021) Large Image Datasets: A Pyrrhic Win for Computer Vision? In *Proceedings of 2021 IEEE Winter Conference on Applications of Computer Vision* (WACV), January 2021, pp. 1536–1546.

Bledsoe, W.W., J.S. Bomba, I. Browning et al. (1959) Discussion of Problems in Pattern Recognition. In P*apers presented at the Eastern Joint IRE–AIEE–ACM Computer Conference 1959*, New York, NY, USA, 1 December 1959, pp. 233–237. IRE–AIEE–ACM '59 (Eastern). Association for Computing Machinery.

Bowker, G.C. and S.L. Star (2000) S*orting Things Out: Classification and Its Consequences*. Cambridge, MA: MIT Press.

Brown, B. and E. Laurier (2017) The Trouble with Autopilots: Assisted and Autonomous Driving on the Social Road. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. New York, NY, USA: Association for Computing Machinery, pp. 416–429.

Ceruzzi, P.E. (1991) When Computers Were Human. *Annals of the History of Computing* 13(3): 237–244.

Clark, W.A. and B.G. Farley (1955) Generalization of Pattern Recognition in a Self-organizing System. In *Proceedings of the Western Joint Computer Conference 1955*, New York, NY, USA, 1 March 1955, pp. 86–91. AFIPS '55 (Western). Association for Computing Machinery.

Crawford, K. and T. Paglen (2021) Excavating AI: The Politics of Images in Machine Learning Training Sets. *AI & Society* 36(4).

De, A and A. Saha (2015) A Comparative Study on Different Approaches of Real Time Human Emotion Recognition Based on Facial Expression Detection. In *2015 International Conference on Advances in Computer Engineering and Applications*, March 2015, pp. 483–487.

Deleuze, G. (1983) *Cinema 1: The Movement-Image*. Reprint, London: Bloomsbury Academic, 2013.

Deleuze, G. (1985) *Cinema 2: The Time-Image*. Reprint, London: Bloomsbury Academic, 2013.

Deng, J., W. Dong, R. Socher et al. (2009) ImageNet: A Large-scale Hierarchical Image Database. In *Proceedings of 2009 IEEE Conference on Computer Vision and Pattern Recognition*, June 2009, pp. 248–255.

Dinneen, G.P. (1955) Programming Pattern Recognition. In *Proceedings of the Western Joint Computer Conference 1955*, New York, NY, USA, 1 March 1955, pp. 94–100. AFIPS '55 (Western). Association for Computing Machinery.

Ekman, P. and W.V. Friesen (1978) *Facial Action Coding System: Investigator's Guide*. Consulting Psychologists Press.

Gibson, J.J. (1966) *The Senses Considered as Perceptual Systems*. Boston: Houghton Mifflin.

Gürer, D.W. (1996) Women's Contributions to Early Computing at the National Bureau of Standards. *IEEE Annals of the History of Computing* 18(3): 29–35.

Halpern, O. (2020) *Beautiful Data: A History of Vision and Reason since 1945*. Duke University Press.

Jain, A.K. (1989) *Fundamentals of Digital Image Processing*. USA: Prentice-Hall, Inc.

Keyes, O. (2018) The Misgendering Machines: Trans/HCI Implications of Automatic Gender Recognition. *Proceedings of the ACM on Human-Computer Interaction 2*(CSCW). 88. New York, NY, USA: Association for Computing Machinery: 1–22.

Kirsch, R.A. (1998) SEAC and the Start of Image Processing at the National Bureau of Standards. *IEEE Annals of the History of Computing* 20(2): 7–13.

Kirsch, R.A., L. Cahn, C. Ray and G.H. Urban (1957) Experiments in Processing Pictorial Information with a Digital Computer. In *Papers and discussions presented at the 1957 Eastern Joint Computer Conference*, New York, NY, USA, 9 December 1957, pp. 221–229. IRE-ACM-AIEE '57 (Eastern). Association for Computing Machinery.

Kirsch, R., R. Cahn, R. Haueter, S. Greenwald and R.D. Elbourn (2002) *SEAC Oral History Interview*, September 18, 2002. National Institute Of Standards And Technology. Available at: https://nistdigitalarchives.contentdm.oclc.org/digital/collection/p16009coll2/id/490/rec/51. [Accessed February 27, 2022].

Kovásznay, L.S.G. and H.M. Joseph (1953) Processing of Two-dimensional Patterns by Scanning Techniques. *Science* 118(3069): 475–477.

Kovásznay, L.S.G. and H.M. Joseph (1955) Image Processing. *Proceedings of the IRE* 43(5): 560–570.

Krizhevsky, A., I. Sutskever and G.E. Hinton (2012) Imagenet Classification with Deep Convolutional Neural Networks. *Advances in Neural Information Processing Systems* 25: 1097–1105.

Lettvin, J.Y., H.R. Maturana, W.S. McCulloch et al. (1959) What the Frog's Eye Tells the Frog's Brain. *Proceedings of the IRE* 47(11): 1940–1951.

Marr, D. (1982) Vision: *A Computational Investigation into the Human Representation and Processing of Visual Information*. San Francisco: W.H. Freeman.

McCosker, A. and R. Wilken (2020) *Automating Vision: The Social Impact of the New Camera Consciousness*. New York: Routledge.

Mendon-Plasek, A. (2021) Mechanized Significance and Machine Learning: Why it Became Thinkable and Preferable to Teach Machines to Judge the World. In J. Roberge and M. Castelle (eds) *The Cultural Life of Machine Learning: An Incursion into Critical AI Studies*. Cham: Palgrave McMillan, pp. 31–78.

Paglen, T. (2014) *Seeing Machines*. Available at: https://www.fotomuseum.ch/en/2014/03/13/seeing-machines/ [accessed December 24, 2021].

Pitts, W. and W.S. McCullough (1947) How we Know Universals; The Perception of Auditory and Visual Forms. *The Bulletin of Mathematical Biophysics* 9(3): 127–147. Springer.

Raji, I.D., T. Gebru, M. Mitchell et al. (2020) Saving Face: Investigating the Ethical Concerns of Facial Recognition Auditing. In *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society*. New York, NY, USA: Association for Computing Machinery, pp. 145–151.

Rosenblatt, F. (1958) The Perceptron: A Probabilistic Model for Information Storage and Organization in the Brain. *Psychological Review* 65(6): 386–408. American Psychological Association.

Ross, D. (2018) Introduction. In D. Ross (ed.) B. Stiegler, *The Neganthropocene*. London: Open Humanities Press, pp. 7–32.

Selfridge, O.G. (1955) Pattern Recognition and Modern Computers. In Proceedings of the 1955 *Western Joint Computer Conference*, New York, NY, USA, March 1, 1955, pp. 91–93. AFIPS '55 (Western). Association for Computing Machinery.

Shannon, C.E. (1948) A Mathematical Theory of Communication. *Bell System Technical Journal* 27(3): 379–423. Wiley Online Library.

Stahl, R. (2013) What the Drone Saw: The Cultural Optics of the Unmanned War. *Australian Journal of International Affairs* 67(5): 659–674. Routledge.

Stark, L. (2019) Facial Recognition is the Plutonium of AI. *XRDS: Crossroads, The ACM Magazine for Students – AI and Interpretation* 25(3): 50–55.

Stiegler, B. (2010) *Technics and Time, 3: Cinematic Time and the Question of Malaise*. Stanford University Press.

The Passion of Joan of Arc (1928). Directed by Karl Theodor Dreyer.

Uliasz, R. (2020) Seeing Like an Algorithm: Operative Images and Emergent Subjects. *AI & Society*. Springer. DOI: 10.1007/s00146-020-01067-y.

Wade, N. and M. Swanston (2013) *Visual Perception: An Introduction*. Psychology Press.

Waldrop, M.M. (2001) *The Dream Machine: J.C.R. Licklider and the Revolution that Made Computing Personal*. New York: Viking Penguin.

Wiener, N. (1961) *Cybernetics or Control and Communication in the Animal and the Machine*. Cambridge, MA: MIT Press.

Chapter 7

Ctenocene: A Network Topology

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Abstract

'Ctenocene: A Network Topology' is an artistic research project that explores a Utopic/Dystopic futuristic soundscape and communication in a post-Anthropocene era, through the optic of instrument making and performance.

This paper introduces the complex nature of jellyfish populations and migration and traces our development of these observations in conjunction with our work using DIY electronic circuits, interactivity and communication networks. By taking a cross-disciplinary approach to an art-based research, we address certain aspects of our artistic practice in relation to questions arising from ecology and technology.

Keywords: ctenocene; jellyfish; invented instruments; electronic music; networked performance; art-fiction

Figure 7.1: Premiere performance with the Jelly-synths at No Patent Pending #27, the Hague 2017 (Photo credit : Pieter Kers | Beeld.nu)

1 Project Background

In 2015 we came across hundreds of beached jellyfish buried in the sandbanks of the Loire estuary. This encounter led us to explore the reasons behind why such mass beachings, that are occurring with increasing regularity in European waters and elsewhere, occur. This phenomenon has been observed all over the world, with increasing reports in newspapers and growing concern from various communities from fishing to marine ecology about the multiplication and the potential invasion of non-native and native jellyfish species in some waters.

> Jellyfish thrive on the chaos humans create. Overfishing wipes out their competitors and predators; warmer water from climate change encourages the spread of some jellies; pollution from fertilisers causes the ocean to lose its oxygen, a deprivation to which jellyfish are uniquely tolerant; coastal developments provide convenient, safe habitat for their polyps to hide. In addition, the great mixing of species transported across the world in the ballasts of ships opens up new, vulnerable ecosystems to these super-adaptors.
>
> (Mathiesen 2015)

In some areas of the planet Fishermen can no longer access fish, where blooms of jellyfish suffocate the water and power plants have been shut down due to jellyfish clogging cooling systems. In 2013 Sweden's Oskarshamn nuclear power plant, which supplies 10% of the country's energy, had to shut down one of its three reactors after a jellyfish invasion clogged the piping of its cooling system. The invader, a creature called a moon jellyfish, is

95% water and has no brain. Not what you might call menacing if you only had to deal with one or two. Jellyfish are not a new problem for nuclear power plants. In 2012 the Diablo Canyon facility in California had to shut its reactor 2 after sea salp, a gelatinous, jellyfish-like organism, clogged intake pipes. In 2005, the first unit at Oskarshamn was turned off temporarily due to a sudden influx of jellyfish. More recently this phenomenon has shut down the UK's Marchwood Power Station, near Southampton in 2020 and in 2021 again clogged Scotland's only active nuclear power station at Torness, which required emergency procedures to shut down the reactor. We are particularly shocked and enthralled by the capacity of these creatures to move en-masse and incapacitate these huge industrial infrastructures. The particularity of the mass movements or blooms of jellyfish is that they seemingly navigate the seas together, rather than drifting individually and at the mercy of the ocean currents.

1.1 Art and Environment

Artists have long been concerned with the impact of mass consumerism on our societies and environment. Chris Jordan drew attention to the plight of the Albatross, photographing the carcasses of baby albatross in the North Pacific in 2009. They had been fed a diet of human trash, plastic collected from the ocean by their parents and substituted for food. Tens of thousands of these chicks died from starvation, toxicity and choking (Leopoldseder et al. 2010: 30). Field recording artist Chris Watson has recorded the shifting soundscapes of wildlife for the past forty years, while Robertina Šebjanič is concerned with the human induced noise pollution covering the soundscapes of our seas, in what she calls the Aquatocene. To list the many other artists working in the field would require its own anthology.

> Within just a few decades since mass production of plastic products commenced in the 1950s, plastic debris has accumulated in terrestrial environments, in the open ocean, on shorelines of even the most remote islands and in the deep sea.
>
> (Barnes et al. 2009)

For over 50 years most goods produced by industries have been made of plastic based on synthetic molecules. A colossal amount of this industrial plastic has been rejected into our oceans, washing up on beaches on remote islands, destroying the natural aquatic environment, killing hundreds of sea species, not to mention birds and mammals that rely on those for food. We are part of the second, nearly third generation of plastic users, intensifying plastic production with single use plastics and an ever-expanding range of applications using plastics for any and every purpose, and it is only now that we feel the consequences of this abuse.

Our own work frequently reflects similar concerns around consumption and the climate; 'Digital Debris' 2008 was concerned with the growing amount of electronic waste or E-waste and the planned obsolescence driving the technology industry that forces individuals, institutions, businesses, service sector companies and educational establishments to update their hardware every few years. The issue of waste consumer plastics and E-waste is coupled with an often-farcical recycling imperative where richer nations outsource the issue to poorer countries. 'Despite the fact that E-waste and EPR legislation is in place in two-thirds of the globe, only more-or-less 20% of E-waste gets recycled legally' (Murthy and Ramakrishna 2022: 14). 'Digital Debris' used obsolete PC's and their accessories to drive an interactive networked installation built out of the guts of these machines and remashing the already enormous audio archives online.

We began to explore the potential of these little understood, terrifying enigmatic sea creatures that elegantly float through our oceans, and are feared for their stings and often avoided or left to drift, during an artist's residency hosted by *iii: instrument inventors initiative*, at the Hague in April 2017.

Jellyfish blooms are a consequence of warming oceans and have the potential to destroy global economies. Frequently researchers in this area draw the same conclusion; How can we limit this invasive species in our oceans? How can we manage jellyfish blooms? What new ressources can jellyfish provide? Can jellyfish open up new economic markets? Etc... These are new areas of research opening up that seek to either harness these sea creatures for new commodity markets or understand the potential of jellyfish to act as environment cleaning agents. Scientist such as Doyle, Hays, Harrod and Houghton propose seeing the jellyfish in a more positive light for the environment:

> Jellyfish are often considered as stressors on marine ecosystems or as indicators of highly perturbed systems. Far less attention is given to the potential of such species to provide beneficial ecosystem services in their own right.
>
> (Doyle et al. 2013)

Their article explains how 'Gelatinous marine species contribute to the four categories of ecosystem services (regulating, supporting, provisioning and cultural) defined by the Millennium Ecosystem Assessment' (Ibid.). Jellyfish, whilst still vulnerable to these same plastic pollutants, by mistaking debris as a food source, may also be capable of filtering these micro-plastics. 'GoJelly – a gelatinous solution to plastic pollution is an [EU Horizon 2020] EU H2020 funded project where we will use jellyfish as a source of innovative solutions to combat marine litter.' Essentially this is killing two birds with one stone, finding a way to exploit the overpopulation of jellyfish blooms and reducing ocean microplastic pollution in the process.

The very nature of this mass blooming of jellyfish raises questions again about our own, human activity and place in the ecosystem. We arrogantly seek to monitor, control and/or utilise an overabundance of another species, with little understanding of its place and overall impact, positive or negative on the planet. We tentatively ask the following question:

What level of threat real or imagined do jellyfish pose to the human population of earth? Could jellyfish shut down our polluting human activities? How can jellyfish coordinate such actions? What does jellyfish communication sound like?

1.2 Design for a Jelly-Synth

Thinking about the gelatinous soft bodied forms, their transparency, haptic responses and modes of communication, we started prototyping a maquette for a modular Jelly-synth. Our intention was not to reproduce a jellyfish, but to create a musical instrument that reacts sensitively to touch and whose form lends itself to an alternative way of interplay and connectivity. That said, the form of the modular Jelly-synth is intentionally mimetic so as to open up an idea of narrative or representation in relation to abstract musical composition and gestural performance. Each module is made from a recycled transparent PVC table cloth and wire coat hanger that acts as the main body, within which the electronic circuit is held and is visible. These transparent forms are then suspended and connected to long tentacle-like power cables, transparent audio cable and brass wires that reach the floor (see Figure 7.3). The Jelly-synths are played with touch; bare skin on brass wires. The instruments react to various conditions including perspiration, pressure, movement and wire extensions, which can be played through various combinations to produce different oscillations, rhythms and tones.

Figure 7.2: Diagram of a Jelly-synth

In total we produced five versions of the first prototype, with the intention of multiplying these modules and creating variations in the electronic circuits in a similar way to a modular synthesiser. The suspended instruments were connected to a mixer and amplified. The installation itself creates a visually interesting space, however the raw DIY electronic audio signals required a lot of mastering.

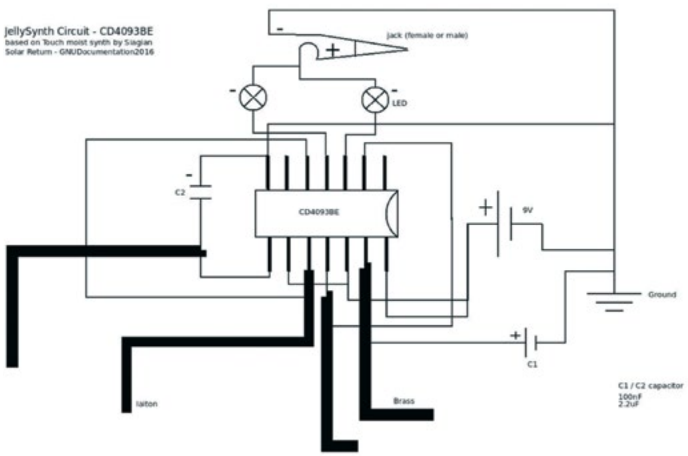

Figure 7.3: Schematic of the circuit used in the Jelly-synths

Increasing the pressure as we squeeze the wires can increase the speed of the audio oscillations or the pitch; the harder we squeeze the higher the pitch. However, the tone of the pitch does not only depend on pressure but also the moisture of the skin. Dry skin produces less connection and lower frequencies, sweaty palms on the other hand increase the connection and produce higher frequencies. In order to control certain aspects of the composition it was necessary to have sweaty palms on demand, which led to a damp sponge being available during the performance. As we were only two playing five Jelly-syths we also devised another way in which we could extend our reach through the mass of wires to create a wider range of oscillations and beats by attaching protruding wires to our hands. As a performance instrument the Jelly-synths were first tested in public for the concert series No Patent Pending #27 in the Hague in April 2017. This first version was direct in its audio output, that is to say there were no additional effects on the sounds produced by the Jelly-synths. The performance was composed and set up in a traditional way whereby the audience receives but does not interact with the musical and performative proposition. The performances explored chaotic patterns using the dirty electronic circuits of the Jelly-synth. The circuit is made using a point-to-point technique, we do not use printed circuit boards, but rather a direct soldering connection between the components. Dirty electronics is a method derived from circuit bending and DIY electronics, where artists get their hands dirty making their own circuits – they are not usually engineers and tend to adapt integrated circuits and components into their own made schematics adapted to their artworks or musical research.

Figure 7.4 Playing the brass wires of the Jelly-synths

2 Project Objectives

Following the first series of performances in 2017, we began to think about how we could extend the instruments, the composition and our performance to develop the interplay between the audiences and performers. An important aspect in the development of this project relates to our curiosity about the migratory communication between jellyfish, their proliferation and an almost viral takeover of some waters.

2.1 Pragmatic, Symbolic, Narrative

This ongoing project operates on three levels.

1. **Pragmatic instrument invention and interface development:** an instrument that reflects how jellyfish function and relate to the environment and aims to echo that by creating an interactive environment where performers, artists and audiences, in the image of jellyfish, swarm our networks. How can we use the communication systems to influence the sound and space of the performance?
2. **Symbolic, mimetic and performative:** a performance that engages our bodies, in a physical relationship with the instrument. This relation is also connected to the sting of the jellyfish in the manner in which the performer plays through touch. The translation of this touch into sound (high pitch sound being interpreted as neurotoxins).
3. **Narrative reflection:** using the science fiction model of future spheres of influence upon the nature of our planet and of human impact on the environment. The concept of the Ctenocene is to take a reflection of the anthropocene to an extreme and perhaps absurd, yet possible level.

As artists we observe and respond to the world differently from scientists. The spectrum of artistic research here works with subjects where scientific prevalence may put up unintentional barriers in its ambition to establish expertise over a subject, but these debates, whilst complex, should imply the inclusion of diverse communities to open up questions and observe or reflect upon areas that cross over in arts/sciences from other perspectives. Artistic and scientific research often stem from observation, both are observers of natural and unnatural phenomena, whilst their methodologies and outputs may deviate enormously from one another; one need look no further than the High Renaissance and artists such as Leonardo DaVinci to understand the history of feedback between those two approaches and observations.

From the perspective of French philosopher François Laruelle pensive on art and science and the theory of Non-Philosophy, we think of art as the non-scientific use of science… a use outside the totality of its conditions of validity or knowledge-relation. It is science applied to the world outside the reduction that finds the scientific relation to the world. How does art function as an investigative and experimental activity, addressing what is usually expressed through traditional scientific means: matter, entropy, time, topology, energy, perception, etc.; beyond becoming a service for public relations or pedagogy?

The aim here is not to explain the subject of art and science but to contextualise a part of our artistic research concerning the jellyfish topology, which began with observation and critical thinking about ecology, environment and global warming. We use a method of research that is based on artistic components, using subjects that seemingly derive from nature and science, and explore these through the medium of electronic music, technology and performance.

2.2 Performers, Participants and Public

In addition to these underlying areas of action the development of the performance blooms operates in three distinct spaces and spheres of influence.

1. **Physical:** The primary sphere where the performers on stage IRL (in real life), playing and moving amongst the Jelly-synths have the greatest influence.
2. **Virtual:** performers/public using the blooms interface are on a secondary plain of influence: the sounds of the performance can be affected directly through various effects.
3. **Hybrid:** influences and members of the public, who are both present at the site of the performance IRL and connected via mobile phone applications that interact with the sounds and space of the performance, this is the third sphere of influence, in that there are 11 blooms apps intended to echo the idea of a single neuron each with a single effect on the performance.

3 Project Description

3.1 The Ctenocene: Post-human Narratives in Art-fiction

Through the performative aspect of the Jelly-synths, there is a narrative function that, however abstract, draws on the notion that jellyfish blooms act as a warning system for the planet's oceans, via overpopulation in increasingly acidic waters, and there is a parallel we could draw with the current urgent state of our planet in the era of the Anthropocene.

> Anthropocene (noun)
> An·thro·po·cene | \ ˈan(t)-thrə-pə-ˌsēn
>
> Definition of Anthropocene
> The period of time during which human activities have had an environmental impact on the Earth regarded as constituting a distinct geological age.

The Anthropocene is an era that clearly announces the impact of human activity on the environment. This period follows the Holocene: the current geological time frame stretching back 12000 cal years of the Earth's long history, to the last glacial era, which enjoyed a relatively stable climate and allowed human civilization to flourish. In stark contrast to this, the Anthropocene represents a period of accelerating instability from the impact of human activity on the ecosystems, including the ongoing sixth mass extinction affecting many species of the planet from deforestation, ocean acidification, pollution and global warming, to name a few (Lövbrand, Mobjörk, and Söder 2020). In contrast to this extinction event, jellyfish populations are now flourishing.

> Human-induced stresses of overfishing, eutrophication, climate change, translocation and habitat modification appear to be promoting jellyfish (*pelagic cnidaria and ctenophora*) blooms to the detriment of other marine organisms. Mounting evidence suggests that the structure of pelagic ecosystems can change rapidly from one that is dominated by fish (that keep jellyfish in check through competition or predation) to a less desirable gelatinous state, with lasting ecological, economic and social consequences.
> (Richardson et al. 2009 : 1)

> Whilst there are still large knowledge gaps surrounding the behaviour and migration of jellyfish blooms, a lot more scientific research on this subject is focussing on understanding what is happening with the jellyfish, whether the augmentation of these populations are impacting the environment negatively or positively, and as a result their potential for economic exploitation as a resource has become a large area of interest.
>
> (Edelist et al. 2021 : 2)

There is little doubt that proliferation of these soft bodied, aquatic animals appears in large part to be related to human impact on the oceans. This radical augmentation of jellyfish populations could be seen to represent another threat to human environmental domination, which when taken to the extreme might even hail an end to the Anthropocene. Far from science fiction, we have already evidenced the potential interruption to our power grids from large jellyfish blooms. We can indeed imagine that jellyfish blooms are trying to interfere in our command over the planet, as they counteract or accelerate the human induced forces destroying our environment. It is on this premise that we want to consider a post-human epoch, one in which the dominant life forms are sea jellies and combs. By blocking the cooling systems of our energy production stations, Nuclear or otherwise, halting commercial fishing exploitation by breaking fishing nets and even fishing boats, they are multiplying like a virus; and those with a sting capable of causing death, indeed, they are also some of the most dangerous creatures in the world! The toll we take on the seas may augur a new world order of jellyfish disasters, which, in turn, could devastate the global economy. A gelatinous future refers to the invasion of the jellyfish in reaction to our over polluting activities.

Ctenocene (noun)
Cte.no.cene \ ˈ/tɛˈnɒ-ˌsēn

Definition of Ctenocene

The period of time during which jellies and ctenophore activities have had an environmental impact on the Earth regarded as constituting a distinct geological and largely aquatic age.

The Ctenocene is a post-Anthropocene condition dominated by jellyfish. The Ctenocene thrives in the wake of the Anthropocene, eventually replacing its influence upon our seas and lands. In oxygen starved, acidic oceans the Ctenocene flourishes, multiplies and evolves. For the purpose of our art-fiction, we assume that a new era is coming, the one of the Ctenophora. In an era that announces the gelatinous future, we appropriate the Ctenophora's ubiquitous presence, nervous system and predatory gelatinous characteristics, which alongside Cnidarian have both negative and positive impacts on marine environments, we announce the Ctenocene.

> ...art-fiction, is the generic solution which is spontaneously lesser known because it is concealed by the almighty power of aesthetics, which renders it invisible as the liberating possibility of new virtualities.
>
> (Laruelle, 2012: 9)

The Ctenocene is an invented concept that reflects on our present through a post-human art-fiction.

It informs the various experiences and experiments in performance and composition that we produced with the Jelly-synths in 2017 and the recent pandemic performances that resulted in *Blooms*, which premiered at *Stadtwerkstatt* in Linz during *STWST48x6 – MORE LESS*, as part of the Ars Electronica Festival in September 2020. Here the Instruments were extended towards a hybrid digital/analogue interface to create a networked performance system based on the notion of a jellyfish bloom.

3.2 Composition of a Network

We begin by inducing the concept of the Ctenocene to create a *network topology*, similar to the modus operandi of a virus – the performance environment is intended to produce Blooms of interaction through hybrid spheres of both physical and virtual instrumentation and includes a potentially exponential number of players or listeners in the system. In 2020, we developed a new version of our performance and named it *Blooms* in reference to the frequent amassing of jellyfish across the globe. The Jelly-synth remains central to the performance but it is augmented by the intervention of online participants, invited to manipulate the resulting sounds produced by the performers in a venue. The Jelly-synth needs amplification in order for the sounds produced to be heard, they are not acoustic instruments and therefore we can create programs that interfere in these electroacoustic chains by bringing more complexities to the music, such as granularity, delay, pitchshifter and live sampling. This decentralised body represented a strategy for *Blooms*; using the electromagnetic spectrum by producing autonomous modules or Jelly-synths which affect the given environment of a performance space through haptic interaction with the body, producing beats, drones, frequencies and flickering lights.

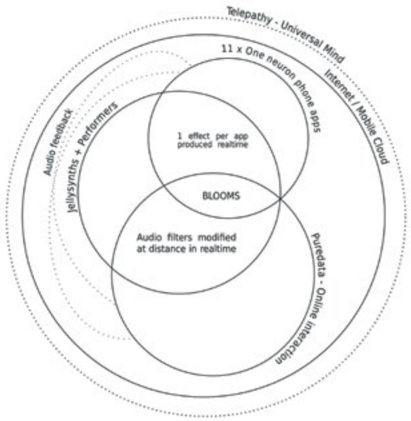

Figure 7.5: Diagram for a Ctenocene: a Network Topology

Creating the network topology we further experimented with live interaction, creating improvisation within a performance driven by a 'Universal Mind', that is to say connecting with the ether or via an instinctive telepathy as a part of the 'Blooms' device, which in itself is to be understood as a musical score.

This notion of the Universal Mind is a symbolic and experiential reflection on the hitherto little understood communication between jellyfish. The jellyfish is an entity completely in symbiosis with its environment, its mass and growth directly reflecting its surroundings. The cells that make up this nerve system are a special cell called a neuron. Neurons have dedicated structures that allow them to send signals rapidly and precisely to other cells.

> Rather than being centralized in one part of the body like our own brains, the jellyfish brain—composed of approximately 10,000 neurons—is diffused across the animal's entire body like a net. The various body parts of a jellyfish can operate seemingly autonomously, without centralized control...
>
> (Dajose 2021)

For our performance *Blooms*, we considered the Jellysynths as a nerve system; an audio synthesiser played with touch – translated into sound by electrical signals that react to movement, pressure and sweat. The nerve system is the representation of a simple, yet remarkably complex life form in our impending gelatinous era. Web-interfaces allowed any number of online participants to manipulate the nerve system, resulting in composition of the performance in real-time and from a distance. Online players could be made equally visible through a dedicated audio/visual streaming server. In addition to this we developed multiple telephone apps for android that are based on the concept of a single neuron: each app allowed the user to send a signal and manipulate one element of the live performance in real time. The feedback of which took place in the physical performance space or via the live stream. The multiplication of participants produces a *Networked Bloom*, wherein their interpretations and signals co-create the whole performance, the movement of the sound influences the composition and modifies the behaviours of this performance environment. Indeed taken to the extreme the Networked Blooms have the potential to crash the system because the invitation to participate is entirely open. A crash happens when the server or software driving the interaction and connectivity becomes overloaded with requests and is no longer able to process those requests. Similar to a Denial-of-Service (DoS) attack, by overloading the *Blooms* server with requests so that the system is no longer able to operate could be understood as a parallel to the unintentional impact jellyfish blooms can have on human infrastructures. In our performance-installation we bring ideas of making noise and sound as a physical representation of this relation between the jellyfish, our environment, our mass wastes and pollution dumped at sea. Taking the concept of a coming Ctenocene to create a musical interface and a modular system that can be extended, multiplied and saturated.

Figure 7.7 shows the schematics for the performance *Blooms* at *STWST48X6* in 2020; it depicts the various spaces in which performing and listening takes place, alongside the complexity of the various audio inputs affecting the music. We also think of this schematics as a device for understanding the interactions, feedback between musicians, performers and public implicated in the performance as a direction in the production of sounds and music and therefore as musical score in itself.

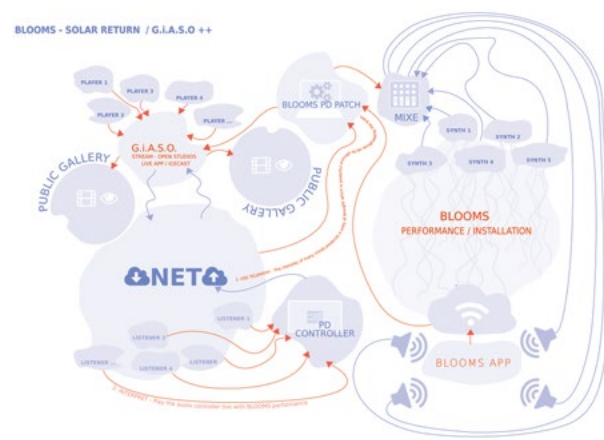

Figure 7.6: Schematics for the networked performance Blooms 2020

3.3 Soft Circuits: Noise and Resistance

Rather than mimicking the creature itself, or its behaviour, the electronic circuits that make up the Jelly-synths recall the transparent soft bodies of a jelly, whilst the cables and brass wires lend themselves to the tentacular form of the synths interface. Nothing is hidden: circuits, capacitors, resistors, LEDs jacks, cables, mixers, computers, etc. They are thought of in terms of a nerve system using haptic and telepathic interconnection through physical and ethereal networks and noise. If the instruments represent a form of jellyfish, the interaction with it belongs to music and art; abstract concepts take the form of frequencies, notes, composition in conjunction with its aesthetic aspect. The composition drives the performers in their interpretation of the Jelly-synth, each as a new instrument, with its own constraints and its own limitations.

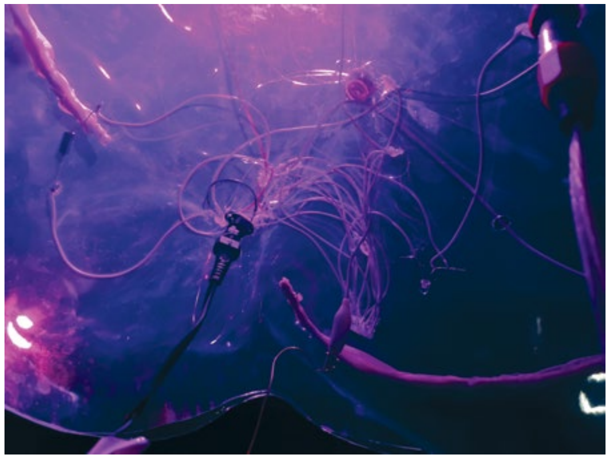

Figure 7.7: Close-up photo of electronic circuits in a Jelly-synth

The invention of musical instruments has many historical precedents in their being influenced or inspired by the environment, whether as hunting tools or imitating bird song. That said, the sound produced by the Jelly-synth has more to do with the sound of electricity and the mechanical clicks and statics of a post-industrial world than with nature. Jellyfish are not concerned by sound but by the acidity of the oceans, our Jelly-synths in relation to this are partly manipulated by the moisture of our hands. The greater the perspiration on the players' hands – the greater the reactivity and the higher the frequencies are; it is an instrument played with pressure, water and acidity. We should note that were these instruments created in any other form than the Jelly-synths, the underlying context of the Ctenocene, and blooms would become somewhat obtuse. For example playing these circuits as

desk instruments further separates the music and performance from the art-fiction narrative.

The Jelly-synth is also a symbol of resistance – the Ctenocene reveals the continued human march towards the autodestruction of our own ecosystems. Playing the Jelly-synth there is always a part of the composition concerned with very high frequencies and the level of moisture in our hands, this section creates an uncomfortable situation for the listeners because high frequencies play with the spectrality of sounds in order to reveal a secondary sound behind in the perception of the listeners which Szabolcs Horvát in his article 'Combination Tones: Demonstrating the Nonlinearity of the Human Ear' describes as a 'non-linear transmission in the middle ear' (Horvát 2017). The harmonics created by the beating of those high frequencies generates another sound in the ear that only exists in people's brains as the *psychoacoustic*, in this case what Hermann von Helmholtz called the combination tones:

> The term Combination Tones [...] describes tones that can be traced not in a vibrating source but in the combination of two or more waves originating in vibrating sources. Combination Tones are the products of wave interference and have physical, physiological, neurological, and cognitive origins.

This phenomenon was first discovered by the Violinist Giuseppe Tartini (1692–1770), who regarded this as the 'third tone'. The discomfort of the listeners in this part of the performance is not intentional but represents somehow the experience of the jellyfish stingers and the pressure on the inner-ear in deep water. Taking the idea of the jellyfish's sensory ecology as a warning system and a starting point, 'Ctenocene: A Network Topology', draws on these observations and reflects critically about the Anthropocene, ecology, the environment and global warming.

Figure 7.8: Photo of J Pickett and J Ottavi performing with the Jelly-synth

The development of *Blooms* extended the instruments to a networked performance that echoes the augmentation of the jellyfish across our seas and oceans. Additional manipulations are controlled by online participants who use a program that connects with the performers locally. Using puredata, we created a patch that users could download and launch in order to manipulate the sound during the live performance. No programming is required from participants, however an internet connection and installing the open source software Puredata is necessary in order to plug and play. The Blooms control interface allowed the user to connect to the main stage program via OSC protocol (open sound control); once connected (many players could connect at the same time) they could change different parameters of the sound including pitch, delay, granularity of the sound (cut the sound in little grains), also there were two samplers to cut extracts of the sound and play them back as much as they wanted.

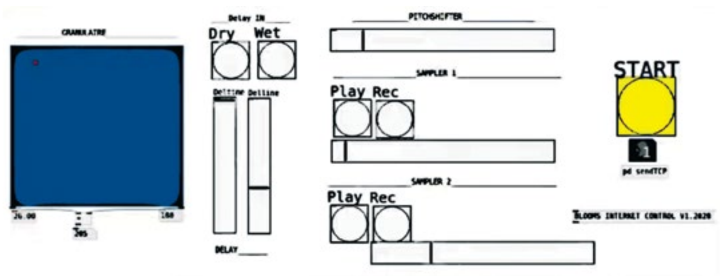

Figure 7.9: Blooms – Network interface in Puredata

It was important to us that *Blooms* could also be created with physical audiences IRL, who would most likely have access to a smartphone rather than a laptop. In order to make these performative blooms accessible we also developed 11 smartphone apps which operate using a single button in order to control an aspect of the performance (pitch, delay, sampling, granularity); the single button is considered part of the network of communication between one neuron jellyfish organisms. During this performance, we as local players or musicians are no longer in full control of the sound produced and have to accept the interferences of external manipulation as a jellyfish gathering or group play.

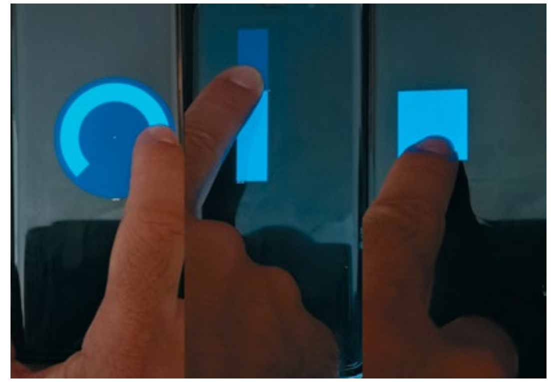

Figure 7.10: Example of single action apps for Blooms performance in 2020

The protocol of this multiplayer performance included a notion of the universal mind – or a kind of telepathy that in theory should allow the music to move in and out of frequencies along the networked ebbs and flows of the ether and through masses of the jellies that form the networked performance bloom, amassing across the internet control protocol. The audience, IRL, virtual and hybrid are given the same direction for interacting with the performance: *1. USE TELEPATHY – – The interplay of many minds produces a unity of thought which is powerful enough to be recognized by the brain.*

4 Observations on a Hybrid Interactive Performance

The performance of *Blooms* took place in *STWST48X6 – – MORE LESS* at Stadtwerkstatt in Linz on 12 September 2020 as part of the Ars Electronica Festival.

Blooms was situated in the club on a low stage in a room filled with water, during a rare moment of relatively relaxed COVID-19 pandemic restrictions, that allowed a small number of audience to be present at the venue. The particularity of this context meant many artists and audiences were unable to travel physically to see art and exchange, and much of the Festival was moved online. Whilst we were lucky enough to be able to travel to Linz, this was also one of the motivations behind developing an online interactive and hybrid performance with *Blooms*.

4.1 Performance Environment and Wet Circuits

The club had created an aquatic environment, filling the venue with water rather than people, initially posing a challenging situation for us, necessitating that we take extra care carrying and installing electronic equipment whilst wading through water, not to mention our concerns as to how this humidity or splashing might affect the exposed DIY, dirty electronic circuits and brass wires. When performing with the Jelly-synths we essentially create short circuits as we touch them. That said, the wet scenography also created a strong visual reference point for the Jelly-synths through both the reflections and the potential of the water itself to interact with the instruments. As previously described, certain rhythms, frequencies and drones in the previous composition require moist hands, something we are not always capable of producing in a performance situation. In this instance, rather than keeping a wet sponge handy, we were surrounded by water. This created another interaction with the instrument, albeit counter intuitive with live electronics, to play the Jelly-synth with soaking wet hands; increasing the sensitivity, oscillations and frequencies we were able to play using these chaotic and absurd circuits.

4.2 A Tele-networked Ensemble

We were joined online by Marinos Koutsomichalis and students from Madlab – Media Art and Design Lab at Cyprus University of Technology, alongside the musicians Amble Skuse, Phillippe Cavaleri, Shelly Knotts, Keiko Uenishi and Robin Plastre who form part of the GIASO – Great International Audio Streaming Orchestra, a distributed online orchestra which was created in 2013 by APO33. These were our primary network of participants and beta testers for the online performance interface in Linz. Whilst the Puredata interface was open to anyone to download, we also wanted to be in direct communication with these two blooms and ensure a certain number of connections, interactions and interferences throughout the forty minute live performance. Due largely to time constraints at the venue, with performances happening before and after on the same stage, we were unable to include a dedicated live streaming server that would have made visible players at distance. This is something that would need to be developed and tested for future versions. That said, each bloom was able to monitor the performance and their interactions with the Jelly-synths in real-time, streamed live over the internet. This provides direct feedback from each performers' interaction, and they were also able to communicate directly with the performers on stage using IRC chat. This relation is important to exchange with the participants/performers on how the performance is progressing, even if it makes the live performance with tactile instruments a bit more complicated. Online performers had the possibility of communicating via text, and taking their time to do this, whereas on stage we are responding to the space, the gestures of the Jelly-synths and the interferences from sound effects. Therefore, all were encouraged to think about their telepathic communication across the ether as indicated in the score.

Figure 7.11: Performance view of Blooms at STWST48X6/Ars Electronica, Linz 2020

Prior to the performance, a limited local audience were given instructions for downloading single neuron interfaces and encouraged to join the 'universal-mind'. The *Blooms* performance began relatively calmly, with us slowly manipulating the electronic instruments and creating bangs and flashes through the brass interface, but as this went on, tensions grew with the irregular and occasionally irrational interferences that were being meted out. Our online participants were particularly active and the effects on the sounds were somewhat unsettling to begin with, as we grappled with the Jelly-synths and attempted to feel connected to the movement of the sounds. However, from the perspective of a purely musical aesthetic, the modification of the Jelly-synths, through the network by implementing various effects, greatly improved on the raw electronic sound meted out by the dirty electronic circuits, and brought about greater depth and timbre to the resulting performance *Blooms*.

IRL the audiences were knee deep in water and social distancing, however, as their confidence with the aquatic space grew, various members began approaching the stage, moving with the frequencies and beats produced with little concern for the mass of electronics a few inches away!

As a warning of the coming Ctenocene, this performance culminated in an extreme accumulation of sounds, movement, flashing LEDs, frequencies and noise, enveloping the audience and saturating the network. *Blooms* induced an overload of sounds, far removed from the tranquil majestic pulsing of a single jellyfish.

5 Conclusion

'Ctenocene: A Network Topology' began as an intention to create a musical instrument and performance that drew on broad research into jellyfish blooms and their current status as either pest, plastic filters, acid test for the oceans, food supplements, renewable materials etc., depending on which area of interest in which research is conducted. We attempted to cross different domains of research through an artistic project: art production, science, fiction and music theory. In this way we try to bring about an impression of the current crisis in which we are living (the anthropocene and global warming), by seeking to echo a more extreme apocalyptic or post-human position. The performance *Blooms* seeks to do this through the networks, as viral audio interferences that play with the jellyfish's otherworldly modes of communication. The multidisciplinary aspect of our proposition takes form in the creation of musical instruments with the shape of a jellyfish becoming at the same time an art sculpture and a symbolic representation of the jellyfish as fictional science.

The instruments and the blooms performance are the first iterations of this artistic research, the complex nature of which is yet to be entirely resolved. The perspective of art-fiction is a way for us to articulate art and research, and can enable this project to develop further; the relation between imagination, intuition and science through art-fiction could become a useful tool for creating new artistic forms that reflect upon, or develop from, but do not necessarily explain or illustrate scientific research. One area we are keen to explore further is that of integrating the art-fiction of the Ctenocene, that with its bases in reality, could be manifest through descriptive text, film or poetry.

Video Links

Documentation from Bestiaire – 'Les instruments inventés' at La Plateforme Intermédia, Nantes 2021: https://youtu.be/SpGoDrY_FsU

Documentation from STWST48X6, Linz 2020: https://stwst48x6.stwst.at/_media/blooms_1.16.mp4

Clip from live stream STWST48X6/Ars Electronica, Linz 2020: https://youtube.com/clip/UgkxcbEQ4ibm9JzaYQFUBOFVFPHAIzo1xnn3

Bibliography

Ambrose, Jillian. 2021. 'Fire Shuts One of UK's Most Important Power Cables in Midst of Supply Crunch.' *The Guardian*. September 15, 2021. https://www.theguardian.com/business/2021/sep/15/fire-shuts-one-of-uk-most-important-power-cables-in-midst-of-supply-crunch

Barnes, David K.A., François Galgani, Richard C. Thompson, and Morton Barlaz. 2009. 'Accumulation and Fragmentation of Plastic Debris in Global Environments.' *Philosophical Transactions of the Royal Society* B: Biological Sciences 364 (1526): 1985–98. https://doi.org/10.1098/rstb.2008.0205

BBC News. 2021. 'Jellyfish Shut Down Marchwood Power Station.' June 15, 2021, sec. Hampshire & Isle of Wight. https://www.bbc.com/news/uk-england-hampshire-57484065

'Chris Watson.' n.d. Chris Watson. Accessed July 27, 2022. https://chriswatson.net/

'CORDIS|European Commission.' 2022. Europa.eu. 2022. https://cordis.europa.eu/article/id/124142-ridding-our-waters-of-plastic-waste-with-jellyfish-filters

Dajose, Lori. 2021. 'How to Read a Jellyfish's Mind.' California Institute of Technology. November 24, 2021. https://www.caltech.edu/about/news/how-to-read-a-jellyfishs-mind

'Definition of ANTHROPOCENE.' 2019. Merriam-Webster.com. 2019. https://www.merriam-webster.com/dictionary/Anthropocene

Doyle, Thomas, Graeme Hays, Chris Harrod, and Jonathan Houghton. 2013. 'Ecological and Societal Benefits of Jellyfish Blooms.' In K. Pitt and C. Lucas (eds), *Jellyfish Blooms*, Springer. https://pure.qub.ac.uk/en/publications/ecological-and-societal-benefits-of-jellyfish-blooms

Edelist, Dori, Dror L. Angel , João Canning-Clode, Sonia Gueroun, Nicole Aberle, Jamileh Javidpour, and Carlos Andrade. 2021. 'Jellyfishing in Europe: Current Status, Knowledge Gaps, and Future Directions towards a Sustainable Practice.' Sustainability 13(22). https://doi.org/10.3390/su132212445

Fanelli, Daniele. 2010. 'Do Pressures to Publish Increase Scientists' Bias? An Empirical Support from US States Data.' Edited by Enrico Scalas. PLoS ONE 5 (4): e10271. https://doi.org/10.1371/journal.pone.0010271

Horvát, Szabolcs. 2017. 'Combination Tones: Demonstrating the Nonlinearity of the Human Ear.' Szhorvat.net. March 5, 2017. http://szhorvat.net/pelican/combination-tones.html

Laruelle, François. 1996. *Principes de la non-philosophie*. Presses Universitaires De France.

Laruelle, François. 2012. *Photo-Fiction: A Non-Standard Aesthetics*. Minneapolis: Univocal Publishing.

Leopoldseder, Hannes, Christine Schöpf, Gerfried Stocker (eds) *Ars Electronica 2010. Repair: Sind wir noch zu retten* [Ars Electronica 2010, Festival Für Kunst, Technologie und Gesellschaft, Linz, 2–11 September 2010]. Ostfildern: Hatje Cantz Verlag.

Lövbrand, Eva, Malin Mobjörk, and Rickard Söder. 2020. 'The Anthropocene and the Geo-Political Imagination: Re-Writing Earth as Political Space.' Earth System Governance, June, 100051. https://doi.org/10.1016/j.esg.2020.100051

'MAL AU PIXEL#4 • Installations – '. n.d. Mains D'Œuvres. www.mainsdoeuvres.org. Accessed January 12, 2022. https://www.mainsdoeuvres.org/archives/article603.html

Mathiesen, Karl. 2015. 'Are Jellyfish Going to Take over the Oceans?' *The Guardian*. August 21, 2015. https://www.theguardian.com/environment/2015/aug/21/are-jellyfish-going-to-take-over-oceans

Murthy, Venkatesha, and Seeram Ramakrishna. 2022. 'A Review on Global E-Waste Management: Urban Mining towards a Sustainable Future and Circular Economy.' *Sustainability* 14 (2): 647. https://doi.org/10.3390/su14020647

'No Patent Pending #27.' n.d. Instrumentinventors.org. Accessed July 31, 2022. https://instrumentinventors.org/agenda/no_patent_pending_27/

Pickett, Jenny, and Julien Ottavi. 2020a. *Blooms*. Edited by Tanja Brandmayr. STWST48x6 MORE LESS. September 2020. https://stwst48x6.stwst.at/en/blooms

Pickett, Jenny, and Julien Ottavi. 2020b. *Blooms*. Apo33.org. September 2020. http://apo33.org/pow/doku.php?id=blooms.

Richardson, Anthony J., Andrew Bakun, Graeme C. Hays, and Mark J. Gibbons. 2009. 'The Jellyfish Joyride: Causes, Consequences and Management Responses to a More Gelatinous Future.' *Trends in Ecology & Evolution* 24 (6): 312–22. https://doi.org/10.1016/j.tree.2009.01.010

Sachkova, Maria Y., Eva-Lena Nordmann, Joan J. Soto-Àngel, Yasmin Meeda, Bartłomiej Górski, Benjamin Naumann, Daniel Dondorp, Marios Chatzigeorgiou, Maike Kittelmann, and Pawel Pawel Burkhardt. 2021. 'The Unique Neuronal Structure and Neuropeptide Repertoire in the Ctenophore *Mnemiopsis Leidyi* Shed Light on the Evolution of Animal Nervous Systems.' BioRxiv. *Current Biology* March 31, 2021. https://www.biorxiv.org/content/10.1101/2021.03.31.437758v1

Šebjanič, Robertina. n.d. 'Aquatocene/Subaquatic Quest for Serenity ||| Aquatocene/v Iskanju Podvodne Tišine | Robertina Šebjanič.' Accessed April 31, 2022. https://robertina.net/aquatocene/

The Editors of *Encyclopaedia Britannica*. 2019. 'Ctenophore | Marine Invertebrate.' In *Encyclopædia Britannica*. https://www.britannica.com/animal/ctenophore

Chapter 8

Re-worlding the Virtual

Exploring Art and Archipelagic Education through Virtual Environments

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Abstract

This paper expands on the use of virtual environments to address educational questions around social isolation, embodiment and knowledge production. Supported by curricular experimentations with archipelagic thinking, it reflects on the potential for virtual environments to provide novel educational contexts for students to explore the relationship between art and environment at a time of climate transition. Archipelagic thinking is a theoretical framework that emerged out of Island studies and postcolonial discourse in the late twentieth century. Emphasising relational flow between islanders, islands, entities and worlds, archipelagic thinking seeks to address the epistemological distinctions between centre and periphery, between the northern and southern hemispheres, what Boaventura De Sousa Santos (2018) has called 'the abyssal line'. Within this context, post-abyssal pedagogies are pedagogies that challenge the epistemic injustices between official and unofficial knowledge, mapped out through geographic location. These theoretical frameworks became the methodological ground upon which a virtual pedagogical experiment was developed in the MA Art and Environment, in West

Cork, in Ireland. Aiming to create a more embodied educational experience within virtual reality, archipelagic spaces were constructed to support exchanges with local voices and local knowledge. Re-worlding the virtual through these processes, the Virtual Archipelago was further expanded into a European-wide conference on the ethics and politics of virtual reality education in arts institutions. Reflecting on the values and principles that have emerged through these discussions, this paper points towards some possible research directions.

Keywords: virtual environments; education; archipelagic thinking; artistic research

Introduction

Virtual Education is an emerging discourse and practice that was significantly accelerated over the course of the COVID-19 pandemic. While this event may retrospectively mark an epochal shift in the development of VR education, it is important not to lose sight of the contexts in which prior explorations and experiments have been developed. Historically, many of the most successful applications of educational-technology emerged through distance models of education, motivated by far-reaching, egalitarian, and democratic principles. For example, The Open University (OU), originally named the *University of the Air*, aimed to provide a broader access route to educational resources for displaced learners that had neither the geographical privilege nor cultural capital to participate in education (Weinbren, 2014). Using advanced technical apparatuses to provide content and communicate with students through television, tape recordings, and phone-lines, the OU became a model of post-industrial, connectivist education (Weinbren, 2014). While the use of technologies in educational practice has always existed, from the textbook and the lectern to the overhead projector (Freisin, 2018), advanced digital technologies such as computers, smartphones, drones, AR (augmented reality) and VR (virtual reality) have only been a peripheral part of educational practice in the last decade.

Expanding on the distance learning histories of educational technology, this paper presents a pilot project developed using virtual reality platforms to explore environmental education in island community contexts. Bridging *pre* and *post* pandemic experiences, the project coincided with the development of an archipelagic programme in art and environment located off the west coast of Ireland. Utilising the framework of archipelagic thinking as both material practice and spatial metaphor, VR pedagogies were introduced to support a broader engagement with the biosphere and the technosphere at a time of climate transition. The term 'biosphere' was originally coined by Swiss geologist Eduard Suess in 1875 but the concept as accepted today (European Geosciences Union, 2022) was actually developed by Ukrainian-Russian Vladimir Vernadsky in his 1926 book The Biosphere. Biosphere refers to the combination of all the ecosystems on the planet; the zone of life on Earth, where an ecosystem (or ecological system) consists of all the organisms together with the physical environment in which they exist (Tansley, 1935: 299). However, we now live in the geological age commonly known as the 'Anthropocene' (Crutzen and Stoermer, 2000: 17–18) which is signified by the fact that the global environment is currently shaped by humankind rather than vice versa (Edwards, 2015). This is manifested in the technosphere, where human technology extends its influence into the biosphere for the first time. As a result, human activity is affecting the geological reality of the planet. Simultaneously, the development of VR technology offers an opportunity to extend the exploration of what it is to be human. The philosopher David Chalmers (2022) writing in *Reality+: Virtual Worlds and the Problems of Philosophy*, contends that VR is real: 'Virtual worlds are not illusions or fictions, or at least they need not be. What happens in VR really happens. The objects we interact with in VR are real.' Furthermore, he adds: 'Life in virtual worlds can be as good, in principle, as life outside virtual worlds. You can lead a fully meaningful life in a virtual world' (Chalmers, 2022:xvii). Virtual worlds can be understood and engaged with in an archipelagic context, as real environments in their own right.

Archipelago as Educational Form

The MA Art and Environment (MAAE)[58] was developed over a number of research projects, events and contexts between 2018 and 2020. Emerging out of the already established BA in Visual Art (BAVA)[59] in Sherkin Island, the MAAE aimed to expand on the distance learning ethos of the BAVA, to focus on a multiplicity of geographic sites and educational themes appropriate to environmental art. Building on research developed through the *What is an island?* project (2018–2021),[60] the MAAE viewed islands and archipelagos as important sites of study within the context of the Anthropocene. Central to the shift from an island-based pedagogy to an archipelagic-based pedagogy, was the transition from a 'root-identity to a relational-identity', from *place* to *space*. One way to understand this more concretely is to consider how relatively easy it is to stand in Sherkin Island and point towards its beginning and its end, whereas, it is almost impossible to delineate the beginning and end of the archipelago that Sherkin is embedded within, it is utterly decentralised and diffuse. This unique

58 https://www.art-environment.com
59 http://bavasherkin.com
60 https://whatisanisland.com

geological dynamic inspired poet and philosopher Édouard Glissant to argue for an 'archipelagic imaginary' that was spatialised and rootless, always in the process of 'relating' *between* islands, and *beyond* boundaries, and where 'the imaginary of my place is connected (**relié**) to the imaginable reality of the world's places, and the inverse is also true' (Glissant, 2009: 47). What is important about this proposal for environmental education today is the extent to which it enables a profound shift away from normative understandings of globalisation as standardised network, and 'continental thought', towards a multi-scalar spatiality that connects locality and world. '[C]ontinental thought [...] makes us think that we see the world as a bloc, taken wholesale, all-at-once, as a sort of imposing synthesis, just as we can see, through the window of an airplane, the configurations of landscapes or mountainous surfaces. With archipelagic thought, we know the rivers' rocks, without a doubt even the smallest ones' (Glissant, 2009: 45).

Thinking through the curricular form of an MAAE, it was important to connect local experiences of climate change to global shifts in planetary consciousness emerging with it. Glissant's conceptualisation of the archipelago and archipelagic thinking was instrumental to the incorporation of this ambition into the programme, and key to his understanding of the archipelago as both 'island chain', and spatial 'imaginary' is the concept of *relation*. Emerging through his later work *The Poetics of Relation, Glissant* (1997) defined relation simultaneously as the geographical reality of islands and the radical potentiality of those spaces to produce culture. Reflecting on the abyss of the ship's *hold* as a material historical reality of the slave trade and a cauldron for the formation of new identities in a new world, Glissant defined *Relation* as the space where diversity, ambiguity and hybridity are manifest in the void spaces between western systems of thinking and doing. Expanding on this unique correlation between islands and diversity, David Chandler and Jonathan Pugh (2021), recently highlighted the significance of the Galapagos islands in the development of evolutionary theory, 'species evolved and adapted differently on the Galapagos because different Island ecologies facilitated and enabled this differentiation. The key word for Darwin was thus 'divergence' which emerged from the separation and bounded nature of islands, and in focusing upon this he drew attention to how Islands are powerful differentiating 'engines' for life itself.' (Pugh & Chandler, 2021: 11). Such 'differentiating' phenomenon can be understood as a 'patchwork ontology', which shifts the towards the ways we 'make, explore, and journey' through the bio-sphere, rather than merely reflect upon our relational intersections with it (Pugh & Chandler, 2021).

Due to the 'patchwork' nature of the archipelago and the island communities it comprises, the use of digital technologies is

an important infrastructure for practical delivery of an archipelagic art education. More philosophically, digital technologies and digital culture have become a defining characteristic of our contemporary environment and need to be interrogated and reinvented in equal measure. As Bernard Stiegler and others have suggested, it is necessary to think of both the natural and technological worlds together because they are equally threatened by the same problems of homogeneity and standardisation (Stiegler, 2018). For Steigler, the archipelago was conceived as a means to overcome the standardising image of the network, which tends to reduce the strategic resonance of local realities, by favoring generic structures. Such generic structures often undermine the real and genuine expression of differences. Alternatively, the archipelagic dimension highlights the role of localities (local institutions, local form of knowledges, local practices, local educations, etc.) as agents of the constant transformation of the relations between the partners, where the promotion of a multiversal (and no more simply universal) framework within which differences can proliferate (Stiegler, 2020). Following this analysis, the project was motivated by four key aims:

- To connect students with island communities around the relational dimensions of artistic research in environmental contexts.
- To connect students with island communities around emerging issues concerning the degradation of the biosphere and the technosphere.
- To use virtual platforms as educational tools that can support student engagement with virtual environments.
- To connect radically isolated students and educators at a time of global pandemic.

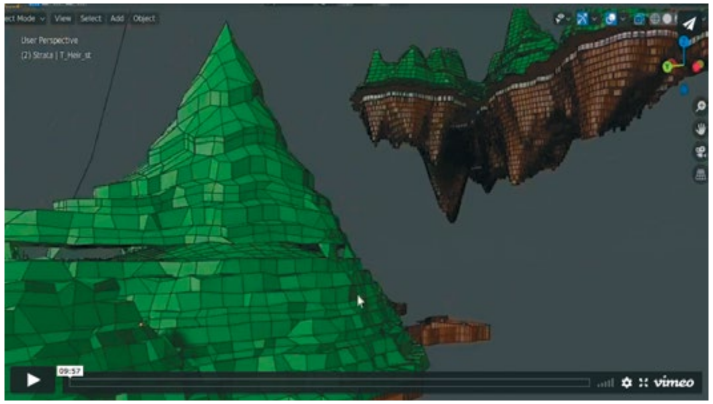

Figure 8.1: Virtual Archipelago (Image Credit: Glenn Loughran)

Relational Pedagogies in the Virtual World

Prior to the mass shift towards online communication that followed the first pandemic lockdown, an immersive, archipelagic, digital-platform was developed to explore the virtual capacities of artistic practice and education. In October 2020, ten Oculus Quest VR headsets were ordered and delivered to the TU Dublin city centre campus in Grangegorman, which were further picked up by a courier service and delivered to a drop-off point in Skibbereen, County Cork. From there, local arrangements were made for delivery to seven students living in seven diverse geographic locations around the region. The students received a VR headset, sterilisation instructions and set-up instructions for the virtual reality platform *Spatial*. The decision to use *Spatial* was educational and related specifically to experiences that are unique to adult education, where the alienating and infantilising effect of educational environments and processes are common. *Spatial* is an open source VR platform, often described as a social VR platform, but which was originally designed as a work space platform for corporate meetings and presentations. Due to this remit, the platform privileged realism, mimesis and spatiality in its design. Unlike many social VR sites, such as Mozilla Hubs, *Spatial* avoided the characteristic over-saturated environments, gamification and multiple-choice avatars. Instead, avatars were based on photogrammetry renderings of individual users and architectural environments were realistically represented and lit.

While *Spatial* was appropriate for use with students on the MAAE it was still necessary to repurpose the programme for more diverse engagements within the visual arts course. Within this context, it is too easy to assume that certain types of teaching, learning and research are more effective, efficient and impactful that others. Due to the novel and experimental nature of teaching

in VR spaces at this time, it was essential to remain open about the methods and techniques used for teaching and learning. For this reason, a balance of educational forms was introduced, allowing equal time to traditional, didactic forms of teaching (chalk and talk), constructivist techniques (workshops), auto-didactic learning (studio-practice/artistic research) and collective study (reading groups).

Initially the students were invited into a pre-set *Spatial* environment and asked to develop an artistic response to a close reading of the first chapter of Edouard Glissant's *Poetics of Relation*. To enable a group dialogue with the text, a number of large signposts were staged around the virtual classroom, on which quotations from the text were written. Installed prior to the students' arrival in the classroom, the signposts functioned as memory prompts due to the absence of teaching material to hand. When teaching in VR a teacher cannot use physical notes in a traditional manner, because this would mean taking the headsets on and off. Having the notes embedded within the environment meant that a certain amount of movement was required to direct the discussion, and as a result the notes took on a spatial, as well as close reading dimension. This spatial dynamic supported sculptural-aesthetic responses from the students, using the fabrication and appropriation tools embedded within *Spatial*. So intuitive and complex were the making capacities of these tools that students were able to develop complex, digital sculpture installations within a couple of hours.

Figure 8.2: Virtual Classroom 1 (Image Credit: Glenn Loughran)

Expanding on this workshop, the students engaged in a specifically designed VR curriculum built to support skills acquisition and critical dialogue over the course of the semester. Providing art students with the capacity to develop artistic work in multiple forms, two-dimensional, sculptural, audio, filmic and performative, was essential to the curriculum and supported by blended skills workshops with digital technicians. With access to virtual making tools such as Blender and Gravity Sketch, students gained the confidence to experiment with their own artistic ideas; however, to further compliment the creative dimensions of the curriculum, lectures and readings were introduced to contextualise the uses of technology and to reflect critically on their historical and political development. Introducing a philosophical perspective to these developments, Noel Fitzpatrick presented on the concept of Techno-genesis, emphasising the evolutionary impacts of technological apparatuses on human societies, while John O'Connor presented on the possibilities and pitfalls of virtual reality through a cultural historical lens. As each class developed, the content and structure of the rooms were adapted to suit the delivery, with students often being given instructions on how to use the room and how to respond to the material staged within it. In this sense, the classes resembled installations or museum education formats, rather than traditional academic ones.

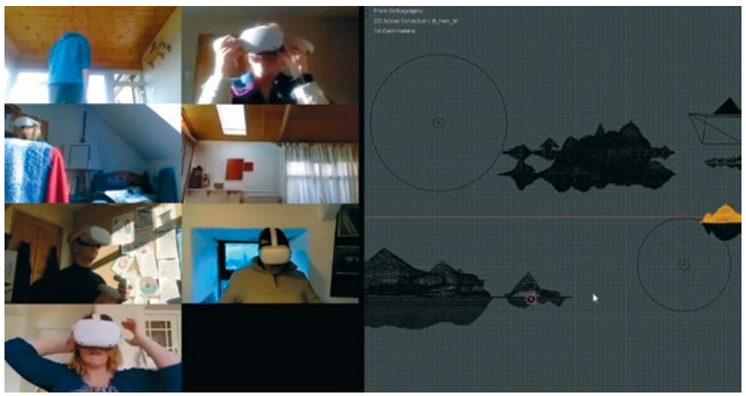

Figure 8.3: Virtual Classroom 2 (Image Credit: Glenn Loughran)

Alongside these curricular processes the students were engaged in independent research, connecting with islands and islanders in the archipelago, developing local interviews, environmental field research and artistic research. From these activities the students would organise virtual representations of their research work to be presented to their peers in VR studio spaces. Expanding on the traditional form of the 'Crit' (Newall, 2019) in art education, these dialogical experiences were surprisingly fluid, analytical and generative, where you could experience island sounds and rhythms, such as the wind, birdsong, rustling trees, the sea, motor boats, discuss three-dimensional models that proposed the construction of a floating cinema, floating forests, plant nightclubs, fog harvesting sculptures and audio interventions that represented the voices and experiences of islanders during the pandemic.

Throughout this time a large-scale virtual archipelago was developed for students and staff on the course, with the aim of presenting the student research in a virtual exhibition at the end of the semester. The islands constructed within the virtual archipelago were modelled on the real-world islands in the archipelago of West Cork using satellite imagery. Once rendered, the class was split into three research groups working collectively in each of the following islands: Sherkin Island, Cape Clear and Whiddy Island. Through this process students constructed virtual maquette proposals of work to be realised on the islands in the third and final semester. Staged on smaller island models and supported by research with islanders, these research processes captured the archipelagic imagination and led towards a virtual exhibition for public consumption. Supporting these ambitions, a proposal was accepted by the European League of Institutes of the Arts (ELIA), to expand the pilot project into a European wide conference on the future of the art school, connecting universities and art schools across Europe.[61] Planned as a three-day event in VR, the conference engaged colleagues from five different European universities including Dublin, Zurich, Amsterdam, Helsinki and Huma University in South Africa. Over this period, the floating virtual archipelagic environment was used as a touring lecture site for presentations and workshops on archipelagic thinking and framed by the students' exhibition of work. Titled *Sensing the Environment*, the exhibition was staged physically in Uillinn and virtually on the archipelago and attended by participants across all of the participating universities, as well as local audiences. For the students, the experience of speaking about their work to individuals across Europe and South Africa was both exciting and disconcerting in equal measure.

61 https://elia-artschools.org/page/ELIAFutureArtsTowardsaVirtualUniversityoftheArts

Figure 8.4: Towards a Virtual University of the Arts
(Image Credit: Glenn Loughran)

Whilst the original motivation for using VR as an educational tool within the course was led by an expanded concept of environment being developed, the global pandemic provided an immanent need and context for it, accelerating its use. Within this, it is important to acknowledge that this was not entirely novel in educational terms, if we consider how the history of distance education has matured and developed alongside emerging technologies. As has been well documented (Weinbren, 2014), such technologies can enable educational access for disadvantaged learners on a massive scale, challenging dominant hierarchies of social reproduction. In many ways, the radical shift to online learning that took place during the pandemic mirrored the historical trajectories of distance learning, and the VR project was no different in this regard. However, given that most of the students on the course had come through the BAVA on Sherkin Island, which is a distance learning course for isolated learners in a rural environment, then it is fair to say that they were used to exploring the connective capacities of online learning. For example, they had previously been introduced to the virtual world Second Life through a semester long project in their second year.[62]

Nevertheless, the VR project was a substantial upgrade from previous long-distance learning techniques, in the sense that it did not aim solely to provide more content than was available on the course, but rather to provide better environmental contexts in which to explore the content; that is, to explore environmental questions within a contemporary environment. Within this there were some obvious physical challenges worth noting. Firstly, the initial experience of VR is extremely disconcerting, one of the most challenging aspects of which is to blindfold yourself within the context of the physical environment in which you are situated. Struggling with this initially, the students were eventually able to locate quiet spaces in their home environments that were safe and uncluttered. To support this transition, the project began in Zoom, which was left on live recording in case someone needed to come out of the VR for technical support. Once the students acclimatised to this challenge they were able to relax into it more and eventually became confident wearing and walking about their environments, with the headset on.

Alongside this challenge was the impact of long time periods wearing the headset and working within the virtual environment. Due to the intensity of the spatial immersion and the saturated nature of the visual environments, it was not uncommon for headaches to occur after about thirty minutes. Again, as students became more used to the environments they built up a tolerance for the visual intensity and could stay longer than needed. Subsequently, the sessions were regulated between thirty minutes of activity with a fifteen-minute break, before returning to VR. In total there were six, two-day weekends in the taught programme when students would have been moving in and out of virtual environments; they also set up their own rooms and studios in which to explore virtual sculptural practice. Access to a studio space for artistic research was of significant value to the students at a time when physical studio space in the college was no longer accessible, and domestic spaces severely reduced. The virtual spaces provided an opportunity to carve out time for creative work and, on many occasions, students pointed to the fact that time within the VR studio could be more uninterrupted and less distractive, than in real spaces where smart phones are competing for your attention. Oddly, it seems as if the radical space of virtual reality as an educational space can function in very similar ways to the traditional school, which aims 'to provide a safe space for children to develop focused learning away from the distractions of family and work' (Freisin, 2019).

Within the overall context of the course, the project took place in the second semester, titled Sensing. This module aimed to compliment the first semester on *Mapping*, by introducing alternative theories of knowing and learning beyond the rational cognitive epistemologies of the first semester. Throughout this semester the focus was on combining indigenous knowledge, as a sensing of the environment, with aesthetic knowledge that redistributes the sensible through aesthetic form. In support of this, the students set up online interviews with key stakeholders on the islands to make initial connections to the community and geography of the island. Expanding on these interviews, individual students contacted local actors to connect around their artistic research projects. These connections began to inform the various ways that the students thought about the VR space, where they began to use it as a research space for presenting their ideas and discussions with islanders, and also as a space to stage their proposals for work on the island, and to develop group discussions in spatial ways that they could not in the Zoom spaces.

62 https://virtualenvironmentsmodule.com [See blog entries for February to May 2017]

Figure 8.5: Student Research (Image Credit: Glenn Loughran)

What was unique to this experience was the surprise of scale, that work could be made to scale on a representation of the island and viewed three dimensionally from an top down viewpoint, or that it could be scaled up into a believable, life-size sculptural form. To be able to walk around student proposals in a three-dimensional space was a significant upgrade from looking at three-dimensional work on a two-dimensional surface. Equally, when viewing two-dimensional work within the context of a three-dimensional space, the representation of the work at scale and with the loss of resolution was significant. Imagine standing in front of a Jackson Pollock painting and being able to experience first-hand the complexity of the web of paint, or to feel the weight of a Richard Serra arc as you stand beside it. The superior representation of work in the virtual field led to much more in-depth discussion about the work than in Zoom; however, it was more difficult to sustain the length of that discussion due to the intensity of the immersion within the virtual.

Finally, with regards to connection and relation, the experience of being in a room with friends and colleagues after such long periods of isolation was quite profound and unexpected. One of the uncanniest moments within the first VR session occurred when two very close friends first met in the virtual classroom. After giggling with amazement over how real their avatars were, they pretended to hold each-other's hand. Unexpectedly, at the moment of their touching, a short vibration was produced in their Oculus handsets and a few visual sparks flew. So extreme was this experience in a post-touch pandemic world, that each student became emotional and slightly unsettled. While the sensation may have come through a prosthetic

experience, it was nevertheless heightened by the isolation of the pandemic, pointing towards the very real possibility of sensation being a key character of the virtual educational experience in future scenarios.

To think about relation in this way is to think about it as the site of creativity, diversity and experimentation, the absence of which was severely impacted by government-imposed routines and restrictions. A significant cause of fatigue within the pandemic was the lack of novelty experienced in everyday life. For French Philosopher Alain Badiou the concept of novelty is an ontological category, that is, it is a phenomenon that uniquely defines the human subject as 'a subject to the event of the new' (Badiou, 2006). It is something we need and something we seek out in our everyday lives, no matter how small or insignificant. Since education is a deeply creative experience, and art education particularly motivated by creative processes, the absence of creativity and novelty had a significant impact on the students. Traditionally art students are used to being given challenging briefs that demand creative resolution, materially and conceptually. The pandemic placed significant barriers to this kind of experience. This is not to suggest that individuals did not respond creatively to the imposed limitations, quite the opposite, imaginative actions irrupted in educational methods across many disciplines, however, what it did lead to was a deeper discussion about the role of embodiment in educational processes.

Re-centring Virtual Education in Uncertain Times

In the broadest sense, the project aimed to provide a creative space for students to think critically about the digital environment within the context of environmental education in the Anthropocene. Importantly, these explorations were developed in dialogue with field work in the natural environment and on islands in the archipelago, rather than as a separate module on virtual worlds. In this sense, the VR research project was initiated in response to a set of localised problems, as opposed to problems inherent to VR itself (some of which emerged through the process). Importantly, by the stage of its implementation the students had already been in and out of lockdown for almost a year and a half. After the adrenaline rush experienced through the pandemic in its early stages, many students had grown used to the rhythm of online education, and a certain weariness had begun to set in. By this time, most students were struggling with the precariousness and uncertainty brought on by pandemic restrictions, but also a disconnect from the norms of an art education which traditionally focuses on spatial, embodied presentations of work, collective discussion/critique, and collective studio dialogue. As has been well documented, this dynamic set of performative educational modes had, almost overnight, been reduced to a single portrait format, within a grid like frame, which was often elliptical due to variable broadband connection.

In response to this issue, the project aimed to create a connection between the students using VR; beyond this, it also aimed to cultivate a relational aesthetic education, as described above (see Wiedorn, 2021), to use the social capacity of VR spaces to think critically and performatively about dislocation and relation. In this sense then, the first workshops aimed to develop an embodied enquiry into the nature of relation at a time of its loss and beyond the standard tropes of connectivism. It also follows that the main tool through which we mediate a virtual environment, the avatar, becomes part of an extended body-schema, as identified by Merleau-Ponty (2012). Stiegler (1998) believed that understanding technology as *technics* (from the Greek *technē*, to make or construct, referring both to technology and the process of creating it) means that human beings cannot be separated from technology. It may seem ironic or contradictory, the experience of taking on a virtual body in a virtual space was initially much more embodied than having no body, and no environment. While there is no replacing the teaching body, interacting with the student body in a physical classroom, there were significantly more embodied educational experiences within these environmental spaces than other VLE platforms being used at that time (Zoom, Teams etc). Of course, the quality of these experiences is limited to the length of time that you can actually spend in them, and while this is an issue that needs to be addressed if any sustained educational engagement is to take place, it was, nevertheless surprising how much more focused time was in the VR environments. Not unlike the enclosed industrial time of the traditional classroom, the focused nature of these experiences offered a direct alternative to the inattentive experiences of screen-based learning that we have come to accept as a necessary evil of technological innovation.

These experiences provided much needed novelty and excitement for the students at a time of extreme routinisation and restriction, and they also raised important pedagogical questions around the potential for embodied knowledge experiences to be staged within the context of virtual environments. If the technological dimension of this experience can be seen as an important advance on the problem of educational disembodiment, then there were also minor advances in the re-worlding of the VR environment. Eventually, the standardised spaces of generically constructed virtual spaces became a challenge for the students and they began to play with creative ways to incorporate the local vernacular of the real-world island environments into the VR spaces that they were using. Through such world-centred, world-making educational practices the standardised and infantilising

spaces of play pedagogy that have dominated the experience of VR education were transformed into spaces of critical dialogue and innovation. Where standardised spaces and experiences often marginalise the subjective, critical capacities of the learner through the twin ideologies of efficiency and effectiveness, a world-centred education has the capacity to reinstate the educational subject as an agent of responsibility and change in the world, both virtual and real. If these experiments provoke important educational questions concerning the potential for educational subjectivity to emerge through virtual spaces, what threatens this possibility is the extent to which virtual platforms and virtual worlds are surveilled by corporate power, and the level of educational autonomy that can be maintained and protected.

The development of VR for education is occurring at a time when the very nature of the university is being challenged in wider society. Michael D. Higgins (2021), President of Ireland, academic and poet, warned of the increasing threat not only to academic freedom but the very nature of the university as a place of independent learning. He argues that the ‘community of scholarship’ is in peril and we ‘must now consider not just the loss of academic freedom at the level of the individual scholar but … the loss of the institution of the university itself, even the space of university discourse’ (Higgins, 2021). The ideal of the classroom has always been a privileged space; a safe place where students and teachers are free to explore ideas without fear of retribution. The same applies to academic research spaces, laboratories and studios, and the value of this privilege is recognised in many jurisdictions where academic freedom is protected by legislation precisely to ensure that unorthodox, controversial, even dangerous thinking can flourish thus leading to new insights, developments and inventions that benefit humankind (Myklebust, 2020). There are no obvious institutions to replace the fostering of such activity so if it is lost to the university it may well be lost to society. Higgins’ (2021) warning that the ‘ruination of the university tradition … is at hand’ and his challenge to ‘the community of scholarship … to robustly defend the university tradition’ is very real. This challenge to the university in the physical campus should raise concerns around the perhaps greater challenges that will arise in the virtual campus. The protection of academic freedom is equally important in both environments.

Yet, much of the technological development required to support affordable VR is being done by corporate entities. Many are young entrepreneurial start-ups with brilliant thinkers at the helm and who, with support from powerful venture capitalists, are capable of breaking previous technological and social boundaries to bring new and exciting products to the market. Others operate within the powerful global corporations that have dominated IT for decades. All recognise the opportunities in this space and are seeking the potentially significant rewards that are likely to be won by those who are successful. Giving such tech billionaires unbridled opportunities to influence the future direction of society has its dangers. Many exhibit questionable notions about the needs of society and exploitation of their fellow human beings. John Carmack, former CTO of Oculus (before the company was bought by Faceboook, now known as Meta) said during an interview in 2020 'People react negatively to any talk of economics, but it is resource allocation. You have to make decisions about where things go. Economically, you can deliver a lot more value to a lot of people in the virtual sense' (Gault, 2021). To hear an influential developer suggest that VR is under consideration as a solution to dwindling natural resources in the real world should set the warning bells ringing extremely loudly. The head of gaming company Valve Corporation, Gabe Newell, was even more explicit when he spoke about the development of brain computer interfaces (BCIs) during an interview in New Zealand and discussed 'the near-future reality of being able to write signals to people's minds – to change how they're feeling or deliver better-than-real visuals in games'. He went on to suggest that BCIs 'will lead to gaming experiences far better than a player could get through their *meat peripherals* – as in, their eyes and ears'. If that isn't enough to cause grave concern he adds that it will soon be possible to edit feelings digitally saying the benefit 'could be the reduction or total removal of unwanted feelings or conditions from the brain, for therapeutic reasons'. The company is contributing to projects developing synthetic body parts in exchange for 'access to leaders in the neuroscience field who teach us a lot' (Appleby, 2021). This is a long way from producing games to amuse teenagers, and it demonstrates the ambitions of a wealthy elite that acknowledges the global crisis but envisages different solutions for the rich and the poor.

Given concerns about the decline in the nature of the university as a place of independent learning and the alarming views of those developing VR technology it seems incumbent on Higher Education to tread carefully when engaging with this new technological paradigm, despite the promise of great potential. Several contenders can lay claim to the epigram 'you are not the customer; you are the product', but O'Reilly (2017) concluded on investigation that the notion originated in the latter half of the twentieth century and was first articulated by artists Richard Serra and Carlota Fay Schoolman in 1973. It has taken on darker connotations in the online digital realm where considerations of privacy, protection of data, respect for identity and control of access are already the dominant concerns. The cavalier approach of global corporations to private and personal data as exhibited by Facebook, Google and Amazon for example, is a matter of public

record. Following the decision made by Twitter to ban Donald Trump from its platform after the attack on the US Capitol in January 2021 there was a perceptible twist in the public discourse. Despite the concern around Trump's abuse of the forum – causing offence, promoting lies and condoning violence – the question now shifts to whether or not Twitter is entitled to exclude any opinion, no matter how heinous. Surely, free speech is a fundamental principle that must be respected above all else? After all, the very company that had facilitated Trump for many years now appeared to be displaying extreme censorship? Was it attempting to act in the public interest or simply protecting its own commercial interests? Alizadeh et al. (2021) argue that content moderation is not merely a technical issue, it is also a political issue 'which has become increasingly contested due to its significant consequences for democratic accountability and civil liberties'.

It is important for the future of society that debate around the development of any new technology is fostered and encouraged. Marshall McLuhan's thinking around 'electric media' and technology in general has been summarised pithily: 'we shape our tools and thereafter our tools shape us' (Culkin, 1967: 51–53, 71–72). VR is already shaping our future society, and its potential impact on education requires particular scrutiny. Arising from our experience developing projects and teaching in VR, we believe it is important to propose some fundamental principles that need to be considered in the development of VR education. Informed by the writing of Eck, Maalouf, Glissant, De Sousa Santos and others, moving away from the habitual thinking dominant in the Western approach to knowledge creation opens new opportunities that can support this development.

1 Identity and Entitlement

Sir John Strachey, an English civil servant speaking of India at the University of Cambridge in 1888, claimed that 'there is no such country'. He was expressing the Victorian belief employed to justify the continued occupation of the continent as part of the British Empire (Eck, 2012: 106). It was, of course, expedient to exalt the nation-state as a natural, rather than a constructed, reality. Eck (2012) explains that 'through the lens of the nineteenth-century West, a lens ground to bring to focus a particular political conception of the nation-state, 'India' did not exist'. This attitude remains a powerful and influential idea in the Northern Hemisphere almost a century and a half later. However, India's diversity and capacity for multi-layered complexity along with a refusal of singularity seems contemporary and even more relevant in today's world than it might have been then. This is reflected in Maalouf's (1996: 2) description of personal identity as an equally complex conjugation: 'so am I half French and half Lebanese?

Of course not… I haven't got several identities: I've got just one, made up of many components in a mixture that is unique to me, just as other people's identity is unique to them as individuals.' The entitlement of identity is a fundamental right. It is the first principle to be encoded in a VR ecosystem for education.

2 The Right to Opacity

In *Poetics of Relation Glissant* (1997) demands the right of the oppressed to opacity in order to counteract the one-way transparency imposed by colonialism. He argues that the theory of difference is invaluable because it made possible 'the rightful entitlement to recognition of the minorities swarming throughout the world and the defence of their status'. Adding, however, that 'difference itself can still contrive to reduce things to the Transparent', he concludes the problem arises from the lens of Western thought: 'in order to understand and thus accept you, I have to measure your solidity with the ideal scale providing me with grounds to make comparisons and, perhaps, judgements. I have to reduce … I admit you to existence, within my system. I create you afresh.' Therefore we must 'agree not merely to the right to difference but, carrying this further, agree also to the right to opacity'. He reasons that the 'opaque is not the obscure … it is that which cannot be reduced' (Glissant, 1997: 189–190). The 'othering' of the colonised, the dehumanisation of the enslaved, are based on the lens of exploitation and denial of any alternative 'reality'. Without a recognition and acknowledgement of this there cannot be an honest conversation and the notion of transparency is rendered ridiculous.

The entitlement to opacity is the second principle to be encoded in a VR ecosystem for education.

3 Communities of Practice

Developing the BA in Visual Art with, and for, an island community off the south-west coast of Ireland at the turn of the last century the team identified three pillars during the initial discussions: partnership; relevance and sustainability (O'Connor, 2001). The first, partnership, is the most important because it was predicated on equality between the university and the community. The success of the programme was predicated on the recognition that each partner has access to knowledge that is valuable to the other. For instance, at its most basic level, the university brings curriculum expertise while the island community understands the art of survival in adverse conditions. The understanding that isolated communities are resources of knowledge was recognised by Norberg-Hodge (1992: 5) who proposes that cultures like that of Ladakh, in the northern Indian Himalayas, can point the way towards a 'sustainable balance – a balance between urban

and rural, male and female, culture and nature'. A community of practice (Wenger, 2010) evolved from the partnership between the university and the island and provided support for the project, nurturing and nourishing its continuing development.

De Sousa Santos (2016) identifies the 'global South' as 'a metaphor for the human suffering caused by capitalism and colonialism on a global level'. Not only located in the southern hemisphere this global South exists in the geographic north in isolated, excluded and silenced communities. 'The problem is that after five centuries of 'teaching' the world, the global North seems to have lost the capacity to learn from the experiences of the world. In other words, it looks as if colonialism has disabled the global North from learning in non-colonial terms' (De Sousa Santos, 2016: 18–19) and therefore is unable to allow for the existence of any knowledge other than the 'universal' knowledge of the West. He suggests that these epistemological differences have resulted in an 'abyssal line' which reinforces the problems identified with the Anthropocene.

The end of the Gutenberg Parenthesis (the era of the printed word) has compounded this contemporary babelisation, ushering in the metamodernist era where, to be fluent, we now have to be metaliterate (Hill, 2020). Participation in digital (and therefore virtual) culture requires the ability for informed, reflective and critical thinking. Acceptance of diverse forms of knowledge on an equal basis to support communities of learning and communities of practice is the third principle to be encoded in a VR ecosystem for education.

4 Open Source and Freedom of Access

Concerns about the threat to academic freedom and the tradition of the university lead to a legitimate suspicion of the corporate sector in the development of VR for education; however, it should not be the goal to exclude the sector. Purdue University and its VR technology partner Kitware developed an immersive learning programme for nursing students using the Oculus Quest HMD to produce an affordable and effective training experience. Both agree that 'open source software naturally supports a service business model' because it enables others to take advantage of the software platforms and avoids vendor lock-in. 'While Kitware encourages open source software, data sharing, and open access publication whenever possible, the company also respects the need for proprietary solutions due to competitive, privacy, security, and regulatory restrictions' (Kiggins, 2020). Such an approach would appear to be most appropriate for the Higher Education sector, and further research into possible structures around this type of collaboration are to be encouraged. Nevertheless, Open Source and freedom of access is the fourth principle to be encoded in a VR ecosystem for education.

5 Impact on the Biosphere

The clean and pure environments most commonly presented in VR can mask some disturbing facts. According to writer, artist and technologist James Bridle (BBC, 2019) 'Computer systems draw a huge amount of energy. Already it's estimated that computer use around the world is responsible for more greenhouse gas emissions than the entire airline industry'. This means that the server farms springing up around the world to support cloud computing, including our access to virtual worlds and VR, is having as significant an impact on the physical environment as if we were flying to these locations. As the technosphere continues to encroach on the biosphere, exhausting the planet's ability to renew the resources needed to support human life, the inevitable conclusion has been clear for some time. The 'World Scientists' Warning to Humanity' (Ripple et al. 2017) bluntly states that 'We are jeopardising our future.' A responsible and accountable approach to sustainability is the fifth principle to be encoded in a VR ecosystem for education.

Conclusion

Academics experimenting with VR technologies for any length of time will be familiar with the practical issues arising when attempting to harness them for teaching and learning. While it became clear during the pandemic that remote learning has earned its place on the curriculum, arguably this has been a greater revelation to those engaged in the practice-based disciplines where physical activities in workshops, labs and studios are a fundamental part of the educational experience. At this time, lecturers and students had no choice but to experiment with new approaches and develop appropriate practices as required (Alsuwaida, 2022).

The Virtual Archipelagic programme is an example of such experimentation, where virtual worlds enabled a relational space for communication and dialogue around the study of contemporary environments at a time of climate transition. Within this, the Virtual Archipelago also provided a contextual space in which to ask critical questions about the politics of technological development (techno-genesis), and the geo-politics of centre–periphery relations, as they become increasingly destabilised and fragmented by the Anthropocene (Pugh & Chandler, 2020). More specifically, it provided a novel context for students to explore the possibilities of creative work and creative time during a period of radical isolation and a space for educators to begin to develop educational questions around educational problems, through virtual reality. In the Virtual Archipelago those questions concerned the role relationality, embodiment and creativity in digital education, but many more questions have also emerged around the systems and structures underlying our engagements with virtual reality in education.

History has taught us how technical apparatuses can be powerful tools to break down educational disadvantage and exclusion (Weinbren, 2014), however, it has also taught us that problems can arise from many quarters. With regards to the use of advanced digital technologies in educational settings, particularly Virtual Reality, there are a number of emerging threats: security issues with accessing networks on a university campus; attempts to convince cautious finance departments to fund the investment in technology; addressing governance policies and procedures that were not written with this technology in mind; concerns around General Data Protection Regulation (GDPR); academic quality assurance and so on. All of this points to a clear need for applications that will satisfy the particular requirements of universities and consequently, the next stage of development within this research.

References

Alsuwaida, N. (2022) Online Courses in Art and Design During the Coronavirus (COVID-19) Pandemic: Teaching Reflections From a First-Time Online Instructor. *SAGE Open* 12(1).

Appleby, L. (2021) Gabe Newell says brain-computer interface tech will allow video games far beyond what human 'meat peripherals' can comprehend. *1 News*. Available at: https://www.1news.co.nz/2021/01/25/gabe-newell-says-brain-computer-interface-tech-will-allow-video-games-far-beyond-what-human-meat-peripherals-can-comprehend/

Alizadeh, M., F. Gilardi, E. Hoes, K. Klüser, M. Kubli & N. Marchal (2021) Content Moderation As a Political Issue: The Twitter Discourse Around Trump's Ban. Department of Political Science Research Working Paper, University of Zurich. Available at: https://fabriziogilardi.org/resources/papers/content-moderation-twitter.pdf

Badiou, A. (2006) *Being and Event*. Trans. O. Feltham. New York: Continuum Press.

Bridle, J. (2019) *Cybernetic Forests*. [podcast] New Ways of Seeing. Available at: https://www.bbc.co.uk/sounds/play/m0004sdb

Chalmers, D. (2022) *Reality+: Virtual Worlds and the Problems of Philosophy*. UK: Allen Lane.

Crutzen, P. & E. Stoermer (2000) The 'Anthropocene'. *Global Change* News l 41.

Culkin, J. (1967) A Schoolman's Guide to Marshall McLuhan. *Saturday Review*.

De Sousa Santos, B. (2016) Epistemologies of the South and the Future. *From the European South* 1.

De Sousa Santos, B. (2018) *The End of the Cognitive Empire: The Coming of Age of Epistemologies of the South*. Duke University Press.

Edwards, L.E. (2015) What is the Anthropocene? *EOS*. Available at: https://eos.org/opinions/what-is-the-anthropocene

Eck, D. (2012) *India: A Sacred Geography*. New York: Crown Publishing Group.

European Geosciences Union (EGU) (2022) Available at: https://web.archive.org/web/20211023164844/https://www.egu.eu/awards-medals/portrait-vladimir-ivanovich-vernadsky/.

Freisin, N. (2018) *The Textbook and the Lecture*. Baltimore: Johns Hopkins University Press.

Gault, M. (2021) Billionaires See VR as a Way to Avoid Radical Social Change. *Wired*. Available at: https://www.wired.com/story/billionaires-use-vr-avoid-social-change/

Glissant, É. (1997) *Poetics of Relation*. Translated by B. Wing. Michigan: University of Michigan Press.

Glissant, É. (2009) *Philosophie de la Relation: Poésie en étendu*. Gallimard.

Hill, V. (2020) *Metamodernism and Changing Literacy: Emerging Research and Opportunities*. USA: Texas Woman's University.

Higgins, M. (2021) On Academic Freedom. *Academic Freedom and Intellectual Dissent*. Available at: https://president.ie/en/diary/details/president-addresses-conference-on-academic-freedom/speeches

Kiggens, J. (2020) Using the Pulse Engine to Bring Patients to Life for Immersive Learning. *Clinic Immersives by Purdue Global University.* Available at: https://clinicimmersivesbypg.com/blog/using-the-pulse-engine-to-bring-patients-to-life-for-immersive-learning

Maalouf, A. (1996) *In the Name of Identity*. London: Penguin Books.

Merleau-Ponty, M. (2012) *Phenomenology of Perceptio*n. Trans D. Landes. London and New York: Routledge.

Myklebust, J.P. (2020) Legislation on Academic Freedom Set to Be Strengthened. *University World News*. November 7. Available at: https://www.universityworldnews.com/post.php?story=20201107080157547

Newall, M. (2019) *A Philosophy of the Art School*. London and New York: Routledge.

Norberg-Hodge, H. (1992) *Ancient Futures – Learning from Ladakh*. San Francisco: Sierra Club Books.

O'Connor, J. (2001) Sherkin Island Art Degree Project. *Rural Issues in Higher Education*. Cork: Higher Education Equality Unit.

O'Connor, J. (2020) Class 1: Welcome to Second Life. V*irtual Environments: Is One Life Enough?* Available at: https://virtualenvironmentsmodule.com

O'Reilly, T. (2017) You're Not the Customer; You're the Product. *Quote Investigator*. Available at: https://quoteinvestigator.com/2017/07/16/product/#more-16480

Pugh, J. & D. Chandler (2021) *Anthropocene Islands: Entangled Worlds*. London: University of Westminster Press.

Purdue University (2020) Virtual Patient Modeling with the Pulse Physiology Engine Transforming the Immersive Learning Enterprise for Nurse Practitioner Clinical Skills. Available at: https://www.incitevr.com/research/pulse.pdf

Ripple, J., C. Wolf, T. Newsome et al. (2017) World Scientists' Warning to Humanity: A Second Notice. *BioScience* 67(12): 1026–1028.

Stiegler, B. (1998) *Technics and Time, 1: The Fault of Epimetheus*. Trans. by G. Collins and R. Beardsworth. Stanford: Stanford University Press.

Stiegler, B. (2018) *Neganthropocene*. Trans. D. Ross. Open Humanities Press.

Steigler, B. (2020) Archipelagic Territorial Laboratories for a Politics and an Economy of Life Forms. *Etica & Politica/Ethics & Politics*, XXII(2): 9–17. Real Smart Cities [collected] Special Edition.

Suess, E. (1875) *Die Entstehung Der Alpen* [The Origin of the Alps]. Vienna: W. Braunmuller.

Tansley, A. (1935) T*he Use and Abuse of Vegetational Concepts and Terms*. US: Wiley (On behalf of the Ecological Society of America). Available at: https://www.jstor.org/stable/1930070?seq=16#metadata_info_tab_contents

Weinbren, D. (2014) *A History of the Open University*. Manchester: Manchester University Press.

Wenger, E. (2010) Communities of Practice and Social Learning Systems: The Career of a Concept. In C. Blackmore (ed.) *Social Learning Systems and Communities of Practice*. London: Springer.

Wiedorn, M. (2021) On the Unfolding of Édouard Glissant's Archipelagic Thought. *Karib – Nordic Journal for Caribbean Studies*, 6(1): 3. https://www.karib.no/articles/10.16993/karib.82/

Chapter 9

Climate Change for a Change in Architectural Education

Evaluating the Curricula

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Abstract

Responses to climate emergencies need to be implemented in the global economy and should be reflected in lifestyle, public administration and legislation, norms, and ethics. Even in the short term, the reflection of principles and technologies is essential in education provided by universities worldwide. In the construction sector, architects must become – as should all professionals involved in conception and design – the promotors and implementers of measures to counter climate change. However, does architectural education have an efficient way of offering climate change mitigation tools as a main ingredient of the basic education of new graduates?

In answer to this question we intend to analyse our faculty curricula. We will identify those disciplines that in their content already make reference to climate change, either directly or indirectly. This is a self-case study, a selfie for climate change. We also intend to identify and classify the disciplines from the curricula according to their capacity and role in accommodating climate change issues. We will look at the theoretical and practical courses as well. As a result of this investigation, we will organize a matrix of potential disciplines to address climate change on different levels. Based on the analysis we will elaborate a potential chart and a plan for updating the curricula for a complete reaction to climate change issues addressed in the field of architecture. This will be both a survey and a plan. The result targets a value for our faculty strategy, for our university use and assessment, and for the EUT + Consortium.

As a method, we structure the research into six parts: building the research team and setting the principles; analysis of the existing curricula by content; establishing the potential by discussion with each discipline responsible; elaboration of the matrix of climate change related disciplines; conclusions and recommendations; extracts and examples. It combines desk top research analysis by the research team as well as individual interviews with professors, and group discussions with professors and students. A database with references, bibliography and case studies will be built to be used as a result product of the research.

The purpose of this exercise is to improve education for sustainability and also to initiate and perform a collective reflection on this key issue for our contemporary world.

Keywords: architecture education; climate change; education strategy

Introduction to the General Context of Climate Change

For decades climate change has been a hot topic studied scientifically to a high degree. Legislative and governmental forums search out answers and elaborate measures regarding this subject. Climate change generates an array of problems and hence a unitary direction is required with clear strategies. The Kyoto Protocol, for example, is a convention targeting measures for monitoring and limiting greenhouse gas emissions (United Nations, 1992).

In addition to the Kyoto Protocol, the Copenhagen Agreement, an international convention, accommodates a series of applied and clear measures on types of interventions that meet the problems generated by climate change. The Paris Agreement requires that each country establish strategies on defined terms to reduce greenhouse emissions. Through the Paris Agreement (2016) the need for worldwide public implication is brought to light to meet climate change. This a landmark in the multilateral climate change process because, for the first time, a binding agreement brings all nations together into a common cause, to undertake ambitious efforts to combat climate change and adapt to its effects (Paris Agreement, 2016). Also, the 13th UN Sustainable Development Goal (2015) regarding climate change impact proposes targets to be followed, such as strengthening resilience to natural disasters and climate-related hazards; reducing greenhouse gas emissions per year; adopting sustainable development education topics in national education policies, etc.

Beyond the bounded international and national governmental measures, situations triggered by climate change involve and mobilize people; they cause individual reactions and cause different authorities and professional groups to work together towards a specific climate change-related problem. In the architecture and construction sector, one such imposed and well-known mechanism is the Energy Performance Certificate that confirms a building's energy efficiency. Instruments and criteria based on the materials used, specific details and technical installations considered in the design process are some of the tools available to the architect to achieve energetically efficient buildings and built interventions.

Architecture–Nature Relationship – Implications in the Education Framework

The climate context is constantly changing. As architects, facing this dynamic state of climate change, we must adapt. In the balance between the permanence and ephemerality of the human and natural environment relationship, all the unpredictable situations caused by climate changes generate problems to which architecture as a synthesis profession must be able to respond.

In this context, if we look at Chomsky's (2019) thinking on the global state of affairs, the permanence of the planet through its straightforward changing climate, the continuous extraction and trading of resources (fossils, forests, various minerals), sources

of pollution (from industry, technology or nuclear weapons) are in counterpose with the economic and political ephemerality. The short-term vision governed by profit and consumerism is thus in conflict with the long-term vision of protection, regeneration, transformation, and proliferation of resources. Resource exploitation to meet a certain lifestyle is outdated and the present challenges us to bring forward new solutions that will generate life without compromising the wellbeing of the planet and humanity. Industrialization, mass production, and availability of resources and technology have allowed internationalization of standards, uniformization of conditions, and equality of access (Moore, 2021). This determined a circular economy of consumption, resulting in damaged ecosystems of the planet and people.

Architecture as a profession exists in an economic-political context and architects are well grounded in this reality. Preoccupations for architecture adaptation, inclusion and integration in nature are explored in-depth in the architectural profession; see, for example, architecture designed and integrated in nature, nature integrated in architecture, or architecture imitating nature. From early vernacular examples to more recent biophilic attitudes integrated into architecture, the overall attitude towards nature and climate has been very different. Although this paper does not further focus on this subject, we must observe that, in this close relationship – Nature and Climate in constant change; Architecture and Nature – it is clear that Architecture (as part of this relationship) must adapt while maintaining a continuous, dynamic and open process. Examples taken up in the next section emphasize several clear and coherent approaches.

> In the face of these responsibilities and professional assumptions, what is the attitude of architecture education? This is a question that triggers this short study.

In a general international effort, the Faculty of Architecture and Urbanism (FAU) at Cluj-Napoca is taking a step forward and defining its position. Using this research, we look at our educational perspective and aim to define an attitude toward the threats posed by climate change. We also formulate possible actions and measures to be discussed from a position of awareness regarding climate change-related issues. However, before referring to the case study of FAU Cluj-Napoca curricula, the implications of climate change in Architecture education are intensively questioned at an international level. The Arch4change consortium is a project that aims to develop a coherent approach regarding the integration of sustainability knowledge into the teaching culture in Architecture curricula (Arch4change Project summary). This consortium, involving several Architecture Schools (Aarhus School of Architecture, Denmark; Bologna University, Italy; Taltech, Estonia; Tampere University, Finland and TU Dublin, Ireland), started in 2020 and developed several activities that are intended to lead to new ways of teaching and learning sustainability. Furthermore, the project aims to link the climate change-related knowledge and competencies learned in Architecture Schools to the ambitious goals of designing and building nearly Zero Energy Buildings and other international and national commitments. Another example of an education statement on the subject of climate change issues is the Climate Framework signed by several Higher Education Institutions in Sweden, among them KTH Royal Institute of Technology. All these institutions, following research on climate change, developing of solutions that will contribute to reduction of the emission of greenhouse gases, education and communication (Climate Framework for Higher Education Institutions – Guidelines) adopt different measures to be in line with the 1.5°C target of the Paris Agreement.

In this context, looking toward architecture education in Romania, at the FAU Cluj-Napoca, in a more focused manner, is interested in observing how specific preoccupations targeting climate change topics and sustainable approaches are developed (in a more intuitive or straightforward manner) and how and where we could further explore more of these topics.

The Architects' Profession in the Climate Change Context

In order to better understand the present context, let us observe some of the key moments that boost the exploration of the subject within the profession.

From the very beginning, we want to emphasize the role of the architect in this context, as a voice that has the potential to generate ideas, and to seek complementary solutions to the other professions involved. Following on from the above, architects are taking a position. For example, the renowned architect Norman Foster chooses to make a statement through the approach in his practice of mediating the social, economic, and technological in tackling global problems. The architect envisions sustainable architecture as a widespread practice in the future (Tureanu, 2020: 54). Italian architect Stefano Boeri is active in promoting conscience living by architectural biodiversity and keeping a well-grounded relationship between humans and other species. The

prototype project 'Vertical forest' brings together technology and nature. The concept behind the project is to create a 'home for trees that also houses humans and birds' (Boeri). But these are not recent preoccupations. In the 1960s–1970s, climate change discussions became more visible to the public eye. One example is the publication of the book *Design for the Real World: Human Ecology and Social Change*. First published in 1971, this book had a major impact on education, and has continued to do so for over 50 years. *Design for the Real World* is one of the compulsory titles in the bibliographies of many design universities. Papanek, an industrial designer and teacher, has given numerous courses and presentations in universities and professional environments; through his lectures and writings, his massive critique of consumerism and its impact on the environment and society, he has had a major influence on designers of the period and many others. In architecture, interest in metabolic architecture, organic architecture, or the utopias created by prolific artistic groups such as Archigram have developed some possible answers to alarming and concerning situations.

In terms of emergency responses to natural disasters, architect Shigeru Ban is widely known for his examples of temporary shelters and reconstructions in Japan, Rwanda, India, China, in the aftermath of earthquakes and tsunamis. Throughout his work, he showcases the relationship between human nature and the natural environment, designing with both traditional and contemporary techniques. Nowadays, large architecture companies with prominent figures are influencing and setting trends in architecture. Therefore, an environmental and humanistic approach at this level in architecture, small and large scale, is important for a global mindset.

Architecture in the Climate Change Context – Defining Criteria

After looking at all these examples where architecture as a profession has conducted research and formulated possible answers to the challenge posed by climate change, we can ask ourselves what might be the defining tools of this profession that could impact on and lead to some possible answers to the problems related to climate change?

We thus define and discuss four vectors/criteria that determine the profession of architecture in the current context of climate change issues.

First vector: adaptability. To a dynamic and ever-changing close context, architects react; the profession thus must be capable of adaptation. In terms of spatial design, orientation strategies, building orientation, window disposition, and space configuration of any kind of architecture, all these are instruments wherewith the architects operate to achieve optimal placement in the environment and the given conditions.

The second vector: inter-disciplinarity. It is necessary for an inter-domain communication to exist (architecture/installations/engineering/geography/geology/economy). Given the complexity and increasingly ambitious climate actions that are carried out by countries, a consistent and continuous inter-professional communication must exist.

The third vector: education and dissemination. Adaptability and communication between domains can be emphasized at the faculty level, but they must transcend the boundaries of academia in order to become known and integrated within the entire population. Thus, an objective of the academic environment may be to be more open and transparent to the population. Conferences, symposia, scientific communications are limited to the educational environment; through networking and more visibility, there could be a bigger impact on the general interested public. For example, the implications of research during the COVID-19 pandemic, with a previous greater visibility, could have been more credible to the public. The more credible the research and its results transmitted to the public, the better the public's understanding of the message. Therefore, the more the public and scientific community find a middle ground for understanding, the more scientific knowledge prevails in the public realm.

The fourth vector: network inter-connectivity between various domains and institutions. If all fields and institutions are related, information can flow from the researcher to the farthest points, to the public; and also in the opposite direction (from the farthest points to researchers, in larger studies). In this way, a massive phenomenon as climate change could be mastered. Otherwise, various measures adopted locally have no major impact, they remain just experiments.

In conclusion, all these four key features that Architecture has as a profession are developing around its core specific – education. In university, education and network inter-connectivity can be very well correlated. In the process of training – and educating the future architect, the problem must be correlated with the perspective of the future profession and its social or economic implications. This is why this auto-analysis of our own curricula is so important.

Faculty of Architecture and Urbanism Cluj-Napoca: An Auto-Analysis Regarding the Climate Change Topic

The second part of this paper follows the issue of climate change and the way it is approached within the disciplines of the FAU curricula. First of all, a very short presentation of the specific education in Romania (FAU implicitly) is necessary. The program study is an integrated Bachelor and Master (six years of study). The

final examination is a Diploma Project and a theoretical paper, the Dissertation. After graduating, two years of compulsory practice experience are required before registration. A regulated profession – by law, architecture is certainly a profession that can have a strong implication in our responses to climate change problems.

The research methodology used in this paper has three steps: a 1st stage – the desktop research; the 2nd stage – a deep content auto – analysis; and the 3rd stage – the measures. All disciplines in the FAU curricula were divided into three categories:

- O disciplines with no connection to climate change issues
- R disciplines with references to climate change issues
- A disciplines with advanced content dedicated to climate issues of integrated practice

These notations (O, R, A) can be read in the following tables that highlight each year of study. Two layers of analysis were created: the current situation and the potential response of several disciplines toward the climate change issue. While assigning the R potential (disciplines with references) and the A potential (advanced related content) we also kept in mind a gradual progression, so that the content of disciplines change in a rather natural way: we studied disciplines that could evolve from O potential to the R potential and disciplines with the R potential that can evolve to the A potential.

1st year	credits	evaluation	potential
1. Mathematics	2	O	O
2. History of Architecture. Antiquity	2	O	R
3. Introduction to Theory of Architecture	2	R	A
4. Elements of Environment	2	A	A
5. Descriptive Geometry	3	O	O
6. Form Study 1	2	R	R
7. Architecture Design Studio 1	13	O	R
8. Foreign Languages 1	2	O	R
9. Sports 1	2	O	O
10. Perspective	3	O	O
11. History of Architecture. Middle Age	2	O	R
12. Evolution of the City	2	R	A
13. Building Materials	2	O	A
14. Form Study 2	4	O	R
15. Architecture Design Studio 2	11	R	R
16. Sports 2	2	O	O
17. Architectural Practice 1– architecture survey	2	O	O
	60	4R/1A	7R/4A

Figure 9.1. Faculty of Architecture and Urbanism – 1st year of study (disciplines table/graphs analysis)

Two measurements were done: (1) by number and percentage of disciplines in the curricula and (2) by number and percentage of credits per year of study and overall. These measurements can be read in the graphs that follow the tables previously mentioned.

In the 1st year of study there are 5 (4R/1A) disciplines that have references to climate change issues. Among them, Elements of Environment is a discipline with advanced content dedicated to climate issues (A). The potential analysis (the second line of the graph) shows that 11 disciplines could be more closely related to this problem. Some disciplines, such as Building Materials, could even be dedicated to the subject.

2nd year	credits	evaluation	potential
18. History of Architecture. Renaissance and Baroque	2	O	R
19. Evolution of the City	2	R	A
20. Computer Aided Design	2	O	O
21. Building Elements	4	O	R
22. Geometry of Architectural Forms	2	O	R
23. Mechanics	4	O	O
24. Design Basics 1	2	O	R
25. Architecture Design Studio 3	12	R	A
26. Urban Residential	2	O	R
27. Theory of Architecture – housing	2	O	R
28. Design Basics – Urbanism	2	O	R
29. Architectural Details 1	3	O	R
30. Art History	2	O	O
31. Design Basics 2	2	R	R
32. Architecture Design Studio 4	14	R	A
33. Architectural Practice 2	3	O	R
	60	4R/0A	10R/3A

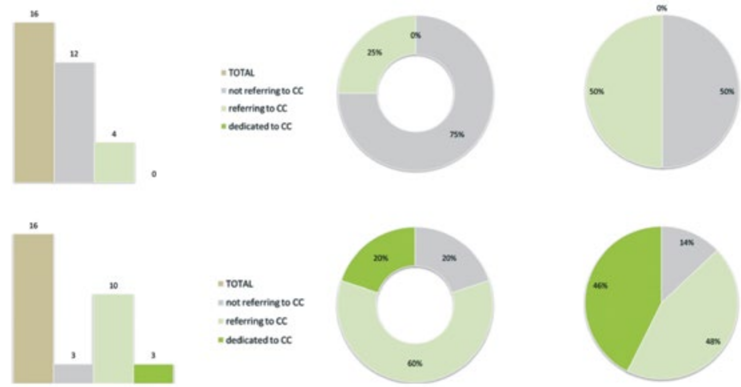


Figure 9.2. Faculty of Architecture and Urbanism – 2nd year of study (disciplines table/graphs analysis)

In the 2nd year of study there are 4 (4R/0A) disciplines that have references (R) to climate change issues, but none of them has content dedicated to these climate issues. The potential analysis shows us that 13 disciplines could be more closely related to this problem, and some disciplines such as the Architecture Design Studio in both semesters could be dedicated to the subject. By comparison, the Architecture Design Studio in the 1st year of study can have some references (R) to climate change-related issues, while the Studio in the 2nd year could evolve towards becoming a discipline with advanced content dedicated to climate issues. In the following years of study, this core discipline – the Architecture Design Studio – could become a discipline with advanced content dedicated to the climate issues, while the complexity of architectural programs and how to approach the associated problems of climate change would evolve.

3rd year	credits	evaluation	potential
34. *Global and Local in Architecture*	2	O	R
Perception and Configuration of Space	2	O	O
35. Theory of Structures	2	O	O
36. Furniture Styles	2	O	O
37. Specialized Design – Urbanism	4	R	A
38. Architecture Details 2	4	R	A
39. History of Architecture. XIX Century	2	O	R
40. Ecological Architecture	2	A	A
41. Architecture Design Studio 5	12	R	A
42. *Traditional Furniture*	2	O	R
XXth Century Furniture		O	(R)
Furniture		O	(R)
43. Theory of Structures 2	3	O	O
44. Building Services	2	O	A
45. History of Architecture. Modern and Contemporary	2	O	R
46. Architectural Programs	2	O	A
47. Specialized Design – Furniture	2	O	O
48. Architecture Design Studio 6	14	R	A
49. Architectural Lighting	2	A	A
50. Architectural Practice 3	3	O	R
	60	4R/2A	5R/8A

Figure 9.3. Faculty of Architecture and Urbanism – 3rd year of study (disciplines table/graphs analysis)

In the 3rd year of study there are 6 (4R/2A) disciplines that have references to climate change issues; with the theoretical courses of Ecological Architecture and Architectural Lighting being dedicated to climate issues. We can thus see that there are disciplines that approach the ecological key issues in a clear, targeted program. The potential analysis shows us that 13 disciplines could be more closely related to this problem, and the Architecture Design Studio in both semesters could be dedicated to the subject. The theoretical course, Building Services, could also be dedicated to this topic.

4th year	credits	evaluation	potential
51. *Parametric Design*	2	O	R
Ambiance Design		O	(R)
Architectural Design		O	(R)
52. History of Architecture in Romania	4	O	O
53. Theories and Doctrines	2	O	R
54. Sociology	2	O	R
55. Interior Architecture	2	O	R
56. Interior Architecture Design	2	O	R
57. Specialized Design – Structures and Services	3	R	A
58. Architecture Design Synthesis Studio 1	13	R	A
59. *Special Structures*	2	O	R
Pathology and Therapy of Buildings		O	(R)
Rehabilitation of Historical Structures		O	(R)
60. *Urban Composition*	2	O	R
Urban Structures		O	(R)
Digital Fabrication		O	(R)
61. Restauration of Monuments	2	O	R
62. Theory of Structures 3	4	O	O
63. Construction Phisics	2	R	A
64. Specialized Design – urbanism 2	2	O	R
65. Architecture Design Synthesis Studio 2	13	R	A
66. Architectural Practice 4	3	O	R
	60	4R/0A	10R/4A

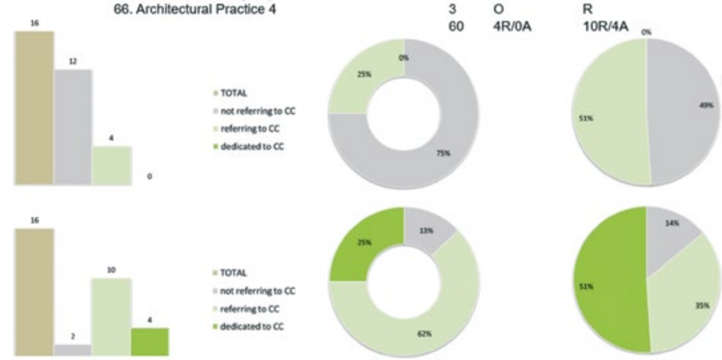


Figure 9.4. Faculty of Architecture and Urbanism – 4th year of study (disciplines table/graphs analysis)

In the 4th year of study there are 4 (4R/0A) disciplines that have references to climate change issues – the Specialized Design Studio (Structures and Services), both Architecture Design Studios and the Construction Physics theoretical course. The potential analysis shows us that 14 disciplines could be more closely related to this problem; a number that indicates that most of the disciplines in this year could be related more to this topic.

5th year	credits	evaluation	potential
67. *Contemporary City*	2	R	A
Strategies for Human Settlements		(R)	(A)
Urban Strategies and Politics		(R)	(A)
68. *Arts and Architecture*	2	O	O
Psychology of Forms		O	O
Anthropology and Cultural Psychology		O	O
69. Urban Laws and Management	2	O	R
70. Architectural Composition	2	O	O
71. Landscaping	2	O	A
72. New Technologies in Architecture	2	R	A
73. Specialized Design – Urbanism 3	4	R	A
74. Architecture Design Synthesis Studio 3	14	R	A
75. *Urban Mobility*	2	R	A
Urban Regulations		(R)	(A)
76. *Architecture Aesthetics*	2	O	O
Historical Programs		O	O
Compared Architecture		O	O
77. Research in Architecture	2	O	O
78. Marketing and Communication in Architecture	3	O	R
79. Urban Ecology and Utilities Networks	2	A	A
80. Specialized Design – Landscaping	2	R	A
81. Architecture Design Synthesis Studio 4	14	R	A
82. Architectural Practice 5	3	O	R
	60	7R/1A	3R/9A

Figure 9.5. Faculty of Architecture and Urbanism – 5th year of study (disciplines table/graphs analysis)

In the 5th year of study there are 8 (7R/1A) disciplines that have references to climate change issues – this is the year that currently has the biggest numbers of disciplines related to this topic. This year's curriculum develops the sustainability subject in a detailed manner, in the framework of contemporary city, urban ecology and new materials in architecture. Some 12 disciplines could be more closely related to this problem, as shown in the potential analysis. Among them 9 could highlight an advanced content dedicated to climate issues of integrated practice – for example: Landscaping, Specialized Design – Urbanism 3, Urban Mobility, etc.

6th year			
83. Practice in Design Studios	22	O	R
84. Architecture Design Synthesis Studio 5	6	R	A
85. Foreign Languages	2	O	O
86. Administration and Public Relations	2	O	R
87. Dissertation elaboration	14	O	O
88. Diploma Project elaboration	14	O	A
89. Consultancy for Technology and Structures	2	O	A
	60	1R/0A	2R/3A

Figure 9.6. Faculty of Architecture and Urbanism – 6th year of study (disciplines table/graphs analysis)

In the 6th year of study climate change has an important role in the design theme that underpins the Diploma Project. Each student creates a scenario for the Diploma Project in which, within the building performance, the requirements that emerge regarding the sustainability of the proposal are highlighted from the start. Considering that this year of study is almost entirely dedicated to the Diploma Project and Dissertation, the potential of having several topics related to climate change issues is quite big: for example, the pre-Diploma (Architecture Design Synthesis 5) and the Diploma Project could have a close relation to the topic.

Figure 9.7. Faculty of Architecture and Urbanism – general synthesis graphics

At the end of the six year analysis, Figure 9.7 reveals a general synthesis of the entire curricula. The graphs on the right (the two graphs that refer to the percentage of ECTS credits) are very interesting to observe. Currently, 2% of the total of 360 ECTS credits are associated with disciplines that have an advanced content dedicated to climate issues. The potential analysis shows that 48% of the ECTS credits could be associated with those disciplines. It is shown that the biggest potential of growth is in the 4th and 5th years of study, where 51% and 73% of the ECTS credits can be associated with disciplines dedicated to climate change topics.

Overall, the percentage of credits is better than the proportion of the number of disciplines. This observation is based on the consideration that the practical disciplines, the Architecture Design Studios of each year of study, could become disciplines with an advanced content dedicated to climate issues. The ECTS potential is for 50% to 83% credits referring to climate change issues. The overall potential is from 180 credits to 299 credits out of 360 credits obtained for climate change related disciplines.

Conclusions

After following this FAU curricula auto-analysis from an overview, we can observe that climate change-related topics come out from general to particular discussions. The 1st stage of the research is interesting and it leads to the next stages based on the potential of each discipline in the curricula. The subject is introduced in general terms from the 1st year of study and then develops in specialized contexts from the point of view of ecological architecture or the architecture project as a sustainable response in the face of contemporary challenges. Each approach to the subject is different and the Discipline Sheets highlight these approaches in various ways.

One important idea addressed in this study is that the practical disciplines, the Architectural Design Studio from the 1st year to the 6th year of study could approach themes that highlight the challenges architecture faces with climate change. All the disciplines that are defined as architecture projects could be regarded as exercises of different aspects relevant to the sustainability subject. This subject is tackled sporadically. Programmatically, through the Discipline's Sheets, the subject is discussed from the point of view of acquired competencies, for example 'Design skills necessary to meet building users' requirements within the constraints imposed by cost factors and building Regulations' (UIA, 2017: 6). Usually, a project's themes can concentrate closely on the subject of climate change. In this context, the Diploma Project has a great potential for evaluation for achievements.

An interesting way to work around the subject is by addressing the problematic side of the subject, rather than treating it through the current norms. Currently, in terms of climate change, the professional competencies that students acquire under the imposed norms are the following: 'Adequate knowledge of physical problems and technologies and of the function of buildings so as to provide them with internal conditions of comfort and protection against the climate' (UIA, 2017: 6). This point incites discussion of the problem of sustainable development and the necessity of the architect's response to it by built architecture. In the end, education is not aimed solely at the student, but also towards the larger population from closely or distantly interconnected domains in order to generate change. The capacity for change can and must arise from the educational environment. In the architecture profession and its education changes are imminent and there is constant adaptation to climate change demands.

Those measures that can be considered for a broader approach to the subject of climate change can be discussed on several levels. The first is at the level of the Faculty of Architecture and Urbanism. This level is where several aspects seized as potential issues could be discussed: in terms of the development of skills necessary for educators and students alike to adapt to changed curricula and the assumption of an overall coherent approach that will integrate this direction in terms of content. This internal discussion could then be extended to the level of the university, the Technical University of Cluj-Napoca. The next step in the development of this subject in the educational context would be at the level of the Ministry – a discussion regarding the National Education for Architecture. At the level of the profession, OAR (the Order of Architects in Romania) would be the organization that could discuss this issue in terms of specific regulation; and another possible level of discussion would be at the level of the international consortium – EUT +.

Architecture currently is caught between political and economic stategies. In order to transcend this deadlock it must address its position, and make meaningful choices to attain a renewable and harmonic relationship with the environment.

Bibliography

ARCH4CHANGE (2020) Project summary available at https://www.arch4change.com/wp-content/uploads/2020/08/ARCH4CHANGE-summary.pdf

Boeri, Stefano. Architetti. Available at https://www.stefanoboeriarchitetti.net/

Chomsky, Noam (2019) *Cine conduce lumea?* Bucharest: Carte Pentru Toți.

Conference of Parties (COP 15) (2009) *Copenhagen Accord*, available at https://en.wikipedia.org/wiki/Copenhagen_Accord

Council for Architectural Education (2017) *Architecture Education Charter*, available at https://www.uia-architectes.org/wp-content/uploads/2022/02/Architectural-Education-Charter_2017_english.pdf

FAU (Faculty of Architecture and Urbanism Cluj-Napoca) Discipline Sheets, available at https://fau.utcluj.ro/fisele-disciplinelor.html

KTH Royal Institute of Technology. *Climate Framework for Higher Education Institutions – Guidelines* https://www.kth.se/polopoly_fs/1.929789.1600783144!/191001_guidelines_Klimatramverk_ENG_anp.pdf

MIT (Massachusetts Institute of Technology). *Climate Portal*, available at https://climate.mit.edu/

Moore, Rowan (2021) Architecture: From Prehistory to Climate Emergency Review – How energy shaped the way we built the world, available at https://www.theguardian.com/books/2021/may/24/architecture-from-prehistory-to-climate-emergency-barnabas-calder-review

Papanek, Victor (2018) *Design pentru lumea reală: ecologie umană și schimbare socială* (Design for the Real World. Human Ecology and Social Change, first published 1971). Bucharest: Publica.

Paris Agreement (2016) 196 Parties, COP 21 Paris 2015, available at https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

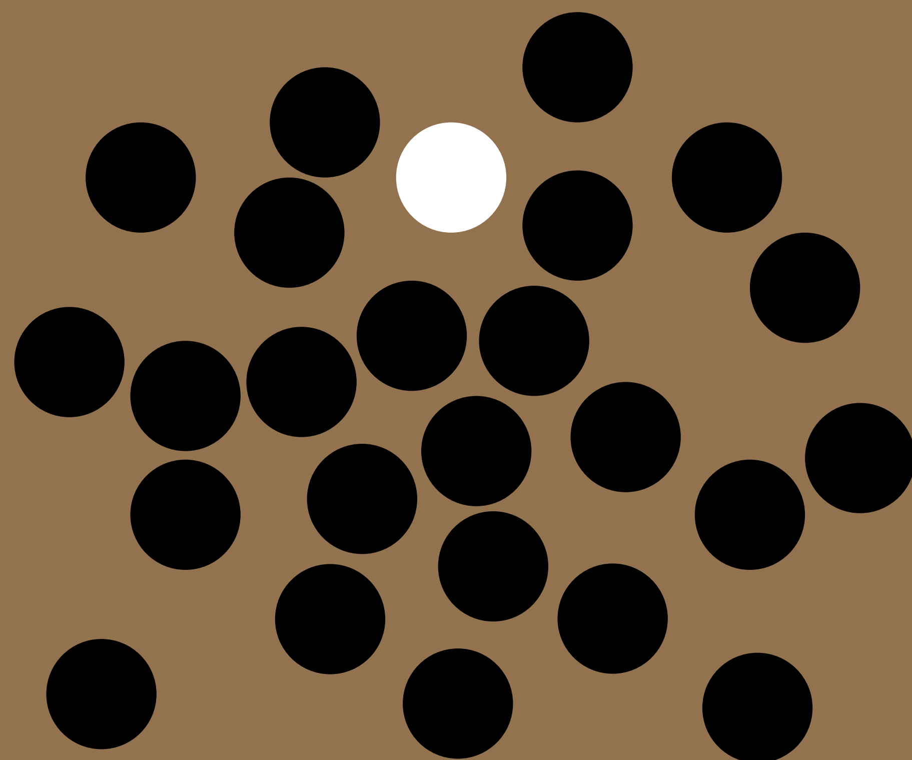
Tureanu, Ileana (2020) *Vizionarul Lord Norman Foster. Lumea va trece de la „eu,eu,eu' la „noi,noi,noi'*, Arhitectura sănătoasă. Foster + Partners, Arhitectura. Revista Uniunii Arhitecților din România fondată în 1906, 2020 (6): 54–81.

United Nations (1992) *United Nations Framework Convention on Climate Change*, available at https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

UIA (2017) *Charter UNESCO/UIA for Architecture Education*, revised edition, 2017 Sexennial revision with no modifications of the 2011 Edition 2014–2017 Revision by UNESCO-UIA VALIDATION.

UN Sustainable Development Goals. (2015) Available at https://www.un.org/sustainabledevelopment/

Part 3 Artwork



Chapter 10

Emergent
A Critical Approach to Performance and Biometric Data

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The body is the database of lived experience. *Emergent* is an artistic intervention and performance that includes generative animations and sound compositions based on data collected from a consumer fitness tracker worn since the start of the COVID-19 pandemic in 2020. As a portrait of experience of the COVID-19 pandemic through the data body (as both body of data and body producing data), *Emergent* engages with the memories of the flesh, becoming the impetus for aesthetic encounters through digital performance. Instead of focusing on the intended use of the fitness tracker as a technical object, *Emergent* draws attention to the gaps in data collection, goals not met, and the capacity of physical activity to exceed sensory quantification and collection. Through this digital performance involving data from collected during 2020–21 – a body of data collected from the embodied experiences of a pandemic – *Emergent* functions as what Bernard Stiegler (2018) refers to as neganthropic gesture, or the therapeutic means of resisting destruction in the Anthropocene. Repurposing the fitness tracker through an artistic intervention points to the limits these devices and the actions they invite (such as the promotion of physical activity through gamification), suggesting how such systems of biometric data collection can be rethought, countering the extreme rationalism of computation affiliated with quantification of the body. For Stiegler (2019), the Neganthropocene encompasses more than surviving in a present state of conflict, but a shift in thinking, working towards a habitable future. *Emergent* enables a means of rethinking the collection and influence of biometric data, revealing the limits of such systems while drawing attention from the body of data to the living body and the entangled systems we inhabit.

EL Putnam is an artist-philosopher working predominately in performance art and digital technologies, exhibiting regularly in Ireland, Europe and the United States. She is a member of the Mobius Artists Group (Boston) and the International Association of Art Critics. Recent publications of note include the monograph *The Maternal, Digital Subjectivity, and the Aesthetics of Interruption* (Bloomsbury 2022) and an affiliated issue of the *International Journal of Performance Art and Digital Media*, co-edited with Conor McGarrigle. She is Assistant Professor in Digital Media at Maynooth University.

References

Stiegler, B. (2018) *The Neganthropocene*. Translated by D. Ross. London: Open Humanities Press.

Stiegler, B. (2019) *The Age of Disruption*, Translated by D. Ross. Cambridge: Polity Press.

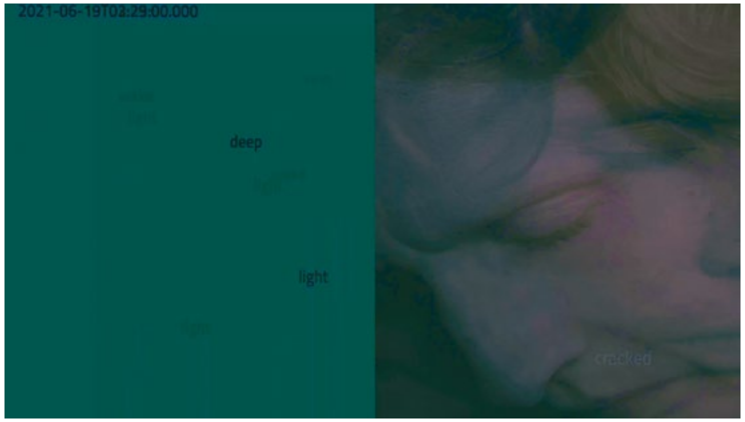

Figure 10.1: Still from Emergent: A Critical Approach to Performance and Biometric Data, video (2020-)

Video URL: https://media.heanet.ie/page/2369e03e52ee40978222f8928f13520b

The ECT Lab+ brings together researchers who are interested in the impacts of technology on society, these impacts can be both positive and negative; this we can term a pharmacology. Following on from the recent material turn in philosophy of technology, the ECT Lab+ conceives of technology as part and parcel of the process and practices of becoming human in the world. Hence the title of the ECT Lab+ reflects the positioning of technology within a culture, acknowledging that technology is not built in a vacuum but in and for society. The second aspect of the cultural environment of technology stems from the philosophical positioning of technics, technē and technology within their cultural locality or milieu.

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