

The Ecological Turn

Design, Architecture and Aesthetics
beyond "Anthropocene"

Edited by

Loreno Arboritanza
Anna Chiara Benedetti
Karilene Rochnik Costa
Simone Gheduzzi
Rosa Grasso
Ivano Gorzanelli
Simona Rinaldi
Ilaria Ruggeri
Laura Succini
Ilaria Maria Zedda

Doctoral Program
Department of Architecture
University of Bologna





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Gabriel Alonso
Rachel Armstrong
Stefano Ascari
Luca Barbieri
Marta Bonci
Elena Brea
María Buey González
Oscar Buson
Alessia Cadamuro
Alberto Calleo
Maurizio Carta
Laura Centemeri
Paul Coulton
Giorgio Dall'Osso
Tuğba Deringöl
Federico Diodato
Pablo Ferreira Navone
Paolo Franzo
Gionata Gatto
Rolf Hughes
Craig Jeffcott
Emanuele Leonardi
Marco Manfra

Saverio Massaro
Cecilia Mazzoli
Eugenia Morpurgo
Alberto Petracchin
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Andrej Radman
Ludovica Rosato
Dario Scodeller
Sema Serim
Miriam Tola
Eleonora Trivellin
Davide Turrini
Alessandra Vaccari
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Ilaria Vanni
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Formafantasma



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The Ecological Turn

Designing and representing the Anthropocene:
a challenge for designers, planners and philosophers

Loreno Arboritanza, Anna Chiara Benedetti, Karilene Rochnik Costa, Simone Gheduzzi, Rosa Grasso, Ivano Gorzanelli, Simona Rinaldi, Ilaria Ruggeri, Laura Succini, Ilaria Maria Zedda

October 2019: at the Mast (Bologna) is on display the exhibition *Anthropocene*, a multimedia experience, with the use of augmented reality, to represent “the incredible human footprint on earth” through the photographs of Edward Burtynsky and the films of Jennifer Baichwal and Nicholas de Pencier¹. From our visit, the construction of the *call* began with an interest in exploring the changes that this new geological era brings to our areas of research. On the one hand, the enormous impression made by the violence of human activity in Niger, Southeast Asia and Europe – quarries, mines, oil pipelines, enormous pumping stations – on the other hand, the impression made by the aestheticization of the ‘Anthropocene’ phenomenon, its translation into pleasant

¹ Sophie Hackett and Andrea Kunard, eds., *Anthropocene: Burtynsky, Baichwal, de Pencier* (Fredericton: Goose Lane Editions, 2018).

images. On the crest of this ambiguity and this challenge we wanted to build the call, orienting it in two directions with the intention of breaking with a certain tradition: on the one hand we asked philosophers, architects and professionals to rethink the forms of representation, aware that only by including the complexity of the living in our narrations is it possible to gain a non-anthropocentric vision, on the other hand we questioned designers and planners on the very foundations of planning, of designing, in search of a relationship between space, territory and time, an alternative to the dominant models.

Needed, in the construction of the *call*, to take note of how some tools of the designer have become obsolete: sustainability, the very idea of crisis, reversibility, the idea that nature returns where man has destroyed, preyed upon, suffocated. An attempt that doesn't stem from an environmental crisis, but from the awareness that our representation of the problem is distorted, anachronistic, still indebted to the idea of the map, to cartographic representations, incapable of adopting new models, scales, interconnections.

The rethinking takes place at several levels: in the very definition of Gaia, questioned by Bruno Latour², in the history of the relationship between humanity and the earth by Jean Baptiste Fressoz and Christophe Bonneuil³, in the discussion of representation from above by Sophie Hackett. We tried to discuss the Anthropocene at two levels: as an emergency in its actuality and as a threshold, a possibility to go "beyond the Anthropocene". What the conference hoped for, and what we believe happened in the great interest that the *call* aroused, consisted in a collective effort aimed not at sectorial competences, but above all at relationships. Relationships between new capacities to represent and think about limits, reciprocal dependencies beyond and within an idea of the world centered on the infinite availability of raw materials, on the extraction and continuous use of fossil fuels. Thinking

2 Bruno Latour, *La sfida di Gaia: il nuovo regime climatico*, trans. Donatella Caristina (Milano: Meltemi, 2020).

3 Jean Baptiste Fressoz and Christophe Bonneuil, *La terra, la storia e noi*, trans. Agnese Accattoli and Andrea Grechi (Roma: Treccani, 2019).

therefore about reproductive forces, permaculture, new materials, new ways of designing the territory, of seeing relationships that were previously hidden, of thinking through the multiple reasons for radical and innovative lifestyles, thinking about the same ontological status of things and the professions of designing.

The conference reflected this intention and broadened the horizon of the *call* by questioning the different parties that supported it. Today, more than a year later, the world has changed a lot due to the terrible Covid-19 pandemic, yet the issues and questions that the conference brought to attention have become no less topical, but more urgent.

The future ‘beyond *Anthropocene*’ is all to be imagined.

Selection process

The importance of sounding out the still little-explored lands “beyond the Anthropocene” with the multidisciplinary outlook that distinguishes our Department of Architecture – *Design, Architecture, Aesthetics* – was confirmed by the number of *abstracts* received – about a hundred – as well as by their diversification in terms of research fields and origins: approximately half of the abstracts received were in fact attended by foreign PhD students, architects, designers, philosophers, planners and researchers, mostly from the old continent, but also from more distant lands such as the Asian continent – Israel, United Arab Emirates, China – or the American continent. The variety of interdisciplinary sectors involved made it necessary to group them into macro-disciplines: Architecture, Design, Urbanism and Aesthetics. The main contribution came from the technical field of the disciplines of Design and Architecture, through concrete examples of experimental materials or new architectural paradigms, but there were also more theoretical contributions. The comparison between different disciplines produced a lively debate where new technological proposals for new forms of living – such as the “Microbial Dialogues” proposed by Armstrong and Hughes – alternated with theoretical reflections for new forms of existence – such as the “Geology

of Morals” proposed by Radman – with the common aim of providing alternatives for new forms of living with and for the environment.

The abstracts received were selected after undergoing the *double-blind peer review* procedure. However, given the positive opinion of the reviewers and the high scientific value, due to editorial and organizational limits, it was necessary to ask the selected authors to send the *full* paper, anticipating the delivery date before the Conference, differently from what was initially indicated in the *call*. Thus, also the *full* papers were submitted to the *double-blind peer review* procedure. Once examined the judgments of the reviewers, the Organizing Committee has dealt with the final choice of the papers presented in this publication with a selection method that would encourage as much as possible that multidisciplinary comparison pursued since the *call*.

Research addresses

Analyzing the full papers received, in order to create a structure that could better ensure the interdisciplinary comparison, we identified a series of thematic areas within which the different researches presented could converge. Each area was then associated with one or more keynotes to introduce the theme. Due to the timing of the conference, only some of the authors of the papers selected for each thematic area were invited to present the content of their research, while the publication provided more content to broaden the reflections on the different topics.

Therefore, if initially the *call* divided the analysis of the ecological turn linked to the Anthropocene into two parts, namely the representation of the phenomenon within the cultures of the project and the changes produced in their processes, in analyzing the material received we have mainly identified four areas in which the research is moving. The selected papers have in fact opened a comparison from an aesthetic point of view, especially related to the analysis of political ecology and its repercussions on the design developments within society, as well as on the necessary overcoming of

the dualism man - nature, to open the design culture also to non-human relationships. A large number of papers then focused on material experimentation, both in terms of innovation of production processes, as well as the production of new materials and their sustainability. Finally, another group of researches is focused on the new forms of the urban, from the change in the reading and design of the city, to the overcoming of boundaries linked to a trans / post - urban logic.

The publication is structured following these four multidisciplinary areas, each introduced by the keynote text and followed by the authors of the selected papers.

Subtitle 1: Eco-political narrative diversification

Within the aesthetic research there were four keynotes to discuss the topic, also through the round table Anthropocene and Care, followed by the presentation of their individual researches. According to **Stefania Barca** there is a need to identify counter-hegemonic narratives of the Anthropocene that oppose the hegemonic end-of-history narrative, echoing Mark Fisher's concept of "capitalist realism" and extending it to the current phase of neoliberal environmental governance. **Laura Centemeri** offered an introduction to the practice of caring for the earth and the relationships between living beings called Permaculture, underlining the difference between "permanent" ecosystems and the design of spaces where to "reinhabit", through repairing social and ecological relationships. **Emanuele Leonardi** is in charge of politicizing the concept of the Anthropocene in order to remove the illusion that all of humanity in its breadth and generality is guilty of the climate changes we experience. Through the contribution of Jason W. Moore, Leonardi hypothesizes that the correct definition of the Anthropocene is Capitalocene, that is, the specific relationship between the form of production and land consumption of capitalism and the epoch known as the Anthropocene. Finally, **Miriam Tola**, always in a critical perspective towards capitalism, focused on the terrestrial and extraterrestrial Elon Musk's ambitions and on

the will to save a portion of humanity from environmental disaster by implementing man's colonizing will.

The ability to propose different narrative models is a fundamental theme for the debate on the Anthropocene. **Stefano Ascari** has therefore tried to shift the focus from the unrealistic questions on how to defuse or reverse the transformations produced by man to learning new models of life adapted to the new context. He critically discusses the models of representation of the Anthropocene through a debate on different theoretical and aesthetic proposals, proposing new models of narration. New narratives are thus proposed and, at the same time, consolidated narratives are questioned. This is what **Elena Brea, Pablo Ferreira Navone, María Buey González,** and **Gabriel Alonso** do in their contribution, which moves from questioning the still current, consolidated concepts of hygiene and health in the domestic environment as the result of a necessary exclusion of any microorganism – regardless of whether pathogenic or non-pathogenic. On the contrary, the authors prompt for a post-anthropocenic design approach to the domestic environment, which does not ignore or exclude microorganisms, yet includes them instead. Thereby, the house ceases to be a fortress for mankind and becomes a place where different lives can coexist in symbiosis, mutually benefiting. A further point of view is proposed by **Yael Eylat Van-Essen**, who suggests rethinking the role of architecture in the Anthropocene era through the new set of “ontopolitical” assumptions that shape contemporary socio-political thought. The paper explores how the principles of mapping, sensing and hacking, discussed by Chandler in the context of Governance, can be applied to the architectural domain thereby stimulating new processes for architectural interventions. Finally, **Andrej Radman** placed an “ecological work of art”, the *Habitan Esas Laderas* (2019), by Argentinian artist Flora Reznik, as the object of his analysis, analyzing it as a starting point to discuss not so much the conditions of possibility of knowledge, but rather the “real conditions” in which things and life germinate.

The full paper by Stefania Barca, for editorial reasons, is not included in the publication.

Subtitle 2: Beyond the dualism of man - nature

If on the one hand there is a change in a political and social vision, this also has repercussions on the relationship between man and nature, overcoming dualism to seek new forms of design and coexistence. **Kjetil Fallan's** presentation Deep Ecology as Deep Design introduced the reflection by presenting the concept of "deep ecology" in relation to design, highlighting how the Deep ecology movement can be used to explore the connections between eco-philosophy and Eco design.

Next, **Gionata Gatto** and **Alessia Cadamuro** defined design as a tool to overcome the hierarchical systems between humans and non-humans by fostering the development of multi-species connections and collaborations. Field experimentation, multi-disciplinary collaboration, and more-than-human ontology lead through design to highlight how the participatory dynamics enacted by plants can activate more inclusive participatory practices between humans and non-humans.

From this new relationship it follows that the concept of User itself, as **Tuğba Deringöl** and **Sema Serim** have explained, suffers in the development of its definition the transformation's effects of the human being within this new era.

At the same time, the effects of the Anthropocene epoch, with developments that are often linked to catastrophic phenomena, leads to the need to establish new figures for the relationship between human and non-human. **Alberto Petracchin** introduces the figure of the Ark as a reference architecture for the coexistence and re-foundation of a new post-catastrophe world.

The relationship between human and non-human is also key in **Craig Jeffcott's** contribution, which seeks to define new strategies for speculative design practice to achieve a biodiverse future, i.e. a future in which we take care of the ecosystem and commit ourselves to repair, maintain and protect it. Moving from an ontological reflection and from a critique of speculative design practices with no impact, nor care to biodiversity, Jeffcott calls for new strategies for the discipline

– strategies that are ecological and attentive to queerness and at the same time capable of overcoming diversity and allowing, by means of play, storytelling, and speculation, the questioning of the established past and the imagination of a better, inclusive future.

Another viable strategy is the one related to *big data*, as reported by **Luca Barbieri**, **Alberto Calleo**, **Giorgio Dall’Osso** and **Ludovica Rosato**. The authors explore in the context of the data age, the possible use of *big data* and artificial intelligence as tools for the transition from a utilitarian and anthropocentric dimension towards an anthropocentric design culture, analyzing how such tools can be used as amplifiers of the weak signals of climatic, social and cultural change to create readings, interpretations and narratives of the complex systems we live in. Finally, **Oscar Buson** questions the culture of energy and the closely related concept of petrolscape, and focuses instead on the alternative culture of entropy, which necessarily affects architecture. New types of infrastructures and architectures based on renewable sources and on the concept circular economy are thus envisioned, where production and living return to establish a reciprocal dialogue and that permit rethinking the relationship between energy production and space creation, as well as between individuals and their community. Just as the culture of energy resulted from human creation and has in turn shaped our ways of living, so it is expected to happen in a more conscious culture of entropy.

Fallan’s full paper, due to editorial issues, is not included in the publication.

Subtitle 3 : the turning point of materials

Within the Anthropocene era, the focus on anthropogenic material consumption is primary, being the main feature linked to the geological definition of Anthropocene itself. At the opening of the debate, **Formafantasma** keynotes present the *Cambio* research, commissioned by the Serpentine Gallery and related to the production and consumption developments of the wood supply chain. Dissecting the

ecological and political responsibilities of the design discipline, through a holistic approach, they started from the material's history, passing through the steps of the production process, finally examining the future of the material in relation to human consumption.

Attention to material development also means developing new materials that reflect the principles of ecological development. **Eugenia Morpurgo** investigates how and if it is possible to plan, through the disciplines of design, regenerative production processes to create new bio-based materials starting from poly-cultural and non-extractive cultivation systems. His proposal is Syntropic material Library – a digital archive of bio-based materials, which allows on the one hand to subdivide materials according to their origin and on the other hand the user to have a vision of the materials according to the link with the coexistence of the species, activating new processes for regenerative ecosystems. **Franziska Pilling** and **Paul Coulton** consider a *More-than-Human-Centered* material design approach that presents artificial intelligence (AI) and data as design materials using the non-anthropocentric *Object-Oriented Ontology* (OOO) philosophy and related alien phenomenology thesis, proposing an investigation into methods of making AI operations, functions and impacts legible through the speculative design practice of *Design Fiction*. Also in the debate of experimental research on new materials are **Rachael Armstrong** and **Rolf Hughes**, who invert the paradigm of microbes as negative agents for our survival into ecosystems capable of improving our lifestyle and ecosystem, providing us with concrete examples such as the European Project *ALICE* and opening the door to a new “life-promoting era of microbial design”.

Equally important is the research on the use of existing materials and their necessary change within a development process oriented to an ecological material consumption. On the one hand, the importance of the role of the practitioner, in addition to the material, is of fundamental importance – as explained by **Elisa Zatta** – who made a clear and complete presentation of on-going reuse strategies applied to the built environment in the European context, and enlighten as



the role of practitioners is fundamental to foster a cultural and architectural change. Between material development and strategic use of artificial intelligence, **Cecilia Mazzoli, Marta Bonci** and **Davide Prati** proposed a “green” alternative to design through a parametric approach to prefabrication that makes use of “another plastic”: 100% recyclable elements made of bio-based polymers such as Green *HDPE*, obtained from sugar cane. As a result we’ll have cheap, flexible and reversible temporary structures, designed for new and above all sustainable urban spaces. Finally **Ilaria Vanni, Alessandra Vaccari, Paolo Franzo**, and explored the unique combinations and interdependencies emerging in contemporary Italian *fashion design*, focusing on the encounter between technology and biology to experiment with fabrics and materials for the fashion industry.

Subtitle 4: shifting urban visions

The great changes in vision, as also described above, clearly affect what is our vision of the city. The territorial planning that refers primarily to the urban and determines a strong division between center and periphery is transformed into a broader vision of territory, going to define new urban paradigms. **Maurizio Carta**, keynote of this last part, rethinks in fact radically the model of development of the city, now generator of a sustainable future, in which humanity takes charge of adopting new behaviors to implement an urban revolution of the transition to a generative and responsible Neanthropocene.

The new technologies influence the change and expansion of the new urban vision, as **Federico Diodato** explained later, proposing an alternative use, not aimed at the production of economic value, typical of the smart city narrative, but as a tool to facilitate social relations and to establish an ethical relationship between territory and community. **Saverio Massaro** analyzed how the vision of the city itself must be translated into a circular vision, illustrating strategies and actions to promote a cultural shift for raising the awareness of waste management systems working in European cities

according to the circularity principle. At the same time, as **Matteo Vianello** points out, the need to expand the boundaries of the urban vision leads to repeat western paradigms in non-urbanized environments: through the analysis of *Oceanix*, the author problematizes the replication of terrestrial urbanization in water space. Even within the urban environment it is necessary to reconsider the relationship between man and nature: **Elena Ferrari** illustrates the history of three abandoned burial areas in Berlin and investigates the role of these biodiversity-rich gardens within urban transformations according to ecological social and political aspects. If, on the other hand, we consider the question of visions and narratives, **Elena Vai** proposed an analysis of the change in the relationship between man and territory, leading us to see how advanced design and speculative design can activate a conscious design community to overcome the current crisis and imagine “probable, plausible, possible and preferable futures”. Finally, **Dario Scodeller, Eleonora Trivellin, Davide Turrini** and **Marco Manfra** explored the context of the inner Italian suburbs with the aim of drawing attention to strategic scenarios, theoretical guidelines and examples of good design practices linked to the promotion of eco-literacy, community and *on-demand* social-health services, the promotion of local food systems, the preservation of know-how and craftsmanship, highlighting the contribution that an articulated and multi-scalar design can provide in transforming territorial fragility into social and economic opportunities.

Conference days and results

The richness of the contributions brought to the conference and especially the interdisciplinary way in which the theme of *Ecological Turn* was treated are difficult to exhaust and summarize in a conclusion. During the two days of talks, it became clear how ecological thinking and sensitivity to the environmental transformations that we are experiencing, deeply affects the practice, even daily, of architects, designers, planners and researchers.

In fact, the conference explored in a highly multifaceted way social, biological, political, geographical and purely architectural themes, at different scales, from the molecular one, of environmental beings, to the global one, which concerns flows and metropolises, with the intention of responding to a problem of degeneration of our relationship with the planet.

The contributions reiterate, some more explicitly, some less so, the need to trigger a new era of ecological anthropocentrism in which humanity, instead of being the problem, designs and implements the transition to ecological development, interpreting this change not only as a reconciliation with nature, but as a total paradigm shift and narrative of non-anthropocentric human/urban development.

CALL

The Ecological Turn

Permaculture; Environmentalism; Eco-design; Care; Einhabiting.

How does the ecological thinking affect architects, designers and the design culture itself? The Anthropocene is a geological event, but also a political one that lies in overcoming the idea of crisis. Acknowledging this change means rethinking the very ecology of the project in environmental and atmospheric terms.

The changes we face don't depend on missing balances, but on compromises reached between conservation and exploitation. The Anthropocene is in our suggested reading the time of the end of our representations and the time of the beginning of other narratives that belong to a non-linear dimension.

The ecological mindset understood here will not be a generic reconciliation with nature, but a political project, a clash between narratives, a challenge to designers and architects, their materials and their design practices to rethink the way



in which human beings define themselves, their images and relationships within the world in which they live. In other words, a renewal of conflicts: between classes, between nations and production models, between technological choices.

Anthropocene is a category which has the merit of challenging our conventions in an oblique manner by reconnecting the history of mankind with the history of the Earth. In this respect, design visions can be the tool for activating new relations.

Within this process of change, how do the figures of architects and designers rethink their role, their knowledge, experimenting with new design approaches?

The conference wants to explore these issues from different points of view, in particular the “socio-bio-geosphere in its uncertain becoming by making the disciplines of the project communicate and by varying the scale of analysis, from the molecular scale of the environmental effects on our heritage, to that of the world’s flow of goods and capital organized by the World Trade Organization, passing through the local scenarios of industrial sites or socio-environmental mobilizations” as Jean Baptiste Fressoz and Christophe Bonneuil wrote.

The questions that guide this talk are on two levels of reading:

- 1 - How to represent, imagine, visualize the Anthropocene through the design cultures?
- 2 - How can this political event change the design and production processes?

Track 1

Understanding Complexity: narratives, representations, images

As Franco Farinelli argues, until 1969 the territorial government was adapted to the methodological limits of the geographical map, that is to the rules of the Euclidean metric and to its three fundamental characteristics: continuity, homogeneity and isotropism. Through these three properties the intellectual appropriation of the world of western culture took place, which was so rendered interpretable and therefore governable.

The Anthropocene is the scenario in which the designer is called to overcome the notion of nature as an object, something that can be controlled and disposed of, to explore the possibilities arising from new ways of interpreting, feeling and perceiving relationship between human beings and the territory.

Are non-anthropogenic visualizations possible?

Which visual culture, which narratives, which forms and images can respond to the need to represent the flows, data and relationships of the earth system?

Possible arguments, suggestions are:

- representation models that go beyond the cartographic conception of territory towards narratives and images of non-anthropocentric urban metabolism;
- informative-narrative proposals of complex phenomena through new design approaches.



Track 2

Thinking and designing ecological

Resolutionist and heroic narratives are no longer sufficient to hide behind noble intentions such as “sustainability”, “environment”, “ethics” or “awareness”, design approaches that in reality still pursue selfish paths of destruction, consumption, extraction functional to the dynamics of a growth linked only to logistics capitalism.

Starting from the current demands of our time such as emergencies, climate change and local conflicts, the need for designers to rethink the very meaning of living and to renew the relationships between the shape of an object, the material that constitutes it and the context in which it is located spreads. Designing in the Anthropocene does not mean solving but gaining points of view where different disciplines contaminate and collaborate towards an anthro-decentralized approach, from design to biology, from architecture to economics, from technology to humanistic knowledge.

Possible areas of reflection:

Time. If until today the contemporary project has responded to the needs of producing and consuming more and more resources, what materials, technologies, production models and processes open up to ecological living? How to rethink the project according to its own reversibility?

Territory. How to rethink the very meaning of living in an era where it is increasingly difficult to rely on consolidated categories and dichotomies, such as subject-object, natural-artificial?

How will the intangible resources of a territory, the identities and relationships between communities be used to make project processes more responsible? In a system of interconnections and interdependencies, how can we imagine urban and rural areas and the relationships between public and private? How can design culture activate ecological design forms and new behaviors?

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Syntropic Materials. Designing Forests to Design Natural Materials

Polyculture; Regenerative Agriculture; Plant/Animal-Based Materials; Indigenous Knowledge, Material Innovation.

Eugenia Morpurgo

Independent researcher, Venice, Italy
eumorpurgo@gmail.com

Design, which concerns the fields of fashion, product design, interior design and architecture, has increasingly sought sustainable alternatives to oil-based materials in response to the looming 'climate catastrophe'. This has led to the creation of a wide spectrum of bio-based materials. Looking for renewable resources, among other solutions, researchers started developing materials from industrial agriculture leftovers, also motivated by the necessity of not stealing land from food production.

Despite giving birth to a richer biodiversity of resources, however, these researches are not questioning the agricultural system that generated them in the first place, which is monocultural industrial farming. A farming practice promoting standardisation to the detriment of ecological and cultural biodiversity. It appears, therefore, necessary to identify alternative agricultural practices and explore their potential.

How can we design regenerative production processes for plant/animal-based materials based on nurturing and polycultural systems instead of extractive and monocultural ones?

With the development of a digital library which archives materials according to the species they derive from and which allows users to browse through materials under the logic of species co-existence, Syntropic Materials hopes to foster a polycultural approach to bio-based materials development.

The research project Syntropic Materials attempts to design regenerative production processes for traditional and innovative plant/animal-based materials using agricultural by-products from regenerative, polycultural and agroforestral agriculture.¹

The project investigates if the great innovation in the field of materials that we witnessed in the past ten years can open new possibilities for the development of polycultures, and vice versa, if the choices taken in designing polycultures can define new directions in new materials development, with the objective of shifting the natural material production process from an extractive, monocultural, entropic one to a nurturing, polycultural, syntropic one.

In the following paper, after introducing the state-of-the-art of materials production which presents the urgency for the research, the methodology and current state of development of the work will be presented.

Climate crisis and design.

The current environmental crisis has proven to be a total one, affecting biodiversity, soil, water and air. Loss of biodiversity is happening at a rate so high that what we are witnessing has been defined as the sixth mass extinction. More and more evidence is demonstrating the anthropogenic responsibility for the current extinction rate.²

1 For some theoretical references to the approach used in the development of the project please see:

T. J. Demos, *Against the Anthropocene: Visual Culture and Environment Today*, (Berlin: Sternberg Press 2017)

Robin Wall Kimmerer, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*, (Minneapolis: Milkweed Editions 2013)

Julia Watson, *Lo-TEK, Design by Radical Indigenism*, (Cologne: Taschen GmbH 2020)

2 Gerardo Ceballos, Paul R. Ehrlich, Anthony D. Barnosky, Andrés García, Robert M. Pringle and Todd M. Palmer, "Accelerated modern human-induced species losses: Entering the sixth mass extinction", *Science Advances* (2015), 1-5.

Design, which concerns the fields of fashion, product design, interior design and architecture, has different implications on the environmental crisis, from land and energy use related to production processes, to waste and pollutant dispersal in water systems, oceans and soil.

This analysis focuses on the entanglement between materials, used for fashion, products and architecture, and the current environmental crisis.

The case study of fibre production is examined with the awareness that the resulting observations can easily apply to many other material typologies.

For the sake of brevity, this analysis focuses only on the environmental impact of materials, putting aside their economic, cultural and social ones.

2. Current materials production.

2.1 Synthetic fibres: Polyester.

Currently, the most used fibre is polyester, an oil-based fibre.

In 2018, with 66.6 million mt, synthetic fibres accounted for 62% of global fibre production. Polyester dominated the market, accounting for 90% of the world's synthetic filament production and 70% of the world's synthetic staple production.³

It is 100% recyclable, but if we look at the data, only 10% of clothing waste ends up being recycled, while 57% ends up in landfills, 25% is incinerated and only 8% is reused.⁴

3 Terry Townsend, 2019, "Natural Fibres and the World Economy": <https://www.scribd.com/document/432643129/7c-Natural-Fibres-and-the-World-Economy-2019-pdf>

4 *Pulse of the Fashion Industry 2017*, Report to the Copenhagen Fashion Summit, 2017, by Global Fashion Agenda & The Boston Consulting Group: https://developmenteducation.ie/app/uploads/2019/12/Pulse-of-the-Fashion-Industry_2017.pdf

But one of the major issues related to polyester, and in general clothing made from synthetic fibres, is connected to the actual use of the garments. Each time an item is washed, it releases thousands of microfibrils, plastic particles less than 5mm in diameter which find their way through waste waters to the ocean. It is estimated that washing synthetic textiles releases almost 35% of the microplastics that are accumulating in marine habitats around the world.⁵

Once microfibrils are in the ocean they act like sponges and absorb chemicals present in polluted waters. They are also so small that they end up being eaten by small animals and find their way into the food chain, carrying with them all the chemicals they absorbed.

And if we think that avoiding eating fish could be a solution, we should be aware that research shows microplastics and microfibrils in about 90% of the table salt brands sampled worldwide. The impact on human health is still to be understood but the consequences they are having on the environment are already very visible.⁶

2.2 Natural fibres: Cotton.

Significant investment has been made into alternative renewable, biodegradable or compostable materials.

Renewable materials are those which can be manufactured or generated quickly enough to keep pace with how fast they are used up, and biodegradation is the naturally occurring breakdown of materials into carbon dioxide, water and biomass by microorganisms such as bacteria and fungi.

5 CO DATA. "Fashion and Waste: An Uneasy Relationship, in Mapping the Fashion Industry. Part Four: Impact on Planet" (June 2018): <https://www.commonobjective.co/article/fashion-and-waste-an-uneasy-relationship>

6 Diogo Peixotoa, T. et al. 2019, *Microplastic pollution in commercial salt for human consumption: A review*, in "Estuarine, Coastal and Shelf Science" (219), 161-168.

So when we look at renewable biodegradable fibres we are mostly looking at natural fibres. And considering that cotton accounted for 81% of natural fibre production by weight in 2018, this analysis will look into the actual impact of its production.⁷

Of the four cotton species cultivated for fibre, the most important is *Gossypium hirsutum*, which originated in Mexico and produces 90% of the world's cotton. It is mostly grown in monoculture.⁸

Cotton is often also grown from genetically modified grains such as Monsanto BT cotton, supplied to 93% of Indian cotton farmers.

Consequently, what we are witnessing is not only a monoculture in terms of land management but also in genetic terms, which increases the risks of exposure to pests and creates an ecosystem even more sensitive to changes in climate.

The correlation between monoculture and biodiversity loss, water pollution, soil depletion, lack of resilience to climate changes and pests which create a higher dependency from fertilisers, pesticides and herbicides has been studied and proven. See the Food and Agriculture Organization of the United Nations report "More people, more food, worse water? A global review of water pollution from agriculture", published in 2018.⁹

The cotton industry is just one example. The same dynamics can be seen in the production of many other natural materials currently produced on an industrial scale, such as the most common bioplastics produced from corn or sugar cane.

7 Terry Townsend, *Natural Fibres and the World Economy*.

8 Yara Knowledge "World Cotton Production" <https://www.yara.us/crop-nutrition/cotton/world-cotton-production/>

9 Javier Mateo-Sagasta, Sara Marjani Zadeh, Hugh Turrall, (edited by), "More people, more food, worse water? A global review of water pollution from agriculture", Colombo, Sri Lanka: Food and Agriculture Organization of the United Nations (FAO) and International Water Management Institute. (2018)

2.3 Agricultural by-products: circular materials.

Parallel to this, in the past 10 years we have been witnessing an attempt to look into alternative sources for plant/animal-based materials.

Motivated by the necessity of not stealing land from food production, and supported by a growing interest in circular economy principles, which shift from a linear to a circular model that see natural waste as resources, companies, material engineers and designers started looking into the use of industrial agriculture leftovers.¹⁰

Based strongly on local bioregional economies, these researches are creating an expanding landscape of natural materials. We have seen bioplastic produced with potato skins in England; leather, insulation materials and hard boards developed from sunflowers in the south of France; threads created from orange peels in Italy; plastics and leather made out of Barbary figs in Mexico; plastics, fibres and paper composed of sugar cane in Brazil; and non-woven textiles obtained from pineapple leaves in the Philippines.

Despite giving birth to a richer biodiversity of resources, these researches are not questioning the agricultural system that generated them in the first place, which is monocultural industrial farming.

As a result, these innovations have had end of life issues but have rarely presented solutions that address the impact of materials sourcing. They are not providing real alternatives to the environmental impact of these materials, and in some ways they are even contributing to confusing people regarding the difference between renewable and extractive resources.

10 Guglielmo Carra, "The urban bio-loop growing, making and regenerating" (2017) <https://www.arup.com/perspectives/publications/research/section/the-urban-bio-loop>

3 Regenerative agriculture.

This initial analysis highlights the shortcomings of the agricultural system from which the by-products are sourced, and also points toward the necessity of looking into alternative agricultural models as potential sources of biomass for the production of plant/animal-based materials.

In the wide spectrum of practices defined sustainable and belonging to the agroecological approach, this research focuses on regenerative agriculture.

Regenerative agriculture is a system of farming principles and practices that increases biodiversity, enriches soils, improves watersheds, and enhances ecosystem services.

Specific attention has been given to syntropic farming: an agroforestry model developed by the Swiss farmer and researcher Ernst Gotsch.

Agroforestry is an agriculture practice which incorporates trees with crops and sometimes animals. Syntropic farming, in particular, mimics a forest's interdependent plant relationships, replicating and accelerating natural processes.

Processes such as ecological stratification, the vertical layering of a habitat and ecological succession, the ongoing process of change in the species structure of an ecological community. It is a polyculture that fosters biodiversity and establishes highly productive agricultural areas, which tend to be independent of inputs and irrigation, transforming depleted land into a rich self-sufficient forestal ecosystem over time.¹¹

11 "Agenda Gotsch" <https://agendagotsch.com/en/>

4 Syntropic materials.

Contrary to monoculture, which allows us to produce a high quantity of one resource, we know that a syntropic field will produce a smaller amount of resources of a greater diversity.

In this model, plants are selected for their ability to enrich the ecosystem but also according to the need of offering a balanced diet. When we look at materials, though, we need to take into account that, unlike food, raw materials need to undergo transformation processes.

From the cotton ball on the plant to the threads and the garment, many things happen.

Farmers are rarely the subject of the transformation process, so they usually sell the raw materials they produce. If their land would produce a smaller amount of random resources of a greater diversity they would have to rely on different transformation partners and by the economy of scale it would easily become economically unsustainable.

So it appears that when designing a syntropic field for material production, we need to add as a new variable the transformation process, and when designing a syntropic field for materials, species can be selected for their ability to enrich the ecosystem, under the condition of belonging to the same production process.

Moving away from monocultures to polycultures necessitates being comfortable with change and flux as constants in the production process. While this method will yield a reduced quantity of materials, it will make up for it in terms of the diversity of materials produced. This, I suggest, is a potential asset, as species change translates to the consistent production of innovative materials and their integration in novel ways as composite materials.

This method draws from the richness of biodiversity, enhancing the productive capacity of and nurturing non-human nature.

4.1 State of development of the research.

In order to begin testing these assumptions the project developed in two parallel directions:

- A systematic analysis of known polycultural, successional agroecosystems and the materials they can potentially produce.
- The construction of a digital library which archives plant/animal-based materials categorised through species and their material characteristics.

This approach draws from a tradition of “transition design”, design which is intended to “develop design solutions that protect and restore both social and natural ecosystems through the creation of mutually beneficial relationships between people, the things they make and do, and the natural environment”.¹² It also shares, with theoretical strands within ‘women’s indigenous knowledge systems’, an attention to the necessity of privileging diversity as a structuring principle, diversity which, as Shiva argues, “[biodiversity] can only be protected by making diversity the basis, the foundation, the logic of the technology and economics of production”.¹³ This necessary shift will inaugurate fundamental change across various areas of production: from the basic relationship between farmers and materials manufacturers, to wider ideological and imaginative domains concerning productive spaces and transformative processes, and finally to larger practical concerns over materials standardisation and their regulation in the market.

12 Terry Irwin, “Transition Design: A Proposal for a New Area of Design Practice, Study, and Research”, *Design and Culture. The Journal of the Design Studies Forum* (2015)(VII, 2), 229-246.

13 Vandana Shiva, “Women’s Indigenous Knowledge and Biodiversity Conservation”, *India International Centre Quarterly* (1992)(XIX, 1/2), 205-214.

4.2 Polyculture analysis. From polycultures to materials.

The first polyculture analysed was the Maya Forest Garden.

“Domesticated crops and useful weedy herbs are cultivated annually over approximately four years, while woody shrubs, fruit trees, and hardwoods sprout and grow in the shade of the tall maize, progressing toward the next stage in the cycle. Some perennial crops are established at this time as well. When the woody shrubs and trees have grown enough to shade annuals, the field advances through successive stages of guided reforestation, transforming from an open field into a managed forest”.¹⁴

The Maya Forest Garden is the traditional Maya orchid plot that evolves from the milpa, a traditional Mesoamerican and Maya agricultural field that employs a system of land use which cycles from closed forest canopy to a field dominated by annual crops to an orchard garden, and from an orchard garden back to the closed canopy.

The Maya Forest remains the second most biodiverse place in the world, second only to the Amazon forest. The milpa cycle is the conservation method of farming and managing the Maya forest. It goes through four main stages over the course of approximately 20 years.

The Milpa Forest Garden system had been selected as the first case study because of the rich availability of scientific and non-scientific documentation and analysis of each growing phase. It presents a circular finite model which frames the research timewise. It is a successional, polycultural, agroforestral system, which allows the research to analyse a variety of diverse species, from annual to perennial, from weeds to trees. To facilitate the initial steps of the research, 13 species of flora were selected among the most recurrent in literature, even if it has

14 Anabel Ford, Ronald Nigh, *The Maya Forest Garden. Eight Millennia of Sustainable Cultivation of the Tropical Woodlands*. London: Routledge. (2015)

been documented that more than 90 species can be found in the Milpa Forest Garden.

Out of the 13 species (maize, bean, squash, tomato, amaranth, chili, sweet potato, banana tree, papaya, mango, avocado, cedar and mahogany), 7 material typologies have been identified (colour, paper, plastic, textile, particle board, timber and veneer).

Each species and associated material typology has been mapped in relation to the duration of the milpa cycle, giving us an overview of what is potentially producible from a polycultural biomass throughout the 20 years of the Maya Forest Garden.

See the following illustrations.

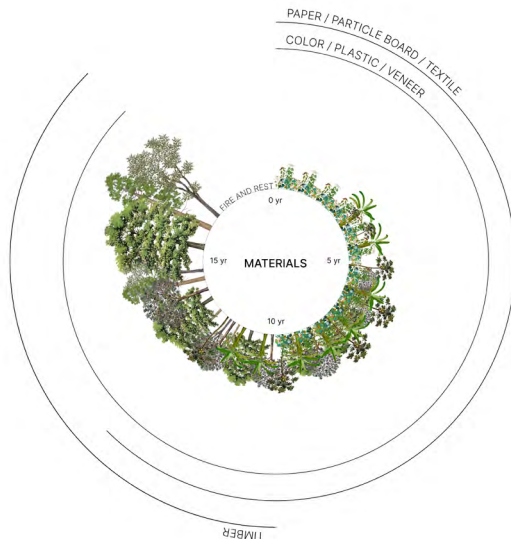


Fig. 1

Overview of potential materials producible in the Maya Forest Garden during the 20-year cycle. Eugenia Morpurgo. Illustration by Eugenia Morpurgo.

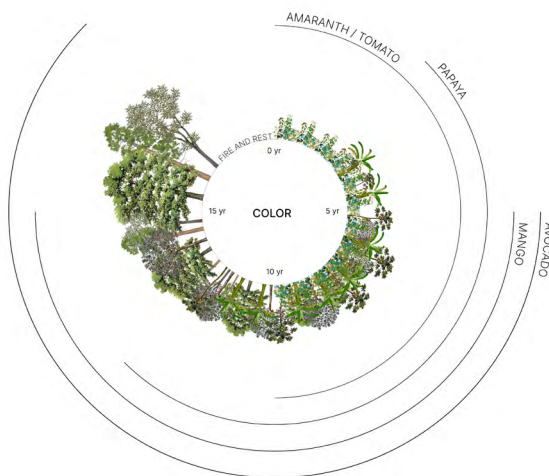


Fig. 2

Potential colours, such as dyes, pigments and inks, producible in the Maya Forest Garden during the 20-year cycle. Illustration by Eugenia Morpurgo.

Fig. 3

Potential textiles producible in the Maya Forest Garden during the 20-year cycle. Illustration by Eugenia Morpurgo.

It is important to note that although this analysis focuses exclusively on the agricultural and productive aspect of the milpa cycle, the values of this model go way beyond this. As Ronald Nigh says, “The making of milpa is the central, most sacred act, one which binds together the family, the community, the universe... [it] forms the core institution of Indian society in Mesoamerica

and its religious and social importance often appear to exceed its nutritional and economic importance.”¹⁵

Milpa moves beyond the economism and instrumentalisation of nature and human relationships that characterise neoliberal and late capitalism. For this reason, I am influenced by this holistic ontology without claiming it as my own, nor reifying it as a piecemeal pedagogic influence to mitigate the disasters of capitalism.

4.3 Syntropic Materials Library. From materials to polycultures.

The Syntropic Materials Library, accessible online at the URL <https://syntropicmaterials.eumo.it/library>, has been conceived as an open platform, an archive of plant/animal-based materials categorised through species and their material characteristics. The library allows the user to browse through the stored information under the logic of species coexistence. When accessing the library, users will be asked to begin their search by selecting a hardiness zone, which is a geographic area defined to encompass a certain range of climatic conditions relevant to plant growth and survival.

This selection will show the user a list of potential materials producible with species growing in the same climatic conditions. From here, users can filter the content presented by deselecting materials or species which are not of interest.

We can imagine that the library could help users to enlarge the spectrum of species taken into consideration while designing polycultural fields for material production, or foster the creation of new briefs for material design based on the combinations of plants that create regenerative ecosystems. Rather than being a simple repository of data, the platform functions as a filter

15 Ford, Nigh, *The Maya Forest Garden*.



and redirect to information already published on and offline. Its primary objective is to centralise this information allowing us to create novel and meaningful connections.

The online library currently accessible is the basic infrastructure on top of which further information and filtering tools will be added with the development of the research.

Conclusions

Syntropic Materials recognises the potential that innovation in materials and the rediscovery of traditional technologies can play in the quest for finding sustainable alternatives to oil-based materials and attempts to bridge the existing gap with sustainable agricultural practices.

It is an ongoing research project developed as part of an independent design practice and is funded by a fellowship at the American Academy in Rome (Sept - Dec 2019) and a fellowship at the Akademie Schloss Solitude (Nov 2020 - April 2021).

At the time of writing this paper, the research has just started dealing with real case studies.

Acknowledgments

I am an Italian designer, educated in hegemonic European schools of art and design. That said, I am sensitive to the responsibilities and forms of power tied to my positionality as a white European designer with significant institutional support. The ideas herein are polyphonic, reflecting the sustained reading and conversations I have had with post-colonial and indigenous scholars, activists, thinkers and writers. They are not the exclusive preserve of my own authoritative voice but the outcome of heterogeneous influences.

In privileging indigenous knowledge, I situate indigeneity not as radical alterity but as a form of world building at odds with our contemporary extractivist moment, in which ecological crisis can only be confronted through pluralistic, open and dynamic traditions.

This openness and the presumed parity between different ontological and epistemological systems is what allows me to experiment with the promises (and failures) of Western science and indigenous relationships to land and environment. This is part of an effort to think ourselves out of the quagmire that environmental crisis portends.

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