Since several decades, Earth sciences have been highlighting the enormity of the metabolic disturbances induced by mass productivism on the global scale. In total, the technosphere is now heavier than the non-human biosphere (Elhacham et al. 2020) and induces a huge global biogeochemical forcing, at magnitudes exceeding pre-industrial levels by several times in some cases. Whereas in the 19th century, Charles Lyell considered human geological activity to be infinitesimal compared to the amount of matter carried by the Brahmaputra, industrial societies today move more matter than ten times the volume of all the world's rivers (Cooper et al. 2018). As we know, these symptoms, coupled with other ones, have been gathered under the umbrella of the "Anthropocene" two decades ago (Crutzen 2002). It is at the same time a proposition for naming a new geological epoch and a new state of the earth system in which industrial activities have massively modified planetary metabolism (Steffen et al. 2011, Rocktröm et al. 2015).

In this anthropocenic condition, more or less new, and credible, "techno-scientific promises" (Benoit-Joli 2010) arise, including industrial ecology, circular economy, carbon neutrality, waste abolition, recycling and upcycling, or material flux optimization by digitalization. However, while the Anthropocene points out the huge materiality of our societies, these various promises often omit a crucial point in the anthropocenic metabolism: the materials themselves. Yet materials can be considered as major historical actors and operators of the Anthropocene: just as some of them (plastics, concrete, alloys, rare earths, …) are key drivers of its advent, new materials with alternative processes of production could also play an important role in a potential post-anthropocene bifurcation. Hence the necessity to rethink materials and materialities in the Anthropocene. Moreover, if material extraction linked to net zero global energy transition might greatly impair biodiversity (e.g. Sonter et al. 2020), it becomes urgent to rethink the dead-ends of industrial materialities even in its climate-compatible versions, in particular their connections to the living. To these ends, the conference will notably consider the materials of the Anthropocene from a "metabolic" perspective (Fischer-Kowalski and Hüttler 2008), i.e. one that looks at the cycles of transformation of matter within the planetary ensemble, and also includes the social, political and economic representations shaping them.

Materials in the Anthropocene: A Joint Science and Humanities Conference

Monday 1st of July

8:30 / Welcoming Coffee

9:00 - 11:15 / Morning Session

- Pierre de Jouvancourt & Sacha Loeve – *The Anthropocene, Materials, and the Metabolic Rift Challenge: Introductory remarks*
- Nelo Maglhães - *Thinking the Missing Mass of the Anthropocene*
- Franck-Dominique Vivien – *Bioeconomy in the Age of the Anthropocene*
- Bernadette Bensaude-Vincent – *Forging an Alternative Concept of Materials to Face the Anthropocene*

11:15 - 11:30 / Break

11:30 – 12:30 / Roundtable – How Did We Get There? The Role of Materials in the Advent of the Anthropocene

12:30 - 13:45 / Lunchtime

14:00 - 16:15 / Afternoon Session

- Mario Giampietro – *Stopping the Metabolic Rift: How to Imagine or Define Yet Unknown Social Practices?*
- Chiara Scarpitti – *Speculative Practices for Design and Fashion Material Imaginaries in the Anthropocene*
- Elena Albergati – *Exploring Sustainable Materials Design for the Anthropocene: Insights from the Made/Trans Research Group*
- Elise Rigot, Christophe Vieu, Laurent Malaquin - *Trajectories: From a Nano Imaginary of Matter to novel perspectives for research with Design*

16:15 – 16:30 / Break

16:30 – 17:30 / Roundtable – How to rethink or redesign the material imaginaries of the "transition"?

19:00 / Dinner

Tuesday 2nd of July

8:30 / Welcoming Coffee

9:00 – 11:15 / Morning Session

- Jean-Baptiste Fressoz – *The Anthropocene is an Accumolocene*
- Michaela Eder – *A reflection on Biogenic Material Use*
- Olivier Hamant - *The benefits of Imperfection: Lessons from Biology to live in a Turbulent World*
- Laurent Heux - *Biomimicry Put to the Probation of Reality: A Few Examples of Practical Trials*

10:45 - 11:00 / Break

11:00 - 12 30 / Roundtable – *Can materials reset current eco-socio metabolisms?*

12:30 - 13:45 / Lunchtime

15:00 - 16:00 / Exhibition Visit at Institut d'Art Contemporain de Villeurbanne: Pratiques cosmomorphes : (re)générer le vivant, 11 rue Docteur Dolard 69100 Villeurbanne

Contacts
Pierre.de-jouvancourt@univ-lyon3.fr
Sacha.loeve@univ-lyon3.fr

Conference address:
Bâtiment Buisson, Salle D8-001
Ecole Normale Supérieure de Lyon
15 Parvis René Descartes
69342 Lyon

Monday 1st of July

8:30 / Welcoming Coffee

9:00 - 11:15 / Morning Session

Pierre de Jouvancourt & Sacha Loeve – The Anthropocene, Materials, and the Metabolic Rift Challenge: Introductory remarks

Nelo Maglhães - Thinking the Missing Mass of the Anthropocene

This presentation discusses the role of the most important materials, by mass or volume, in the Anthropocene, based on an environmental history of large infrastructures in France: land, sediment, soil, sand and gravel. I first recall the criticisms of infrastructure studies on the absence of non-human actors in the economic history and narratives of the Anthropocene: "moderns" would neglect, even deny, their presence even though they are constantly intervening in social processes, as evidenced by moments of infrastructural rupture.

In contrast to these assertions, I then show how they have been integrated into a body of knowledge and know-how in the technical administrations of the French state since the 19th century - in particular, the *Ponts et Chaussées* engineers. Far from describing them as inert or ignoring them, these "moderns" consider them very seriously: in deciding whether to build an infrastructure on a given site, in repairing and maintaining those already in service, and in preventing instabilities and failures once construction has begun.

They are therefore eminently affected by these ordinary materials: what changes are the social relations they are embedded in, notably the technical and scientific field linked to the developmentalist state. The growing instability of this "assemblage" of humans and non-humans in the 1960-1970s is not attached to their hypothetical agencies but to the new dimensions of transport infrastructures required by globalisation of trade. Overall, it is necessary to articulate this missing mass with social sructures and power relations to make their omnipresence in the Anthropocene intelligible.

Franck-Dominique Vivien – Bioeconomy in the Age of the Anthropocene

The idea of integrating economic dynamics into that of the biosphere is not new. It has taken a new turn since the end of the 2000s with the reference to bioeconomy made by private economic actors and institutions in charge of public policies. This notion of bioeconomy remains largely controversial (Vivien et al., 2019). We would like to show that it covers very different economic, social and environmental perspectives, within which that of the Anthropocene does not necessarily have its place.

A first bioeconomy aims to use biomass to produce fuels and materials. It has very distant historical roots, dating back to the 1920s, and has since gone cycles of hopes and disappointments. It made a strong comeback in the 1980s, with the aim of exploiting the agricultural surpluses generated to the CAP. Arguments in favor of the environment have appeared more recently (fight against climate change, circular economy) and are used to build a carbon economy which does not really break with the logic of productivism.

A second bioeconomy to the developments and promises surrounding the rise of biotechnologies since the 1970s. Joël de corresponds Rosnay (1975), author of *The Macroscope*, is one of those who best describe this bioeconomy as a new agricultural and industrial revolution. He even sees biotechnologies as the solution to the environmental crisis (Bonneuil, 2020). Despite the reference he made to the Meadows report, this bio-industrial perspective is not a « thought of limits », it corresponds to a Schumpeterian scheme which announces a new cycle of growth.

Bernadette Bensaude-Vincent – Forging an Alternative Concept of Materials to Face the Anthropocene

Beyond the circles of Materials Science and Engineering who characterize materials by the relationship between processing, structure, properties and performances, materials are considered as major socioeconomic and geopolitical actors in social sciences. In the context of the Anthropocene, materials are understood as typical nature-culture hybrids, physical-chemical substances and social-economical actors at the same time. This approach, exemplified in the materials flow analyses (MFAs) performed within the current society metabolism paradigm is a highly effective way of highlighting the global imbalances caused by human treatments of materials, and of pointing potential pathways to remediation.

In this paper I will argue that MFA is a form of accounting of the inputs and outputs of materials that may produce a screen effect on the complex dynamics at work in the Anthropocene. The balance method developed with great success in modern chemistry proved to be extremely powerful to make both solid demonstrations based on quantitative data and rational judgements based on ratios. However, it rests on a number of preconceptions deeply rooted in popular culture such as the balance of nature that has been questioned as too static by ecologists. Furthermore, when applied at the global planetary scale this approach obfuscates that every material has its own temporal regime. While they belong to nature and depend on nature's laws, materials nevertheless were born and have a lifespan of their own. I will conclude that transcending the modern divide between a stable natural order and the progress of civilization to reconfigure materials as *historical beings* interacting with other historical entities may be conducive of a more sophisticated view of the Anthropocene.

11:15 - 11:30 / Break

11:30 – 12:30 / Roundtable – How Did We Get There? The Role of Materials in the Advent of the Anthropocene

12:30 - 13:45 / Lunchtime

14:00 - 16:15 / Afternoon Session

Mario Giampietro – Stopping the Metabolic Rift: How to Imagine or Define Yet Unknown Social Practices?

Given the seriousness of the current sustainability polycrisis and the solutions proposed by the establishment—which are failing miserably, we cannot but conclude that something is seriously wrong in sustainability science and policy. We are confronted with systematic ideological disinformation based on policy legends, such as the circular bioeconomy, a rapid decarbonization in 20 years, and the preservation of biodiversity through green growth. How is it possible that governments can get away with selling stories that are scientifically absurd?

Drawing on the principles of biosemiotics, I will show that the functioning of human society depends on the formation of sociotechnical imaginaries. The adoption of myths about desirable common futures (e.g., "Yes, we can!") are necessary to hold together the social fabric to reproduce and update our social identity. For this reason, human society does not tolerate heavy doses of uncomfortable knowledge (e.g., "Houston, we have a problem!") in sustainability discussions. They would delegitimize the establishment and (further) compromise its ability to govern.

On the other hand, the ongoing metabolic rift has created a situation of radical incompatibility between the processes taking place in the anthroposphere and those taking place in the ecosphere. We must urgently reconnect the economy to the ecosphere, but how? While we dedicate a lot of resources to studying the impact of replacing traditional cars with electric cars (a "more of the same" silver bullet), we are unwilling to study the impact of abolishing the private property of cars. Indeed, exploring social practices and futures that do not (yet) exist requires two radical changes:

- Prioritizing sociotechnical imaginaries that emphasize taking care of each other and the planet rather than economic growth.
- Stopping the use of meaningless complicated scientific models that generate "road maps to nowhere".

Both changes require moving to participatory quantitative storytelling to co-create new desirable futures.

Chiara Scarpitti – Speculative Practices for Design and Fashion Material Imaginaries in the Anthropocene

The paper summarizes in key points some research outputs resulting from two research projects funded by the University of Campania 'L. Vanvitelli' in 2022 and 2023.

The contribution deals with bio-hacking practices applied to contemporary design and fashion, aimed at an aesthetic and philosophical exploration of do-it-yourself materials. The objectives include an unexpected ecological awareness and a new post-anthropocentric gaze at materials that sees the designer as a catalyst for a more responsible vision of using material resources.

Cross-referencing aesthetic and philosophical theories on the Informe (Valéry, 1938, Bataille, 1974; Castoldi, 2018; Krauss, 2003) and the dark ecology (Morton, 2019), the contribution illustrates some bioskins experiments conducted to offer new human-nature relationships, looking at bioplastics from a perspective of sustainability and continuous metamorphosis (Coccia, 2022). The research is based on a complex philosophical framework, identifying speculative steps that influence the various experiments. Adopting a transdisciplinary approach between philosophy, design, and biology, the experimental practices illustrated take the form of open and replicable study processes oriented towards a new way of conceiving bioplastics manufacture.

In a context where material culture can restore equal importance to human beings and environmental ecosystems, the contribution highlights the extraordinary opportunity that emerges from the realization that the Anthropocene (Crutzen, 2002) is only a temporal phase necessary for a deeper and more mature awareness of the earth and its extractive resources. In opposition to an arrogant anthropocentrism that sees matter exclusively as an external resource to be exploited, an ethical awareness of materials appears necessary to understand the interdependence between humans and non-humans, living and non-living, for the well-being of the entire planet.

Investigating matter in its aesthetic and symbolic expressions reveals a new way of becoming intimate with the richness and heterogeneity of substances in nature. It is about "generating kinship - kinship-making - and exercising one's care for the other" (Haraway, 2019) to go beyond the human and the living. The research conclusions show how the laboratory experiences realized directly express production-based post-anthropocentric thinking capable of blurring the division between the subject-human and the matter-non-human, thus opening the way for further questions and speculative implications.

Elena Albergati – Exploring Sustainable Materials Design for the Anthropocene: Insights from the Made/Trans Research Group

This abstract presents the initiatives of Made/Trans (Materials Design for Transition), a global research collective dedicated to exploring materials from a designer's perspective, with a focus on promoting sustainable and circular development. Through rigorous research, applied projects and knowledge transfer initiatives, the group advocates for the adoption of alternative and emerging materials that are crucial for the transition towards sustainability. This transition means moving from the Anthropocene to the Post-Anthropocene.

The presentation will explore key research themes, including the development of circular and sustainable materials from unconventional organic and biological sources, the potential of DIY materials to stimulate innovation, and ecological practices for the sustainability transition in business. It will also explore interdisciplinary links between design, materials science and additive manufacturing, emphasising the integration of design and engineering through materials science and digital technologies. The use of bio-based materials derived from bacteria, algae and mycelium will be discussed as viable alternatives to traditional materials. Finally, the concept of Biological Interactive Design will be introduced, highlighting the integration of living organisms into interactive products to drive design innovation.

Elise Rigot, Christophe Vieu, Laurent Malaquin - Trajectories: From a Nano Imaginary of Matter to novel perspectives for research with Design

The design of scientific research projects, the nature of the investigated questions and the format of the subsequent scientific productions, either for peer scientists or for laid citizen, is a powerful trace of the social, epistemological and cultural role of Science and Research. With the raising awareness of a humanity entering anthropocenic era, the making of science needs to be deeply reconsidered. In this contribution, we would like to present possible postures and scientific trajectories for such a paradigmatical change that deviate strongly from the "old" vision of technoscientific developments.

Taking the example of the blooming of Nano technologies as a starting point, we will present on one hand, how this community of researchers intends now to tackle the ecological perspective and how they introduce sustainability in their nanoscale activities, materials and processes. On the other hand, we will also mention the emergence of research collectives and associations trying to address the question of the ecological impact of research activities as a whole. Finally, we will present another route for designing research projects in a totally different perspective. We will comment the development of a trans-disciplinary project gathering physicists, biologists, taxonomists, environmental scientists, and designers which addresses the question of Coral extinction. In this project we propose the use of 3D technologies and engineering science that avoids any techno-solutionism drift, to promote a scientific posture of mediators of coral's reef memory. Indeed, by applying advanced 3D technologies to coral skeletons structures visualization and reconstruction, we have initiated an open science archive named « Corallum fabrica »[1].

Through these examples and the scientific trajectories of the three contributing authors, we will discuss the necessary shift that we need to operate from a science of precision and control to a science of the care, and identify some of the numerous obstacles along this route.

16:15 – 16:30 / Break

16:30 – 17:30 / Roundtable – How to rethink or redesign the material imaginaries of the "transition"?

19:00 / Dinner

[1] See online https://corallumfabrica.laas.fr/3dlibrary.

Tuesday 2nd of July

8:30 / Welcoming Coffee

9:00 – 11:15 / Morning Session

Jean-Baptiste Fressoz – The Anthropocene is an Accumolocene

The Anthropocene refers to a double irreversibility, a double accumulation, an accumulation of accumulations: not only are material flows piling up in the different compartments of the earth system, but the anthropogenic material flows themselves tend to follow a logic of accumulation over time.

Although energy has been the focus of attention, it is by no means exceptional. Over the last two centuries, the range of raw materials used has expanded constantly, and each of these materials has been consumed in increasing quantities. Substitution processes are largely offset by rebound effects and reorientation of use. Despite the proliferation of synthetic products (plastics, etc.), no major raw material has declined, apart from sheep's wool, which is losing out to synthetic fibres, which is not good news for the environment. Over the last half-century, growth and innovation have never produced genuine substitution on a global scale. Put another way: no raw material has yet become obsolete.

Michaela Eder – A reflection on Biogenic Material Use

Plants, and in particular trees, are the largest contributors to biomass on earth (Bar-On et al 2018). Plants do not only feed various other organisms, they are also an important source as a material. One of the first materials used by humans was wood and it is still used for numerous applications. However, despite the abundance and regrowth, plants cannot be seen as an unlimited resource any longer. With increasing population and negative impacts of climate change on forests, our use of trees needs to be re-thought and discussed.

Currently, only a small proportion (~40%) of harvested trees is used for high value applications, such as wood taken from straight grown stem segments of adult trees. A large proportion of harvested trees are cut into small pieces and reassembled to boards by using glue which complicates re-use. Other parts are refined for making paper or directly used as an energy source. The reasons for this practice was the availability of wood for decades in the past, the maximization of profit, existing wood processing technologies and our limited understanding of wood apart from wood of straight stems.

An important step to change current use of trees is to better understand the diversity of geometries and material properties of wood. I will give an overview about current knowledge of natural wood and bark properties, their dependence on the location in the tree and effects of the environment on wood formation. This will be followed by a discussion about the activity of wood (and bark) during use. The focus will be on the dependence of properties

on moisture content and a discussion about difficulties and possibilities to harvest this activity in a responsible way.

Olivier Hamant - The benefits of Imperfection: Lessons from Biology to live in a Turbulent World

Unbridled competitiveness, just-in-time flow, precision agriculture, smart cities... Paradoxically, the age of optimization, performance and control makes our world ever more turbulent: mega-fires, security drift, globalized war. Taking inspiration from living beings, we will explore another way of inhabiting the Earth. While modern human societies have emphasized efficiency to the service of individual comfort, life is rather built on vulnerabilities, slowness, inconsistencies... that is to say, counter-performances, serving the group's robustness. A counter-program?

Laurent Heux - Biomimicry Put to the Probation of Reality: A Few Examples of Practical Trials

Abstact forthcoming.

10:45 - 11:00 / Break

11:00 - 12 30 / Roundtable – Can materials reset current eco-socio metabolisms?

12:30 - 13:45 / Lunchtime

15:00 - 16:00 / Exhibition Visit at Institut d'Art Contemporain de Villeurbanne: Pratiques cosmomorphes : (re)générer le vivant, 11 rue Docteur Dolard 69100 Villeurbanne

Contacts

Pierre.de-jouvancourt@univ-lyon3.fr

Sacha.loeve@univ-lyon3.fr

Conference address:

Bâtiment Buisson, Salle D8-001

Ecole Normale Supérieure de Lyon

15 Parvis René Descartes

69342 Lyon