

FEATURE

By Claudia Pasquero and Marco Poletto

Designing the Urban Microbiome



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It is timely in the Anthropocene, and even more so in the age of a global pandemic, to search for a non-anthropocentric mode of reasoning, and consequently also of designing. The Photosynthetica Consortium, established in 2018 and including London-based design innovation practice ecoLogicStudio, the Urban Morphogenesis Lab (Bartlett School of Architecture, University College London (UCL)) and the Synthetic Landscape Lab (University of Innsbruck, Austria), has therefore been pursuing architecture as a research-based practice. This Consortium has been exploring the interdependence of human and biological intelligence in design, by working directly with non-human living organisms.

¹ Timothy Morton, *Dark Ecology: For a Logic of Future Coexistence*, Columbia University Press (New York), 2016, and *Ecology Without Nature: Rethinking Environmental Aesthetics*, Harvard University Press (Boston, MA), 2007.

² See the Urbansphere, doctoral thesis by Marco Poletto <http://researchbank.rmit.edu.au/view/rmit:162673>

Dark Ecology¹. The current rush of many cities to develop blue-green plans dealing with future threats of climate change is a testament to the obsession of searching for ‘true’ answers within a problem-solving framework. The experience in practice illustrated in this article highlights the urgent need for a new design method capable of engaging the systemic nature of urban landscapes and their architecture.

Architects and planners often rely on a ‘sanitised’ and therefore highly aestheticised vision of the world’s eco-

systems, exemplified by the very notion of blue-green planning and its focus on greening cities. This notion may be one of the most enduring aspects we have inherited from modernity. And if bacteriological control was at the origin of its sanitation efforts, modern architecture and urban design turned it into a style; in other words, modernity did embed sanitation into an aesthetic value system. The contemporary paradigms of green cities and smart cities are the direct consequence of the evolution of that value system.

However, urban systems today are non-linear and composed of billions

of interlocking feedback loops forming what the authors call the Urbansphere². Waste production, pollution emission, contamination, decay and dissolution are some of the most intense processes within the Urbansphere and a critical part of its contemporary metabolism. These processes often constitute the dark side of urban ecology, a side that is often invisible to the human eye, one that is confined to restricted zones of our cities or exported to poorer regions of the world. Most significantly, it is erased from the consciousness of most urban dwellers, at least in the developed world.



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Microbiological landscapes

Reassessing the dark side of urban ecology implies bringing into focus a new aesthetic of nature and, as a consequence, of the urban landscape. This new aesthetic of nature projects the design practice into the realm of micro-organisms such as virus, bacteria and fungi. These creatures induce fear because their tactics often elude our comprehension; however their collective behaviours endowed them with exceptional properties. For example they are capable of turning what we consider waste and pollution into nutrients and raw material.

From this perspective, ecoLogicStudio's biodigital architectures promote a new urban aesthetic centred on a novel appreciation for the microscale of bacteria, as well as other forms of non-human intelligence. Within ecoLogicStudio's body of work the cultivation of these organisms becomes an act of 'culturalisation'³, thus entering the realm of architecture.

A notable example is ecoLogicStudio's 'H.O.R.T.U.S.' series, begun in 2012 and currently ongoing. H.O.R.T.U.S., the Latin term for garden, here works as an acronym for Hydro Organism Responsive To Urban Stimuli. It refers to a series of photosynthetic sculptures and urban structures that create artificial habitats for cyanobacteria integrated in the built environment. Within H.O.R.T.U.S., cyanobacteria are deployed not only as photosynthetic machines but also to absorb emissions from building

systems. They constitute a new active layer part of both urban and natural metabolic cycles, thus reconnecting the so-called green and dark sides of urban ecology. It is a new kind of architectural symbiosis.

The Photo.Synth.Etica venture.

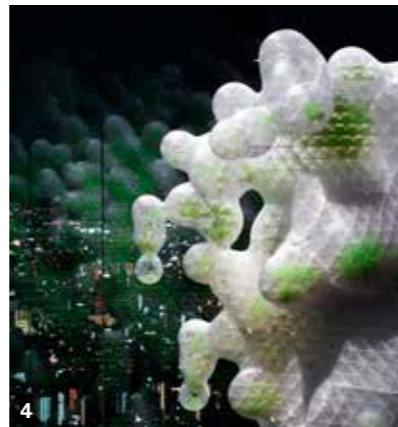
This symbiotic relationship has been explored in a recent project unveiled in Tokyo in November 2019, at the Mori Art Museum. Suspended at the 53rd floor of the Mori Tower and with the backdrop of Tokyo's urban sprawl, the sculpture materialises its urban dimension as a new prototype of living architecture, the PhotoSynthetica Tower. Explored through a series of associated speculative images, the project unfolds the architectural implications of H.O.R.T.U.S. as the embodiment of Tokyo's evolution into a future powerhouse of biodigital culture and technology.

At the city scale it appears as a complex synthetic organism in which bacteria, autonomous farming machines and other forms of animal intelligence become, alongside humans, biocitizens thus contributing to the formation and transformation of Tokyo's own synthetic urban landscape.

The biomass that grows in all the active areas of the tower is made available to the occupants of the building itself. This constant supply enables a plethora of emerging industries that will define the programmatic mix of the building itself and its occupational patterns (the times in the day and the night when



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ecoLogicStudio's biodigital architectures promote a new urban aesthetic centred on a novel appreciation for the microscale of bacteria...

each building unit is either empty or occupied with one or more activity), both in the case of human and non-human inhabitants.

Biodigital research units, gardening centres, wildlife observation terraces, self-sufficient dwellings and a potentially infinite variety of other programmatic combinations will be supported by the continuous catalytic action of the tower. It will constantly remetabolise anthropic pollution as well as biotic contamination into local circular economies of raw materials, data and energy.

In order to promote the evolution of this concept the authors have recently launched the PhotoSynthetica Venture, a transdisciplinary design-innovation project. The first PhotoSynthetica demonstrator was unveiled in November 2018 in Dublin, Ireland. 32 meters long and 7 meters high, it took the form of an "urban curtain" and was commissioned by the Climate-KIC, EU's most prominent climate innovation initiative.

The photosynthetic building membrane captured CO₂ from the atmosphere and stored it in real time at a rate of approximately one kilo of CO₂ per day, equivalent to that of 20 large trees. The innovative building technology achieves this through the integration of three layers of functionality⁴:

- Wetware: the selection and management of the living microalgae cultures
- Software: the digital management system. It uses sensors to optimise performance in real time. It also

provides long-term projections and predictions of the system's carbon capturing and air cleaning abilities

- Hardware: the artificial habitat for cultivation of living cultures, or photobioreactor. The project combines digital design and fabrication technologies to optimise aesthetic qualities, environmental performances and architectural integration.

Conclusion

PhotoSynthetica hopes to actualise significant economic, social, environmental and health benefits once it can be scaled up. The project embodies the multigenerational long-term benefits of adopting a carbon absorbing technology now, as it is 10 times more efficient at carbon sequestration than any other nature-based green technology.

The pandemic that is currently engulfing the world is a direct manifestation of the disbalance within the Urbansphere. While chronic exposure to air pollution affects our lungs and weakens our immune system, unsustainable food supply chains and practices are now and will continue to vector more and more pathogens within our bodies. This scenario calls for a broader systemic approach to urban development as well as for long-termism in any design approach. Our design practice seeks to enable both. Cyanobacteria from this perspective emerge from the urban microbiome to become a powerful design medium.



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³ Claudia Pasquero, Marco Poletto, Culturalizing the Microbiota, Routledge 2019

⁴ <https://www.photosynthetica.co.uk/system>