Reconceptualising zoos through *Mille-oeille*: a posthuman techno-architecture to sustain a human/non-human/culture continuum

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Introduction

The COVID-19 pandemic has once again shown that humans exist in a continuum with other species and nature, and also revealed the violence of our human-animal interaction and the nature of human interference, which has become an environmental and social problem on a global scale. Thinking beyond anthropocentrism has become an historical imperative, together with the way in which we conceptualize and create architecture: "ideologies are practices settled in our artefactual surroundings" (Broncano, 2020, p.98).

Zoos, as well as natural history museums and other nineteenth-century Western cultural institutions, have traditionally been the strongholds of taxidermic specimens, colonisation and classification systems for more than questionable exhibitions associated with knowledge production, entertainment and educational activities. We are now facing the need to decolonise historical narratives and unidirectional, lineal forms of thought, as well as the 'universalization' of knowledge produced by Western culture, constructed on the basis of excluding all kinds of "sexualized, racialized and naturalized 'others'" that were not recognized as part of humanity and therefore were not considered subjects of knowledge (Braidotti, 2013, p.27). The idea of 'this man of reason' underlying these built environments is rooted in a mind-body divide which has been crucial to Western thought since the Enlightenment and which most cultures on Earth do not share (Descola, 2009, 2013; Viveiros de Castro, 2015). This has created a sense of exceptionalism in relation to other species and bodies, including nature, which regards them as endless resources to be exploited. The scale of devastation in recent times urgently requires new ways of thinking and new ethical commitments.

Situated at the point of tension between the convergence of the Fourth Industrial Revolution and the Sixth Great Extinction, *Mille-oeille,* a speculative techno-architecture alternative to the traditional zoo, aims to move beyond anthropocentrism, sharing a 'vital materialism' sensitivity (Deleuze & Guattari, 1994) within the posthuman condition.

The key question in this post-anthropocentric approach, which also "enlists science and technology studies, new media and digital culture, environmentalism and earth sciences, biogenetics, neuroscience and robotics, evolutionary theory, critical legal theory, primatology, animal rights, and science fiction" (Braidotti, 2013, p.57), concerns how we can architecturally reconceptualise the idea of a zoo that supports the human and non-human continuum and is therefore ethically in keeping our times.

Methodology

In order to address this question, we applied a research through design method, a "designerly inquiry focused on the making of an artefact with the intended goal of societal change" (Roggema, 2017, p.3). *Mille-oeille* was originally conceptualised in 2007 to rethink the obsolescence of zoos and was graphically revised in 2018, when it was presented at the 16th Venice Biennale International Architecture Exhibition (European Cultural Centre, 2018). *Mille-oeille* is a symbiotic techno-architectural pavilion coexisting with its environment, whose name is derived from the French *mille-feuille* cake and the noun *oeil*, meaning 'eye' in English. In other words, it offers a 'thousand layers' of data and information from the local environment and other ecosystems across the planet, casting a 'thousand eyes' onto the world to collect the information that *Mille-oeille* receives and displays. It incorporates innovative technologies, including augmented reality (AR) and climate simulation,

embedded in a multi-layered smart envelope that offers a unique form of engagement with natural phenomena whilst supporting energy conservation. An empirical scientific method was therefore applied to design the material, using an iterative process of prototyping and testing. Since new forms of thinking and being in the world may need to be expressed by other types of materialities, Colored Liquid Crystal (CLC) was prototyped in parallel with the architectural proposal to resolve and express the qualities and potential of new aesthetic and sustainable paradigms for this specific project. Consequently, the environmental and social sustainability concerns underlying the research are addressed on both the material and the building scales. In addition, the review of the scientific literature and the analysis of case studies provide a concrete theoretical framework that validates *Mille-oeille* as a coherent response with potential for realisation.

Mille-oeille precedents and state of the art

Zoo design evolved considerably in the previous century, from paying little attention to animal habitats to mimicking original ecosystems. Although these technical improvements have advantages in terms of ensuring a better environment for animals, the major issue of keeping living beings in captivity remains one of the last relics of the modern era. In order to respond to such a fundamental question, the concept which geographer Gail Davies terms the 'electronic zoo' comes into play: "an emerging form of animal display […] as informational patterns in multi-dimensional electronic spaces […] [where] digital imaging, the internet and virtual reality take their place alongside more established technologies such as film, photography and television. These offer new ways of conceiving of and portraying natural history, and introduce the possibility of different relationships between human and animal experiences" (Davies, 2000, p.244).

The 'electronic zoo' model has already been partially or fully implemented in various ways. On the one hand, traditional zoos are increasingly making use of new technologies to display and represent animals or to enhance the physical experience through digitalisation. Technology-based interventions include education and entertainment materials based on gamification, virtual navigation, mobile learning applications, digital content systems and AR (Wibβotzki & Wichman, 2019), the latter system having been identified in studies as optimal in terms of not detracting from the physical space, as other technologies do (Karlsson et al., 2010; Kelling & Kelling, 2014; Perry et al., 2008). In addition, new technologies have been implemented to assist and explore animal-computer interaction (Webber et al., 2017).

On the other hand, completely virtual solutions are gaining attention. For example, the pioneering *Wildscreen at Bristol*, planned as part of the UK Millennium Projects, combined in-place accessible IMAX cinema and an internet-accessible database on endangered species in the world, namely the *Wildscreen ARKive* (2003). State-of-the-art AR technology is being applied in zoos and other programmes involving animals for entertainment or education. One example of this is the German Roncalli circus (Miley, 2019), which used Optoma ZU850 laser projectors to provide a 32-metre wide arena with a depth of 5 metres and 360-degree visibility for the entire audience. Another similar AR application, used for educational purposes, featured in the programme *Who do you Think You Really Are*? and presented at the Natural History Museum in London (2011), enabled the audience to watch and engage with life-size dinosaurs and other extinct creatures roaming around the museum.

Although the main achievement of electronic zoos has been to avoid keeping animals in captivity, we recognise that the model has still inherited controversies from the traditional zoo, such as unidirectional narratives and taxonomical perspectives. Moreover, it poses a variety of new challenges, such as privileging the visual over the multi-sensorial experience or excessive disengagement with nature.

Searching for inspiration in other models not related to human-animal interaction, we looked back to 1960s immersive and multisensory spatial designs in which artists and architects worked together to explore 'radical juxtapositions' (Sontag, 2009). The so-called *Movie-Drome,* conceived by the experimental filmmaker and media artist Stan VanDerBeek, is relevant to this research. The experiment consisted of an immersive experience involving a mixture of light, sound, photographs and news performed in real time at a geodesic

dome built in the north of New York state. The artist intended his installation to be a planetary experience that would run simultaneously in other *Movie-Dromes* which could potentially be scattered around the world (Sutton, 2003). The multiple, simultaneous multimedia information was identified by Colomina (2001) as a 'new form of distracted perception': a different way of generating and perceiving reality far removed from bounded narratives, which is generative in itself and intrinsically aimed at planetary communication.

Mille-oeille builds on these precedents, aiming to generate innovation by critically adopting, mixing, transforming and improving them in conceptual, aesthetic and technological terms.

A posthuman techno-architecture to sustain the human/non-human/culture continuum

 "Augmented reality creates coexistent spacial realities in which anything is possible, anywhere!" (ManifestAR group, 2011). How do we resolve the important socio-cultural dimension associated with actually visiting a zoo as a relevant part of this experience (Sickler & Fraser, 2009), from the perspective of creating a just setting for all human and non-human entities? How can architecture use technology wisely to provide a relevant experience, without keeping living beings in captivity or losing sight of its research, educational and entertainment purposes, thus supporting a human/non-human continuum?

Mille-oeille is installed in 'encapsulated' habitats (Sloterdijk, 2016), all unique in terms of the way humans, free or domesticated animals and nature have established reciprocal relationships, in reserves, veterinary farms, animal therapy centres or national parks, for example. All these instances constitute being 'atmospheric spheres of existence', 'bubble-worlds' or a 'foaming together', whilst remaining existentially apart (*Ibidem*): they are all unique places and different paradises in which coexistence between animals and humans has been deeply cultivated over time.

Multiple *Mille-oeille* pavilions could be distributed throughout the globe, 'foaming' a vast information network. They would receive images, data and objects from scientific expeditions and experts around the globe. Cameras used by scientists in the field are the pavilions' eyes onto the world. The images they record are transmitted and projected in real time using holographic-based AR, which is considered an ideal solution for providing 3D visuals (although it still needs to be perfected) (He et al., 2019). The appearance of the pavilions changes according to the number of projections occurring at the same time. The transparency level of their interior membrane fluctuates to accommodate incoming transmissions and, when viewed from the outside, the darkening of the envelope informs visitors in the surrounding park when a projection is taking place. The exhibition is organized by selecting one meridian of the globe and the expeditions taking place there. This allows the visitor to experience multiple ecosystems and different environmental conditions.

Morphologically and programmatically, *Mille-oeille* consists of a flattened spherical exoskeleton in which local animals can nest, thus creating other ecosystems in symbiosis with the building. The interior contains concentric rings of interconnected spheres decreasing in diameter from the biggest, at the centre of the pavilion, where AR holographic images and environmental conditions are recreated and multi-sensorial experiences take place, to the smaller 'bubbles' on the periphery where visitors can consult a detailed database. Between both regions, visitors pass through a section containing objects brought back from expeditions that can be studied. They enter *Mille-oeille* from the centre, where the exoskeleton stands, and can wander towards the periphery. This periplus within the pavilion provides an 'augmentation' experience: "a palimpsest-like process of overlapping information" (Gheorghiu & Stefan, 2014, p.257). The skin of *Mille-oeille's* inner volume is a multi-layered responsive envelope that changes its transparency, tincture and coloration dynamically, modulating the natural light coming in for optimal holographic projection-based AR and visualization in response to different transitory conditions. It can filter both visible and thermal radiation to avoid energy loss. Together, the exoskeleton and the metamorphic envelope create a moiré effect, functioning like the peripheral nervous system of a cephalopod to create dynamically controlled fading,

iridescence and pulsations with a behavioural plasticity that responds to different stimuli, such as the amount of visual information it receives, programmatic requirements and weather conditions.

Mille-oeille not only proposes a sensitive use of technology but also reformulates architecture from a phenomenological point of view in terms of form, materiality and spatial perception, including the aesthetic potential of AR. In order to enhance seamless perceptual depth via the spatial layering of the building, it avoids the use of headsets, screens or other obtrusive devices, instead proposing gloves as an interactive device, together with holographic projection-based AR, similar to the Roncalli Circus technology. Experts agree that viewing interfaces have to be flexible and robust and the tracking system moving around the audience has to be reliable for AR systems to be successful in this kind of environment (Barry et al., 2012). However, in our view, in order to create the most effective illusion, the way in which the AR is woven into the physical space is extremely important. Therefore, *Mille-oeille* is more of an architectural interface with transitory qualities which is able to express the different conditions that affect it (Fig. 1). (For more information about *Mille-oeille's* technical aspects, see Pérez-Guembe & Rubio-Hernández, 2021).

Discussion: *Mille-oeille* and a Garden of Earthly Delights.

In *Mille-oeille,* the environment, technology, AR, new media and the arts are choreographed through a bio-techno-architecture, following a human-animal-nature-culture continuum principle that understands life as a holistic collaboration of symbiotic relationships (Margulis & Sagan, 1995). It stresses the phenomenological experience, the embedded and the embodied, supporting active visitor engagement with knowledge creation, educational and entertainment goals. It moves beyond unidirectional views, gathering information from expeditions and studies of animals rather than the animals themselves. It avoids any overemphasis of the visual over other senses or excessive disengagement from nature, placing the interconnected pavilions in varied ecosystems, 'diverse paradises' or 'Gardens of Earthly Delights' and allowing them to generate others… This kind of techno-cephalopod with architectural features and a morphing skin, positioned and connected throughout the globe, advances spatio-temporal concepts in architecture such as simultaneity and ubiquity, and the multi-temporal and multi-scalar, "merging the cyberspace with the physical space", and creating "a knowledge-intensive society", as in the Society 5.0 paradigm (Deguchi, 2020, pp.6, 15), which advances the Fourth Industrial Revolution (*ibidem*). In addition, the CLC design with AR premises for image adequacy, site-specific and site-augmentative possibilities, together with the artistic and aesthetic potential and magic which both elements bring together, imply a provocative and poetic approach to scientific content. *Mille-oeille* aims to serve as a technological apparatus "far more complex and generative than the prosthetic, mechanical extension that modernity had made of it" (Braidotti, 2013, p.83). This project actively aims "to reinvent subjectivity, actualizing a relational self that functions in a nature-culture continuum and is technologically mediated" (*ibidem*). The vitality of this bond is based on the fact that we are all entities sharing the planet. (Fig. 2)
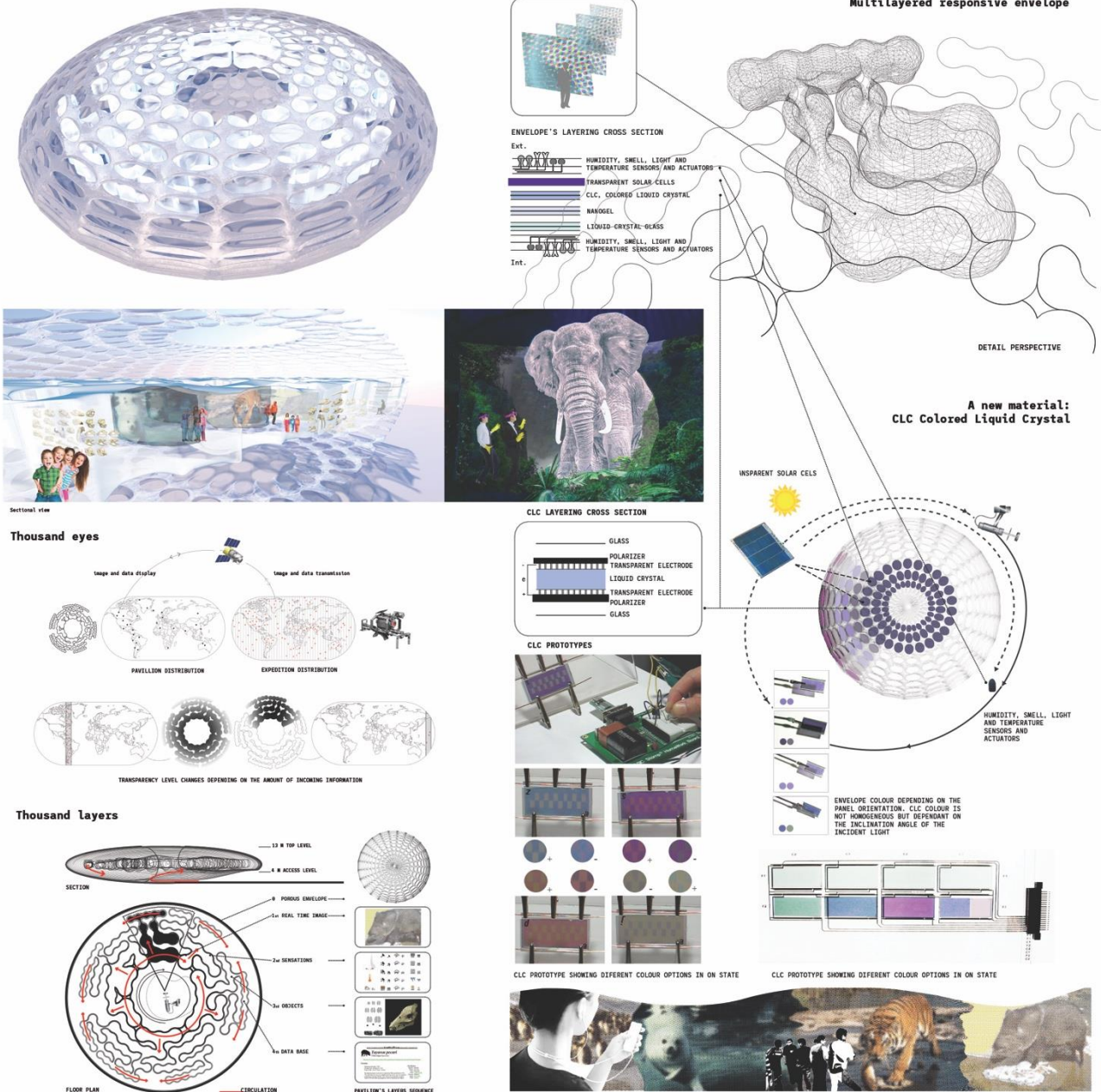
Figure 1: *Mille-oeille*: how it works and what it is made of

Figure 2: *Mille-oeille* in an exuberant Garden of Earthly Delights*

* We thank Mme Giraud for allowing us to add in this collage, Moebius' characters such as Arzach and Stel and Atan from the 'World of Edena', which not only belong to a 'diverse paradise' but to our cultural heritage. In memory of Luis Guembe and Jean Giraud for an open, exuberant and diverse world made by all and for all.

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