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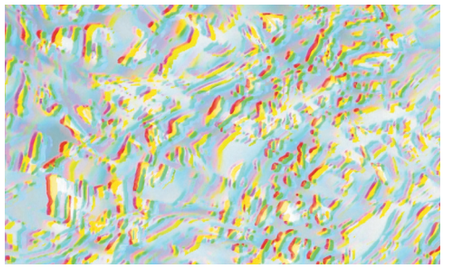
Ioana is a designer working between architecture, set design and critical practice, and is studying in her final year at the AA. Through a form of practice that combines theatrical techniques with academic research and architectural design, she seeks to question the architecture, science and rituals that influence what futures we are heading towards. Currently, Ioana is working on a project that aims to bring architects closer to the microscopic scale, and the scientists that harness it.

THE ARCHITECTURAL EXPOSOME



HOW COULD THE MEASURE OF EXPOSURES CHANGE THE BUILT ENVIRONMENT?

In biology, as in architecture, our understanding of the world is tied to how we can perceive it. In turn, what we are able to perceive is tied to the technologies we use to read, record and communicate. The exposome, first coined by the epidemiologist Dr Christopher Wild, is a relatively new concept that stems from precision medicine and has been defined as the environmental equivalent of the genome. The study of an individual's exposome is the cumulative measure of environmental influences and associated biological responses throughout that person's lifespan.[→1] It includes exposures from the environment, diet, behaviour, and endogenous processes. In a way, the exposome feels like a cross between a personal inescapable cloud and an ever-growing microscopic archive, linking the individual to its context and behaviour through the quantification of stimuli across time and across scale. It recognises that each person is in a state of flux and in constant exchange with all that it comes in contact with. At the architectural scale, the exposome reveals that constructed things are part of the environment and inextricably linked to all that they are exposed to.

In the biomedical field, Wild's idea was not able to gain much scientific traction or to seep into larger society until the Snyder lab at the Stanford University designed a device to quantify ones exposome. Their findings painted a comprehensive picture of the multitude of living beings, chemicals and particulates that swirl in, on and around us.[→2] The device takes small puffs of 'breath' and traps the matter that one might inhale, ingest or touch in a sub-micron filter. With over 70 billion readouts that reflect changes in location, spikes in cleanliness or changes of lifestyle, the study shows the specificity and extreme variety in exposures at the individual level – no two exposome could ever be identical. Once we start regarding the microscopic, context becomes hyper-specific and moves beyond the anthropocentric and the vitalist. Bacteria count as much as humans do and things don't vanish when they die.

In the same way as the individual exposome changes with even the most subtle stimuli, the architectural exposome is also a detailed record of all that a construction gets exposed to. The exposome of a building includes microscopic exposures in the description of its spatial context. Every wall, window or beam is in constant exchange with bacteria, fungi, viruses and all other molecules they come in contact with. The fungus Serpula lacrymans[→3] comfortably colonises timber and brick, while at the same time, probiotics for buildings are being proposed as a solution to sick building symptom.[→4] Architecture is inhabited by much more than just humans and creates environments for beings of many different sizes. As the measure of exposures expands the definition of a site to include volatile compounds, particles and microscopic life, they can all become active agents in the design of space. We now design in a time in which we can no longer afford to see architecture divorced from the natural world. In order to counter the fear that led to antibiotic resistance and the staleness that surrounds conversations on 'green' architecture, maybe we could start engaging the exposome to push for a design that functions cross-scale, cross-time and cross-species.

CROSS-SCALE

Architects work at scales that are always 1:something. We design large, complex structure and then draw them small, abstract and neat. At 1:1000 a wall is a solid line; at 1:1 a wall is the line between one space and another. But at 10,000:1 a wall is no longer a line or a solid mass. It is a penetrable ecosystem that mediates exchanges and exposures. As we zoom in and slow down, the intangible becomes tangible, microbes count as much as humans do and walls become porous and elusive. Moving beyond our scalar bias that favours the simplification of the very large, we could uncover a world that is ecocentric and non-deterministic.

In order to deal with the microscopic, we normally have to operate across the entirety of the scalar gradient. The European Commission adopted in June 2017 a comprehensive action plan in order to tackle the increased ability of microorganisms to resist antibiotics. The One Health Action Plan→[5] promises to tackle the 33,000 yearly deaths due to antimicrobial resistance, and perhaps the even more important issue of the '1.5 billion Euros per year in healthcare costs and productivity losses'. In order to design our exposome and achieve meaningful change at the scale of a bacterium, the action plan has to be pan-European and cross-species. As such, borders between nation states and between species dissolve. The ontological line in the sand that separates the 'micro' and the 'macro', as well as the political imaginary that presupposes nested scales (individual governed by community governed by nation), becomes fuzzy.

To understand the exposome is to understand that microscopic exposures are measures of cultural, legislative and physical climates. It also argues that no entity is divorced from the ecological and political systems they inhabit. Even at the most atomised, particles still neighbour many other types of particles, and can be broken down into many other particles that do the same. Phenomena are always entangled across scale.

CROSS-TIME

The exposome works by slow accretion. It is not momentary, but rather quantifies the many different elements one is exposed to through many data points over a long period of time. According to Dr. Wild, the exposome is 'from conception onwards' and acknowledges the ever-changing nature of stimuli one might come in contact with. Exposomes show that one cannot be neatly framed into a category or bubble and reminds us of the rhythms of the natural world. Architecture is not removed from these rhythms; it is inextricably entangled in dynamic and unpredictable systems.

The built environment does not remain as constructed, not to mention as designed, but rather constantly oozes and absorbs matter. Exposures over time are usually something that clients demand resilience against, and so architecture is most often designed to resist them. However, buildings do indeed change – their exposome changes them and they change exposomes in turn. If we were to regard the built environment slower, closer and with lenses from different disciplines, we could start seeing the many processes of exchange, growth and decay that happen in, around and with architecture. Echoing Isabelle Stenger's plea for 'slow science', architecture should engage with the slowness inherent in the development of a building's exposome. As a result, designers will be better positioned to accept and engage in the messy, fragile and elastic nature of the built environment.

The exposome shows that architecture is an amalgam of 'matters of concern'→[6]; it is not a set of 'right answers', but rather a constant negotiation of difficult choices, hesitation and scrutiny. This is despite the complaints of developers for whom time is money and space a profit equation. But, as the horizon of the future narrows in our increasing ability to predict change, we must slow down in order to see that nothing is ever static. Buildings or rather changes to the built environment can have consequences that long outlive their intended lifespan.

CROSS-SPECIES

Modernism purified, outlined and constrained the environments we inhabit in order to optimise our exposomes. The rational man was to live in a world that was clean, transparent and easy to monitor. Meanwhile, nature was labelled as a sublime and romantic space of anti-modernity.→[7] The intrinsic messiness of ecology was allowed to keep existing, but had no place in the built environment. In Corbusier's dream 'there are no more dirty, dark corners. Everything is shown as it is. Then comes inner cleanliness...'. The previously irrational fear of microscopic life was formalised into a social value and desirable design language that ended up achieving the opposite goal; microbes learned to evade our efforts and survive antimicrobial moves.

At the same time, the people inhabiting space are more microbes than humans. Microbes are so prevalent in and around the human body that they outnumber human cells and have profound effects on how we function, feel and think→[8]. Animals, plants and humans have co-evolved in and with environments that are rich with microbes. In many ways, a healthy microbiome is a quality of space that is more important than any other element conventionally drawn by an architect. In Lowenhaupt Tsing's words: 'Making worlds is not limited to humans – all organisms make ecological living places, altering earth, air and water. (...) Each organism changes everyone's world'. We sit alongside other critters in ever-changing configurations or places, times, matters and meanings. The exposome pushes them to the foreground.

As microbiologists push for a shift away from 'bad germs' towards a reconceptualisaton of microbes as invaluable partners in health and comfort, architects should start challenging the modernist myth of cleanliness. Just as bodies are not fortresses to be protected, but rather complex symbiotic systems, space is also not something to be sanitised, but rather a collection of pulsating ecosystems. By continuing to stick to an anthropocentric lens, we are not just losing individuals, species or macro-environments, such as coral reefs, but we also forfeit the ability to generate and nurture complex multispecies partnerships.

DESIGN BY EXPOSOME

By proposing a design methodology that functions cross-scale, cross-species and cross-time, the exposome makes trouble.→[9] It highlights the complexity and the mess that makes up space, in order 'to stir up potent response to devastating events, as well as to settle troubled waters and rebuild quiet places'.→[10] To see architecture as a space of symbiosis complicates thought habits. Walls are no longer the solid boundaries we so trusted and we must reassess what new boundaries there are and how architects can design them. The rigid enclosures our current societies rely on no longer safely contain the bubble of the nuclear family or the border of the nation state. Suddenly we realise that the teleological line-drawings architects conventionally work with evade many aspects of how we actually perceive space. At the same time, we see that nation state borders mean nothing to microbes and so we can no longer isolate environments with political demarcations. The Newtonian separation between discrete entities comes undone which in turn tears apart modernist determinism.

In order to understand the complexity of our surroundings and the many ways in which we put fragile balances at risk, architects could shift the focus from human and short term profit, to the microscopic and the entangled. As scientists like Margaret McFall-Ngai →[11] push for more collaboration between microbiologists, macrobiologists and ecologists, I argue for the importance of an architect at that table. In the same way that the exposome increases the reach of the body or the building to its adjacent areas, so too can architects use these tools to design increase the agency and responsibility of the profession. The alternative is architectures' continued complacency and ignorance of its role in the extinction of animals, plants and (crucially) microbes.

'In ignoring messiness, and dreaming of its eradication, we discover that we have messed up our world.'→[12]

1 Gary W Miller, *The Exposome*, (Burlington: Elsevier Science, 2013), p 1

2 Michael Snyder, et al. *Dynamic Human Environmental Exposome Revealed By Longitudinal Personal Monitoring*, (Cell 175 (1): 277-291.e31. doi:10.1016/j.cell.2018.08.060, 2018)

3 Commonly known as dry rot.

4 *Air, Surface, And Object Purification Systems*, (Better Air), 2019 (betterairus.com)

5 *Antimicrobial Resistance*, (Antimicrobial Resistance – European Commission), 2019. (ec.europa.eu/health/amr/antimicrobial-resistance_en)

6 Bruno Latour, *Why Has Critique Run Out Of Steam? From Matters Of Fact To Matters Of Concern*, (Critical Inquiry 30 (2): 225-248.doi:10.1086/421123, 2004)

7 Anna Lowenhaupt Tsing, *The Mushroom At The End Of The World*, (Princeton, N.J.: Princeton University Press, 2015), p 5

8 J A Bravo, et al. *Do Gut Bacteria Make A Second Home In Our Brains?*, (Science | AAAS. *www.sciencemag.org/news/2018/11/do-gut-bacteria-make-second-home-our-brains*. 'Ingestion Of Lactobacillus Strain Regulates Emotional Behavior And Central GABA Receptor Expression In A Mouse Via The Vagus Nerve'. *Proceedings Of The National Academy Of Sciences* 108 (38): 16050-16055. doi:10.1073/pnas.1102999108), 2019

9 I use the word trouble in the sense that was proposed by Donna Haraway.

10 Donna J. Haraway, *Staying With The Trouble*, (Durham: Duke University Press, 2016)

11 Margaret McFall-Ngai, *Noticing Microbial Worlds*, (In Arts Of Living On A Damaged Planet, M51 - M67. Minneapolis, London: University of Minnesota Press, 2017)

12 Isabelle Stengers, *Another Science Is Possible* (Cambridge: Polity press, 2018