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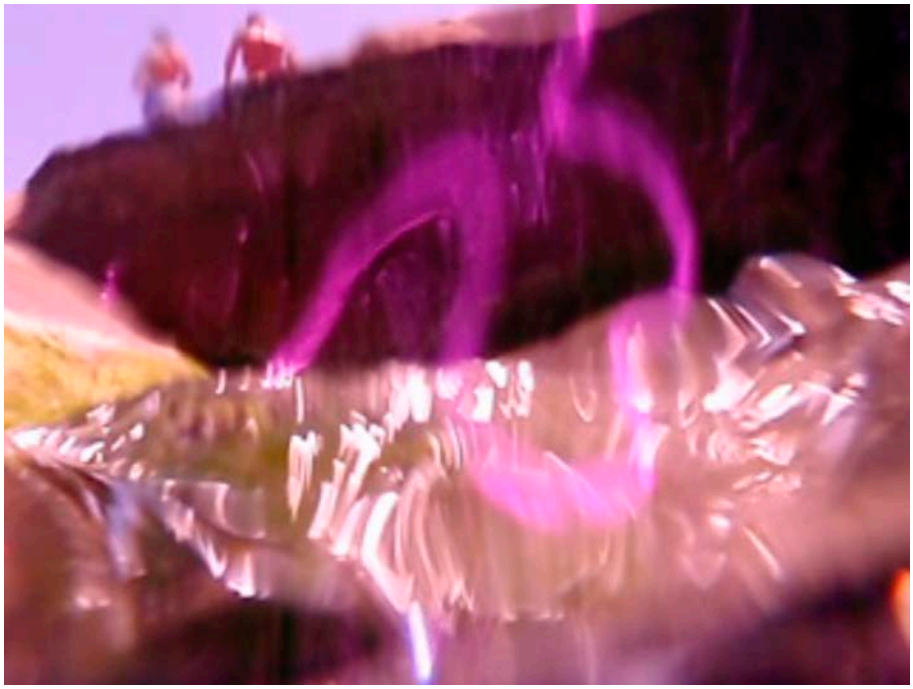
*How can academics have a more powerful influence on the development of practical environmental solutions and improve the likelihood of their being adopted by society at large?*

**Dr. ARMSTRONG:** Academics can have a more potent influence in ecological innovation through working with companies whose activities have significant environmental impacts. My own work has engaged with professional architects, construction engineers, and property developers to begin new conversations about what "sustainability" actually means and how they may respond to this in practice. For example, collaboration with Arup *Thoughts* on a blog post entitled "From sustainable to evolvable" challenged expectations in ecological practices within this international construction engineering company by proposing that building solutions needed to account for continual change and not simply to consider the efficiency of a particular product, or building, at the time of its construction (Armstrong, 2012a). Also, with Astudio architects, I have been working as a consultant and facilitator in their new research and development department, where I shared my research and brought new academics into their networks. Now, the architectural practice is able to design and develop new projects such as algae installations and facades that were not previously within their skill set to achieve (Astudio, No date).

Yet the challenge for academics in commercial environments is to make the dissemination of knowledge a profitable endeavor for universities. While it is one thing to offer consultancy and knowledge transfer, getting paid sufficiently as an academic to make it worthwhile for the educational institution is another matter altogether. University funding structures are complex, and without formal financial systems that can facilitate commercial exchanges between academia and business, goodwill and the desire for outreach are not in themselves sustainable. Yet, such partnerships are powerful ways of bringing academic visions, which stimulate new ways of thinking, into an active public forum where complex conversations about professional practices and traditions, costs, social impacts, and cultural values can transform the potential of a forward-looking organization into a far-sighted one that is also able to initiate innovation. Indeed, industry has the potential to support new ideas through their endorsements.



*This view of the Romanian Black Sea shoreline encapsulates the turbulent, lively character of the natural world in the 21st century that Koert van Mensvoort describes as* Next Nature. *Photograph from movie still by Rachel Armstrong, 2009.*

In a perceptive comment following a panel discussion on a talk I gave on "Tomorrow's Technologies" at Wragge & Co., a legal firm specializing in patents for emerging technologies, Head of Sustainability Pascal Mittermaier proposed that large corporations such as Lend Lease have a duty to support cutting-edge and challenging research, since it

is the way they can predict the future and anticipate public and commercial needs—by having a role in shaping it (Tomorrow's Company, 2013). His comments on spreading risk in innovation were inspiring, as it appears that when it comes to the social value of new developments and visionary thinking—risk operates as a form of currency. This starkly contrasts with wealth generation, which is about reducing risk to maximize profits.

Potentially then, academic, commercial, and community contracts could be developed along these principles whereby radical developments are underpinned by sharing investments in change, which may take various forms, such as in kind, skill sets, knowledge, funding etc. Maybe by examining alternative forms of value and how they may be used as a contract between universities, businesses, and communities, foundations for sustainable and even profitable relationships with academia may become possible—so that academics may indeed play more effective roles and influence the development of practical environmental solutions and their uptake by society.

*Given that the public and governmental debates on environmental issues often include discussions about science, technology, and business practices, what do you think is the most constructive path to achieving active working relationships with all members of society?*

**Dr. ARMSTRONG:** To achieve active working relationships with all members of society, a much broader understanding of the complexity of the cultural issues that are entangled with prevailing discussions of science and technology need to be more fully grasped by the organizations responsible for the public understanding of science. In the language of institutions, science has a special place as the language of secular truth, and from an institutional perspective, it may be difficult to comprehend why even an informed public may appear to be so resistant to persuasion by "evidence." However, from a public perspective, scientific narratives are newcomers to a much deeper and complex understanding of reality. Yet, 21st century culture is deeply steeped in scientific advances and technological developments that have become naturalized as part of everyday reality. Indeed the "magic" of gadgets and their ability to transform our world has bound them so closely to us that we think of them as extensions of ourselves, whereby we actually miss our mobile phones when we forget to bring them with us. In this sense, science does not have a special place in the construction of narratives but is simply just one more form of storytelling in a palette of competing narratives that shape our understanding of the world.

Interestingly, we are also very comfortable with paradoxical perspectives on the nature of our reality since, while our understanding of technology has become naturalized, our relationship with the natural world appears increasingly contrived. Koert van Mensvoort observes that technology, ecology, and culture are deeply entangled in a phenomenon that

he calls Next Nature – or, the Nature produced by people (Mensvoort, No date). Dealing with this complex entanglement of belief systems and desires in an age of advanced technology is no simple matter but is critical to developing inclusive and active working social relationships.

*The Charles Ray 'Boy with Frog' statue in Venice, discusses how science and culture play an entangled role in shaping our communities. Photograph by Rachel Armstrong, 2011.*

Arguably, the greatest challenge that academia and institutions face in the current environmental crisis, is in galvanizing the efforts of the public and organizational bodies to respond synergistically to the unpredictable liveliness of our material world—a challenge that is shaped by discourses about "climate change." Yet this term refers to more than a set of empirical changes in environmental conditions that can be attributed to specific causes—such as climbing partial-pressures of carbon dioxide; greater-than-average rainfall; reductions in biodiversity; the march northwards of tropical diseases; or apparent shifts in the earth's magnetic poles. It also represents our cultural experience of materiality, which is not only extremely lively (Bennett, 2010), but also highly technologized. So while Old Nature may spontaneously produce tornadoes—which are the kind of nonhuman phenomenon that architects are typically called upon to design against and factor out of our lives—(for example, Q4 Architects' Tornado-Proof CORE House, for the American Institute of Architects Designing Recovery competition, is equipped with a virtually "indestructible" inner concrete core (Grozdanic, 2013))—Next Nature offers a different kind of materiality that gives rise to energy-producing human-

made tornadoes such as those produced by Louis Michaud (Michaud and Michaud, 2010). Or, it creates dramas for storm chasers where tornadoes do battle with wind turbines. Moreover, although the Fukushima nuclear disaster was precipitated by a tsunami of shivers down the geothermal spine of the Pacific tectonic plate, its radioactive leakage into the Pacific Ocean is a co-designed act of environmental radiation, in which we've played a significant part.

Timothy Morton insists that to observe Nature more clearly, we should divest it of entrenched aestheticisms since they obscure and constrain its true materiality (Morton, 2007). Yet, how do we begin to embrace this material strangeness through an understanding of say, the continent-sized toxic entanglements of plastics, wildlife, and currents that constitute our Great Ocean Garbage Patches? Yet, not all of these bizarre encounters with Next Nature are shocking. When torrential rainfall burst the banks of the River Severn and water surged through the streets of Worcester this Christmas, graceful white birds paddled through the flooded town in a magnificent spectacle known as—*Swangeddon* (Edmonds, 2013).

Next Nature has a radically different materiality from Old Nature and may be distinguished by its profound technological and social transformations that promise new design opportunities. While Old Nature has always been restlessly unpredictable, our design attitudes have generally sought protection—by assuaging her fits of ill temper in appeasing the deities of a pre-industrial age. Or, since the Industrial Revolution, we have sought to create the illusion of environmental stability—through the construction of barriers, powerful machines, and knowledge from scientific insights—that have enabled us to believe that we can understand, control, and therefore conquer matter. Yet, in the late 20th century researchers such as Rachel Carson and Edward O. Wilson also showed these very processes—that spawned the conglomerations of Le Corbusier's "machines for living in" of our modern cities—are irreversibly destroying our environment. Global governments have responded with notions of "sustainable development," where generations can meet their own needs without compromising the prosperity of subsequent generations. This commitment has intensified with the recent advent of megacities and with a global population set to hit 9 billion by the middle of this century, according to the UN Population Division; the survival of our species is deeply entangled with the future of the built environment.

Potentially, more inclusive relationships with all members of society may be developed through creating new narratives about Next Nature that break from our industrial past and paint new possibilities of survival in a time "beyond" our umbilical dependency on machines. For example, following 30 years of biotechnological advances, we are now at a

point where we can use the technologies of life to create new developmental platforms that shape our world. Governing bodies, policy makers, and academics therefore need to think differently about the power of story telling, and how this may be applied in their own work to more persuasively expose people to the complexity of the issues that we all face and remind them just how important their individual choices really are. Creating enabling frameworks where new stories, which speak of empowerment, enable people to engage, make choices, and feel as if they are able to constructively contribute to society by living well, rather than being constrained by notions of austerity, which foster "learned helplessness." Indeed, new, optimistic, but not naive, visions of future possibilities may bring about positive responses to the challenges posed by climate change. This is not to say that careful conservation of our limited resources should not be practiced in an industrial era, but rather, that institutors and academics may forge better working relationships with general audiences by using their "facts" and "data" to free the public imagination—rather than constrain it—and encourage them to speculate on what happens "next" so we may collectively and positively shape human development in the next technological era.

*What global activity/process/innovation would you put in place immediately to address environmental challenges?*

**Dr. ARMSTRONG:** It is urgent and essential to invest in developing qualitatively different production platforms to our current industrial technologies, so that we may produce new toolsets that shape human development without fundamentally harming ecological systems—but rather restore and strengthen them.

My research seeks such a technological system by working across the Two Cultures to develop ecological design principles and practices that shape our encounters with the unique materiality of Next Nature. I have been working on a unique production platform since 2009 based on the notion of "assemblage" technology. The term originates from Giles Deleuze and Felix Guattari's notion of *agencement,* which refers to specific groupings of interacting, intrinsically empowered objects called *actants* (Deleuze and Guattari, 1979). In my research activities, I have operationalized the concept of assemblages using *dissipative structures* (Prigogine, 1997, p27) to produce a meta-technology that can couple together heterogeneous agents to form new tools and technical objects. Assemblage technology can be manipulated by applying the principles of *natural computing*—a term inspired by Alan Turing's interest in the computational powers of Nature (Denning, 2007). Natural computing techniques influence assemblages by constructing spatial programs that alter their chemistry, context, and infrastructure, which lead to different outcomes that deal with the transformation of matter, rather than resource consumption.

Through a set of design-led experiments—which included the cybernetic installation Hylozoic Ground, a collaboration with architect Philip Beesley that was exhibited at the 2010 Venice Architecture Biennale (Armstrong and Beesley, 2011), and Future Venice, a site specific proposal to grow a carbon-fixing limestone reef under the city to attenuate its sinking (Armstrong, 2012b) —I developed a set of design principles that can be used to apply assemblage technology in a range of contexts, such as in the under-imagined sites in our buildings, like cavity wall spaces that are currently filled with inert, or toxic materials.

*The golden orbs within this Hylozoic Ground installation by architect Philip Beesley, shown at the Venice Architecture Biennale 2011, contain "living" chemistries that can sense the carbon dioxide breathed out by gallery visitors by changing color. Photograph by Rachel Armstrong, 2010.*

Pressing support for further developing this platform is essential, since, despite being at the earliest stages of its scientific and technological development, it promises to be a powerful integrating platform and may offer a radical new platform for human development that builds, rather than harms, ecological relationships. Importantly, assemblage technology creates new architectural design opportunities where the lively and technological properties of the material realm may be applied in the construction of spatial

programs as physical expressions of *vibrant architecture,* which take the form of post-natural fabrics and synthetic ecologies (Armstrong, 2011). By supporting the development of vibrant architectures, we may transform the materiality of our megacities so that they are not static edifices but maintain their liveliness through metabolic processes. Metabolic networks enable vibrant architectures to continue to couple with others actants, bodies, and networks of material-flows that strengthen relationships within ecosystems. They are therefore consistent with Morton's notion of an *ecological* practice (Morton, 2007), where metabolic processes shape design and engineering practices in ways that do not replicate the tactics of mechanical systems. From a pragmatic perspective, vibrant architecture is not an architectural "fix," for it does not propose to save us from the contrary predicament of Next Nature, which is continually constructing surprising new material encounters. Rather, in its current form, vibrant architecture may simply increase the portfolio of strategies through which we may (re)negotiate our own ecological survival.

Yet, from an idealistic viewpoint, vibrant architecture proposes to completely change the developmental platform that underpins this millennial wave of human expansion. It utterly rejects the austere view of sustainability as a continuation of the "war on matter" that was begun during the Industrial Revolution and looks to the technologies of life as its allies. Indeed, lifelike materials offer something potentially revolutionary to architectural design by liberating the radical creativity of the material realm and catalyzing many different kinds of couplings with Next Nature. These potent hybrid bodies may continue to combine with others in ways that transform, rather than consume our surroundings. Of course, humans may play a part in these manifold metamorphoses by unleashing the shocking fertility of the material realm through the production of vibrant architectures. In this way, we may resist the relentless march of industrial machines that are unrepentantly reverse-terraforming the Earth.

At this critical juncture in our existence, we cannot accept the glut of economic taboos, political inertia, conceptual blind spots, and social platitudes that prevent us from rewriting our shared future as one of mutual survival. Instead we must urgently seize this moment and invest in the science, technology, and design practices that midwife the existence of vibrant architectures to prompt an immediate (re)imagining of our world, notions of life, community, and what it means to be human at a time of ecological crisis—so that we can set free the creative powers of our nonhuman partners in (co)existence and facilitate their inexorable evolution.

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