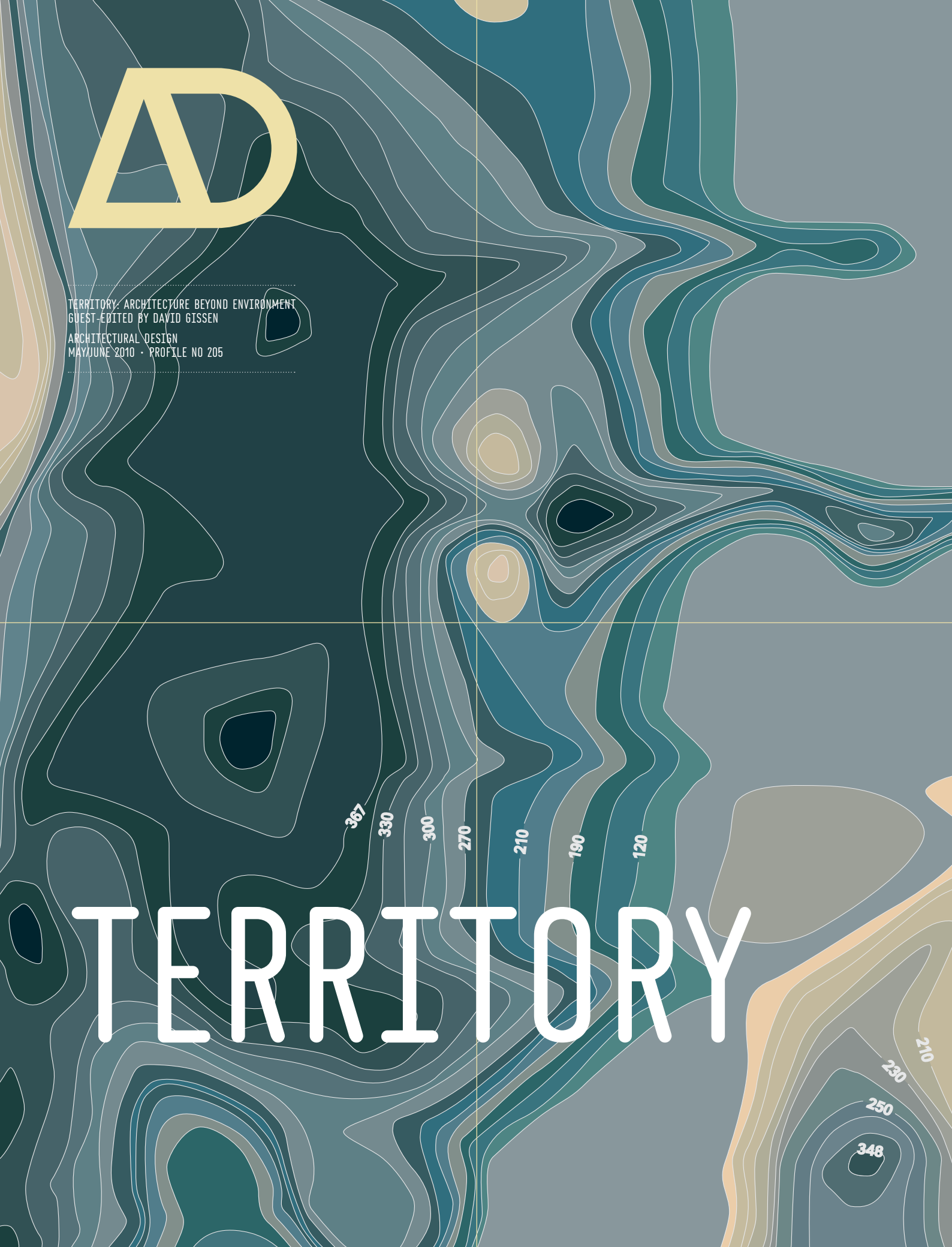
AD
TERRITORY: ARCHITECTURE BEYOND ENVIRONMENT
GUEST-EDITED BY DAVID GISSEN
ARCHITECTURAL DESIGN
MAY/JUNE 2010 • PROFILE NO 205
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Volume 80 No 4
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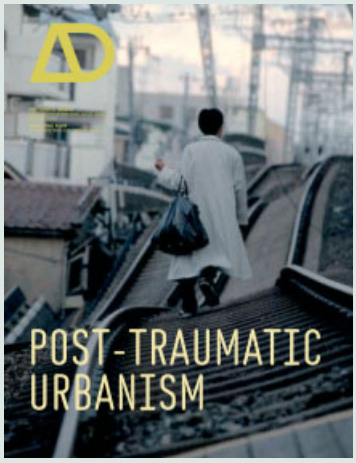
JULY/AUGUST 2010
PROFILE NO 206

THE NEW STRUCTURALISM: DESIGN, ENGINEERING AND ARCHITECTURAL TECHNOLOGIES

GUEST-EDITED BY RIVKA OXMAN AND ROBERT OXMAN

Today the convergence of design, engineering and architectural technologies are breeding a new material practice in experimental architecture. The significant emphasis on the structuring logic of tectonics is resulting in a 'new structuralism' in design. In this pioneering publication, this important shift is fully defined as a highly dynamic synthesis of emerging principles of spatial, structural and material ordering integrated through the application of materialisation and fabrication technologies. Providing the foundations for a new theory of structuring in architecture, *The New Structuralism* has broad implications for the way we both conceive and undertake architectural design, as its impact starts to emanate not only across education internationally, but also through architectural research and practice.

- Features exemplary work by research and experimental design-oriented structural engineering practices: Bollinger + Grohmann, Buro Happold, Hanif Kara (AKT) and Werner Sobek.
- Theoretical contributions from: David Chilton, Holzer and Downing, Neri Oxman, Helmut Pottmann, Nina Rappaport and Yves Weinand.
- Focuses on new design and fabrication technologies in the recent work of Barkow and Leibinger, EMBT (Enric Miralles and Benedetta Tagliabue), Gramazio and Kohler, and Fabian Scheurer (Designtoproduction).



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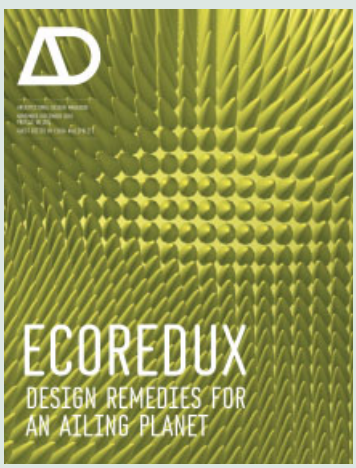
SEPTEMBER/OCTOBER 2010
PROFILE NO 207

POST-TRAUMATIC URBANISM

GUEST-EDITED BY ANTHONY BURKE, ADRIAN LAHOUD AND CHARLES RICE

Urban trauma describes a condition where conflict or catastrophe has disrupted and damaged not only the physical environment and infrastructure of a city, but also the social and cultural networks. Cities experiencing trauma dominate the daily news. Images of blasted buildings, or events such as Cyclone Katrina exemplify the sense of 'immediate impact'. But how is this trauma to be understood in its aftermath, and in urban terms? What is the response of the discipline to the post-traumatic condition? On the one hand, one can try to restore and recover everything that has passed, or otherwise see the post-traumatic city as a resilient space poised on the cusp of new potentialities. While repair and reconstruction are automatic reflexes, the knowledge and practices of the disciplines need to be imbued with a deeper understanding of the effect of trauma on cities and their contingent realities. This issue will pursue this latter approach, using examples of post-traumatic urban conditions to rethink the agency of architecture and urbanism in the contemporary world. Post-traumatic urbanism demands of architects the mobilisation of skills, criticality and creativity in contexts with which they are not familiar. The post-traumatic is no longer the exception; it is the global condition.

- Contributors include: Andrew Benjamin, Ole Bouman, Tony Chakar, Mark Fisher, Christopher Hight, Brian Massumi, Todd Reisz, Eyal Weizman and Slavoj Zizek.
- Featured cities: Beirut, Shenzhen, Berlin, Baghdad, Kabul and Caracas
- Encompasses: urban conflict, reconstruction, infrastructure, development, climate change, public relations, population growth and film.



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NOVEMBER/DECEMBER 2010
PROFILE NO 208

ECOREDUX: DESIGN REMEDIES FOR AN AILING PLANET

GUEST-EDITED BY LYDIA KALLIPOLITI

This issue of *AD* explores the remarkable resurgence of ecological strategies in architectural imagination. As a symptom of a new sociopolitical reality inundated with environmental catastrophes, sudden climatic changes, garbage-packed metropolises and para-economies of non-recyclable e-waste, environmental consciousness and the image of the earth re-emerges, after the 1960s, as an inevitable cultural armature for architects; now faced with the urgency to heal an ill-managed planet that is headed towards evolutionary bankruptcy. At present though, in a world that has suffered severe loss of resources, the new wave of ecological architecture is not solely directed to the ethics of the world's salvation, yet rather upraises as a psycho-spatial or mental position, fuelling a reality of change, motion and action. Coined as 'EcoRedux', this position differs from utopia in that it does not explicitly seek to be right; it recognises pollution and waste as generative potentials for design. In this sense, projects that may appear at first sight as science-fictional are not part of a foreign sphere, unassociated with the real, but an extrusion of our own realms and operations.

- Contributors include: Matthias Hollwich and Marc Kushner (HWKN), David Turnbull and Jane Harrison (ATOPIA), Anthony Vidler and Mark Wigley
- Featured architects: Anna Pla Catalá, Eva Franch-Gilabert. Mitchell Joachim (Terreform One), François Roche (R&Sie(n)), Rafi Segal, Alexandros Tsamis and Eric Vergne

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GUEST-EDITED BY
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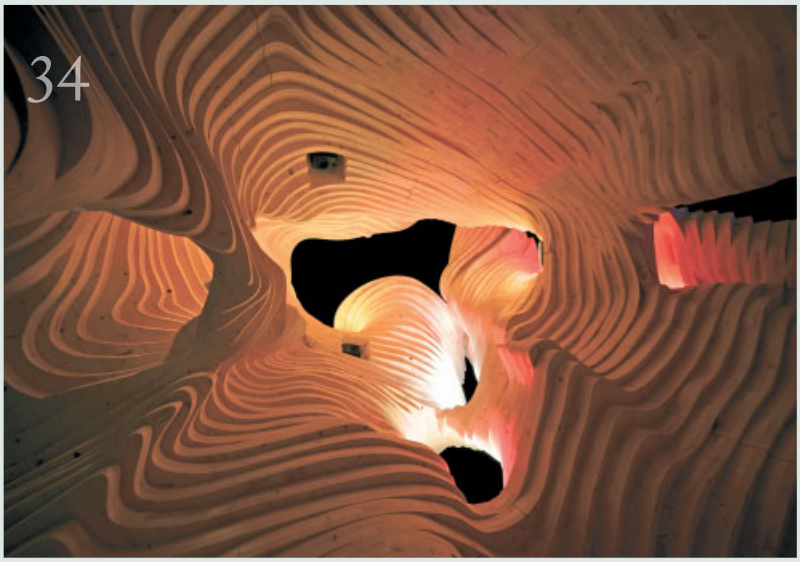

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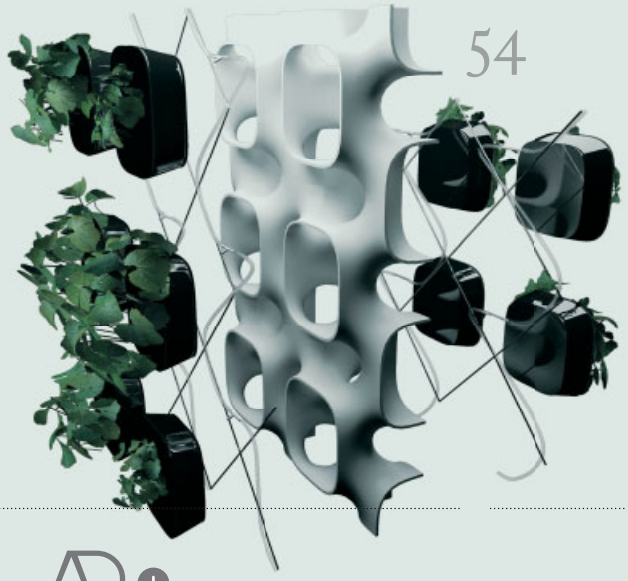

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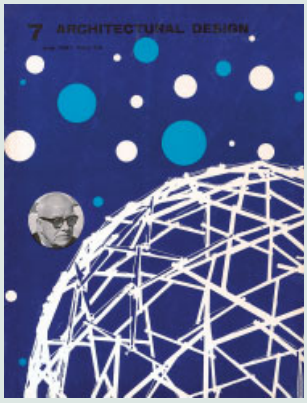
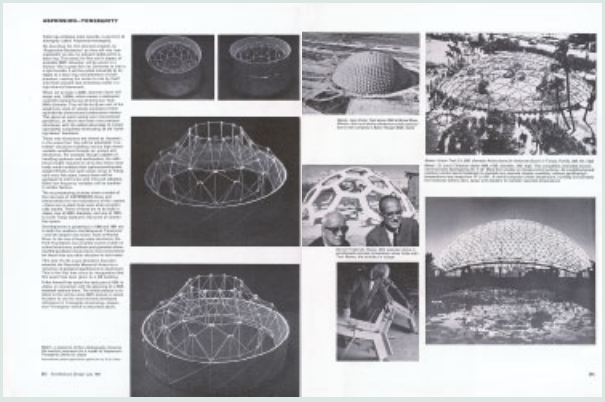
EDITORIAL

Helen Castle

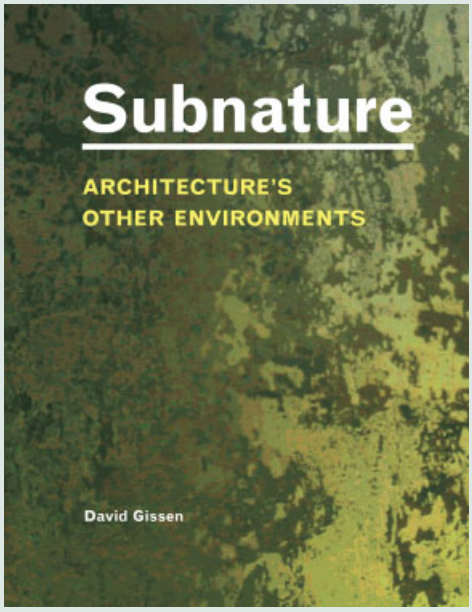
In this title of AD, David Gissen redefines the notion of territory for contemporary architecture. In the past, territory could be perceived as often having negative connotations or outcomes: 'virgin territory' coveted by governments or individuals for control and ownership was the potential site of occupation, domination and national conflict. In the context of this issue, though, Gissen turns territory into a positive category, as so articulately outlined in his introduction. *Territory* expands the parameters laid down by postwar conceptions of environment and autonomous architecture (see pp 8–13). It affords architecture a wholly new space in which to operate. It is no longer restricted by site, ecology or even structure. The place it inhabits encourages the transformative potential of architecture. It recasts architecture with a dynamic relationship to its external environment, in which it interacts with climatic conditions regardless of whether they are 'natural' and benign or potentially polluting. Architecture is no longer a separating and controlling agent, sealing off its occupants from its surroundings. It is freed up to act on the 'natural' as much as the 'civilised': the forest is transformed into inhabited tree canopies (pp 20–7) and the city is verdantly cloaked and transformed into ravines and rainforests (pp 28–33); insect and animal life permeates architectural structures (pp 34–39); the previously hard and fast separation of land, water and air are morphed (pp 60–5 and 66–73).

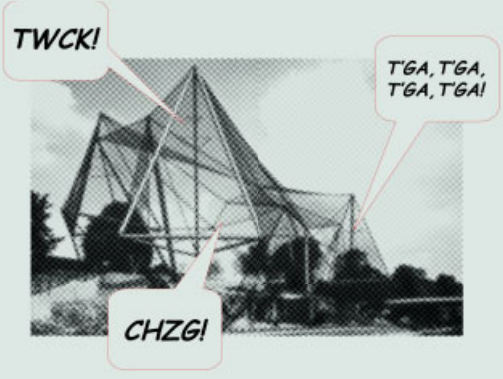
Gissen thus provides a new and highly contemporary way of seeing nature and architecture. This is to some degree in line with the current preoccupations with nature and biology in architecture, exemplified by issues of AD such as *Emergence* (No 3, 2004) and *Neoplasmatic Design* (No 5, 2008). But whereas the contemporary obsession with the biological and biomimetic has been awakened and enabled by the genetic algorithm and parametric computation, territory as a category has been influenced by urban geography and the dynamic cartographic modelling processes (pp 74–81 and 82–93). This opens up the discipline not only to wholly new methods for architectural exploration, but also to new spheres and new conversations. AD





***Architectural Design*, July 1961**
This special edition of AD was dedicated to Richard Buckminster Fuller, who is depicted on the cover. In the 1960s Buckminster Fuller, with large-scale structures, extended the notion of architecture to the environmental. His 'climatrons' and climatic-controlled domes became a byword for the environment.





top left: Cover of Gissen's book *Subnature: Architecture's Other Environments* (Princeton Architectural Press, 2009).

top right: David Gissen delivering a lecture on experimental forms of architectural history at Postopolis! LA, sponsored by Storefront for Art and Architecture, 2010.

tabove left: David Gissen, Socio-Natural Archive, 2008. This illustration accompanied a short piece from Gissen's website (htcexperiments.org) on the relationship between social-historical archives such as libraries, and natural archives such as zoos.

above right: Opening pages of Gissen's article 'Energy Histories' in *AD Energies: New Material Boundaries* (May/June 2009). The image shows Gissen's reconstruction of the air-conditioned interiors of midtown Manhattan, *c* 1975.

ABOUT THE GUEST-EDITOR
DAVID GISSEN

David Gissen is a historian, theorist and self-proclaimed 'experimental' historian of architecture and urbanism. His work explores histories and theories of nature within architecture, relationships between geographical thought and architecture, and various critical-alternative methodologies within architectural history. His writings and historical projects have been published in books and journals and he has lectured on his research internationally.

Much of Gissen's work examines concepts of nature in architecture, a topic that is becoming increasingly central to architectural thought and practice. His work resists the notion that nature is external to architecture and therefore something architecture can better emulate or mimic. In contrast, his work is formed around a concept of the 'architectural production of nature'. For Gissen, nature is already laced with architectural historical representations whether we speak of the atmosphere that moves in and out of buildings or the verdant nature within contemporary cities. All of nature has been reworked – literally and conceptually – by the constructs of modern society, including architecture. He believes that what is needed is a new type of architecture and a new type of history that uncovers and projects this reality.

In addition to exploring these ideas in *Territory*, Gissen authored the book *Subnature: Architecture's Other Environments* (Princeton Architectural Press, 2009), which examines those denigrated natures codified and examined within the history of architectural thought (dankness, debris, smoke or mud) from the 16th century to the present. He views the sub-natural as a type of nature laced with a specifically architectural presence and history. Among the contemporary projects examined in the book are those that revel in this historical aspect: Tom De Paor's Irish Pavilion made of murky Irish bog mud (2002) or Jorge Otero-Pailos' preservations of the pollution and dust on a factory's walls (2008).

Finally, Gissen's research into architecture and nature lead him to examine how such explorations might be the groundwork for new forms of experimental architectural historical practice. This is the subject of a website he authors (htcexperiments.org) and was the subject of his article in the *Energies: New Material Boundaries* issue of *AD* (May/June 2009). In this latter work, he examines how various historical practices from early modern history – such as architectural reconstructions of architectural environments or various institutional appropriations – might let loose new appearances of architectural history outside the text.

Gissen is based in the San Francisco Bay Area where he is an assistant professor and coordinator of the architectural history and theory curriculum at the California College of the Arts. He studied architecture at the University of Virginia, Yale and Columbia Universities, and completed his PhD at University College London under the direction of Matthew Gandy and Adrian Forty.

By David Gissen

TERRITORY
ARCHITECTURE BEYOND ENVIRONMENT

Advancing an alternative relationship between architecture and nature, *Territory* emphasises the simultaneous production of architectural objects and the realms surrounding them. This title of *AD* explores the possibility of an architecture that actively produces its external, environmental conditions. In short, a territorial architecture both investigates its world and infuses its immediate surroundings with particular geographical concepts, patterns and sensations. *Territory* charts out a position for architecture beyond entanglements with 'environment' – understood as that socio-natural setting which pre-exists the production of new things, but it also avoids a retreat to architecture's imagined, internal logic – via the ongoing pursuit of architectural 'autonomy'. Ultimately, *Territory* suggests a role for architecture as a strategy of tinkering versus one of accommodation with, or refusal of, an external techno-natural environment.

Territory advances a set of strategies for engaging with matter and a strategic category of thought in dialogue with key post-Second World War architectural debates. Of the dozen or so concepts of postwar architectural theory that still appear in contemporary architectural writing (programme, diagram or authenticity), the concept of the architectural 'environment' and the concept of an 'autonomous' architecture remain at considerable loggerheads. The former can be typified by a building that is sublimated into the mechanics of its setting; the latter by that architectural work that stands as a distinct counterpoint to its givens. An environment-architecture attempts to emerge from its environs – natural, social and technological – an autonomous architecture is answerable to itself alone. One is about world, and the other is about architecture. The concepts of a territorial architecture advanced here attempt to move us out of the traps of either environment or autonomy in their most recent manifestations. *Territory* is both an alternative way of working and a space of thinking about architectural things and their socio-natural surroundings.

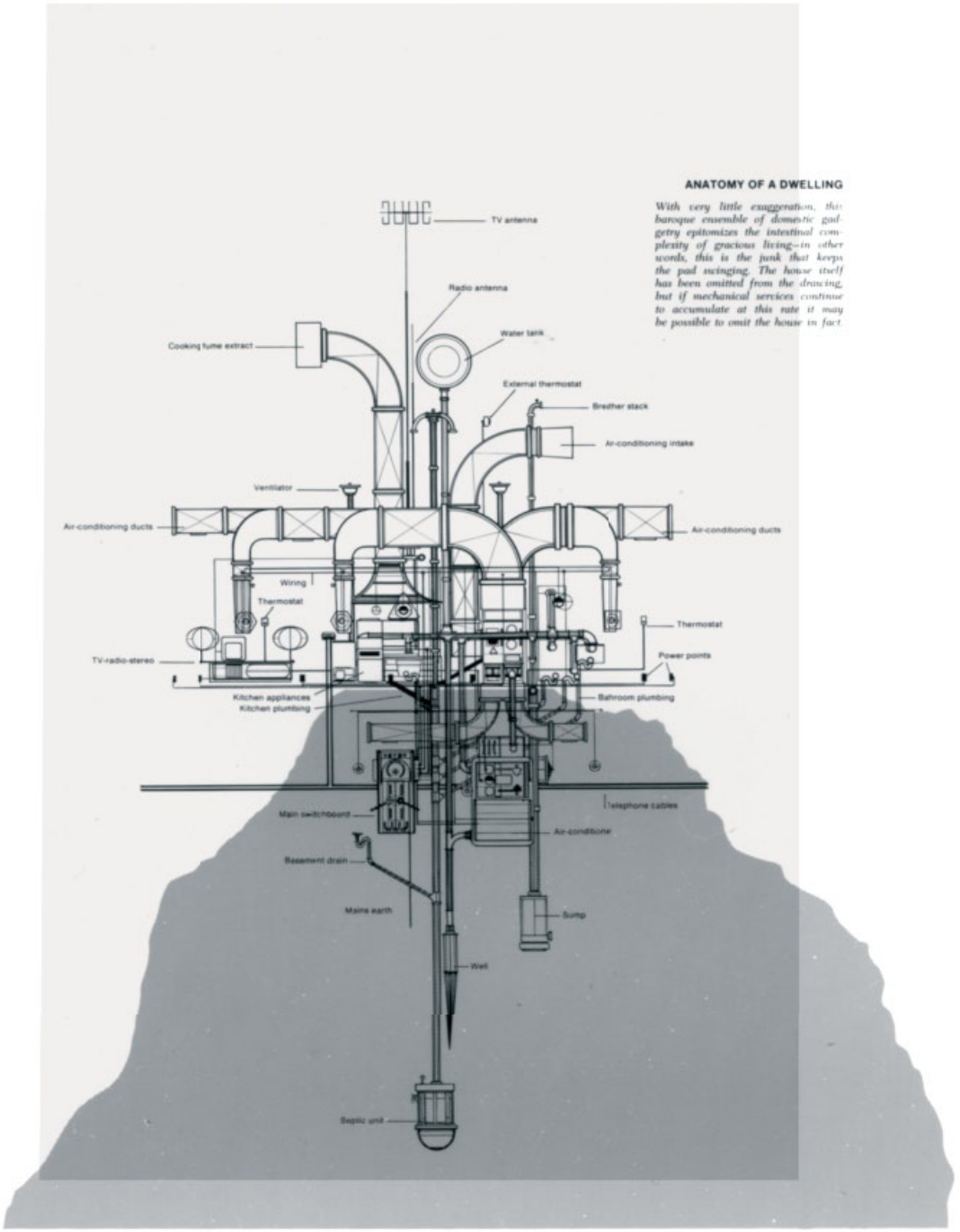
Autonomy versus Environment

We might understand the value of a concept of territory by illustrating the conflicts between environment and autonomy in the writings of Reyner Banham and Manfredo Tafuri, two key postwar architectural theorists and historians. In his essay 'A Home is Not a House' (1965) and book *The Architecture of the Well-Tempered Environment* (1969), Banham called for an architecture as the direct outcome of a techno-natural environment.[1] He conceptualised this environment as something that had an external relationship to architecture proper, although it could be generated by technologies within an actual structure. Inspired by both the primal environment of the camp fire and the 19th-century American shell-frame house with its commanding, warming fireplace, he developed a concept of environment in which flows of heat, water and electricity would generate spatial enclosure. This Unhouse (1965), as he eventually termed his architectural vision, offered its inhabitants a new type of interaction with their surrounding nature through an updated technological expression of the initial primitivist inspirations.

Banham understood his concept of environment as intensely fleeting and anti-architectural, and therefore anti-monumental. Because environment was external to architecture, it enabled architecture to disengage from its history and enter into a new dialogue with the technological and natural conditions within which then-contemporary human subjects found themselves. Where Banham aligned his concept of environment with the resource-driven, technological and natural techniques of postwar American capitalism, Tafuri demanded of architecture a radical silence in the face of the very same contemporary environment.

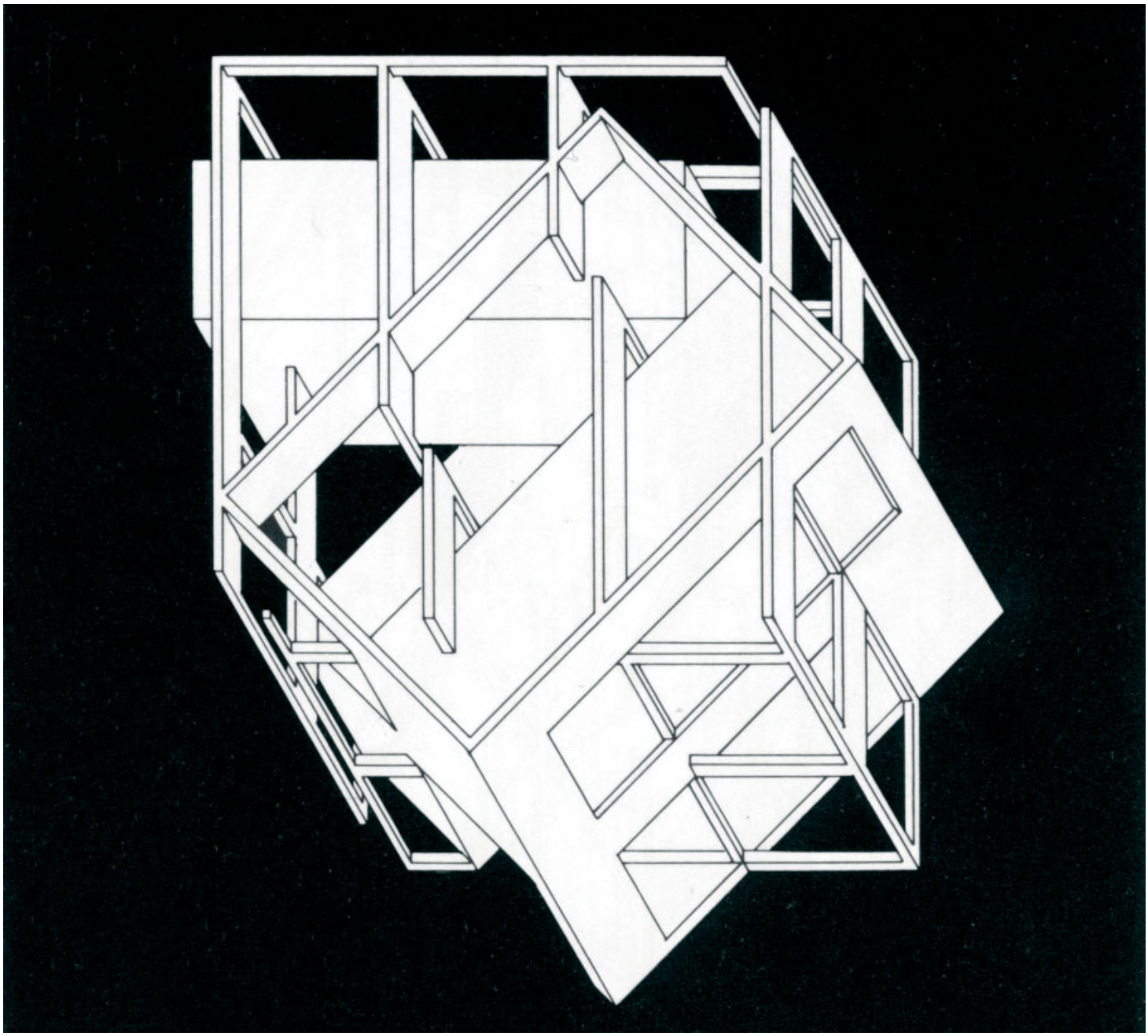
We can typify autonomy as architecture's refusal to integrate into the surrounding conditions of a capitalist world – a rapidly expanding economy that transformed nature into a resource, urban space into investments, and ideas into consumerist spectacle. In many ways, the technologies embraced by Banham became the after-effects of the intolerable conditions critiqued by Tafuri. This environment of postwar European and American architecture is rejected outright. Within the writings of Tafuri, the only hope for architecture as a humanist discipline was its disengagement – freedom from integrating those constructs that simply transform architecture into a tool ('technique') of expanding economic development.[2] Absorption of the environment (understood as the sum

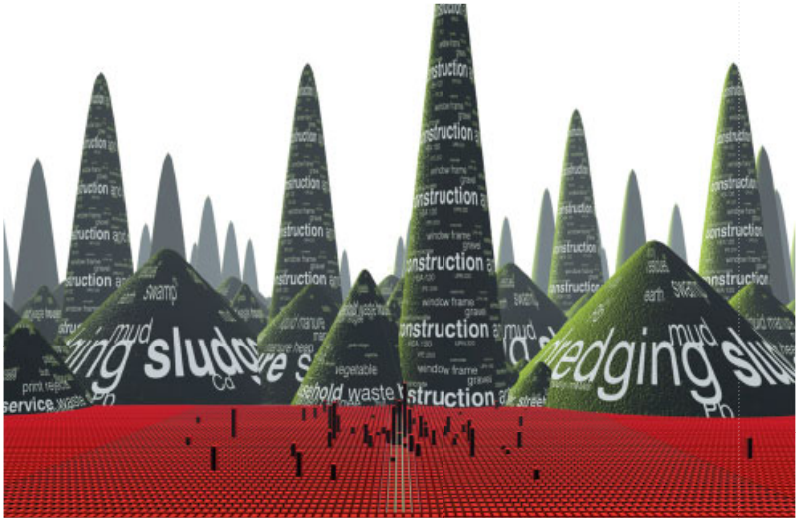
Reyner Banham and François Dallegret, Anatomy of a Dwelling, 1965
Banham's ironic take on the state of dwelling in a techno-natural environment drawn by his artistic collaborator François Dallegret.



Peter Eisenman, Diagram of House III, Lakeville, Connecticut, 1969
below: Unlike Reyner Banham's Unhouse (1965), this autonomous building stands distinct from the techno-natural environment of late-Modernity.

Florencia Pita, Macedonian Philharmonic Orchestra, Ministry of Culture of the Republic of Macedonia international competition, 2007
right: The latest variation on autonomy turns to organicist, vitalist expression, yet is generally resistant to 'environment' as thing and concept.





MVRDV, Metatown, Data City, 1999
Environmental data literally produces the city.

external pressures, both human and natural) is rejected in favour of an architecture that is aloof relative to the given context. Tafuri, and the architects with whom he shared influence, such as Aldo Rossi or Peter Eisenman, refused to integrate their buildings directly into the environment, as it was conceived.[3]

The above dichotomies continue within contemporary writing and design that take this debate to a new level of intensity. On one hand we have a theory of environment that understands works to emerge from extreme social and ecological data sets (for example, the Km3 project 2006, and Data City 1999, of MVRDV). And on the other hand, we have a new, more radical form of architectural autonomy that confronts any notions of environmental entanglement. In updating the concept of autonomy, architects such as Mark Foster Gage or Florencia Pita call for an architecture discursively enclosed, in which architecture exists in a para-environmental sphere communicating its own 'affect' of 'wonder'.[4] Gage most vociferously attacks environmental engagement, calling the environments beckoned by architects the 'virus' that 'mutated the red blood cells of architectural design'.[5] Where the latest explorations of environment repeat the problems of an earlier era (in their passive acceptance of settings), the latest call for autonomy has a different, more complicated set of limitations.

The most recent arguments for architectural order are really a call for a double form of autonomy – separation from environment and from the initial act of disarticulation. We can contrast this approach to Tafuri (or the early Rossi or Eisenman), who understood that a building's refusal to emerge from the given physical and discursive environment of its time could operate as a vivid representation of the dominant use of space and nature. In other words, Tafuri's autonomy visualises late-Modern urban realities even as it holds out the possibility of a future. If Gage's writings represent the latest theories of autonomy, then his neo-Nietzschean language of wondrous becoming and biological calls to order (mutations and viruses) leaves us with an eerie xeno-autonomy – an organicism of anti-degeneracy.

Territory, or the Autonomous Environment

We can continue by turning our heads away again, furthering the dizzying, circulatory motions of the environment/autonomy divide; or we might reconsider the terms of this debate. In this issue of *AD* we try to do better by building a more considered environment for a more expansive concept of architectural autonomy. After all, the latter concept remains powerful. A brief turn towards the philosophical aesthetics of things and realms, critical theories of nature, the insights of post-structural geographers, or recent architectural historical writings instruct us that the imagined isolation of things from the world is a fantasy and the presumed pre-existence of socio-natural environments as fixed spheres a fallacy.

In many ways the writings of the critical geographers are the most instructive for a way forward, as they directly absorb many of the philosophical critiques and scientific theory, while orienting their insights towards spatial and aesthetic ideas and a deep concern with the complexities of that most difficult environment of all – the natural environment. From geographers such as Matthew Gandy (see his critical piece on pp 28–33 of this issue) and Erik Swyngedouw, we understand how authored things contain worlds within and extending through them.[6] Within their work on nature and urban aesthetics, something as distinct as an urban monument emerges as a complex territorial assemblage of natural and urban webworks (its realisation stitching together nature and people through city and country), aesthetic concepts (of the picturesque and beautiful), as well as cash and matter (the actual investments and materials that go into the thing). The production of *it* and its sphere is simultaneous; the monument brings routes, aesthetic ideas, rendered natural materials and investments into focus and, more significantly, into existence, just as much as all of these aspects represent a system that enables the production of a monument.

The dialectical or existential relationships between the thing and its environment are exceeded by a more complex concept of metabolic circulatory exchange. Unlike a Heideggerian concept of thing and world, these geographers do not believe that systems of production bear

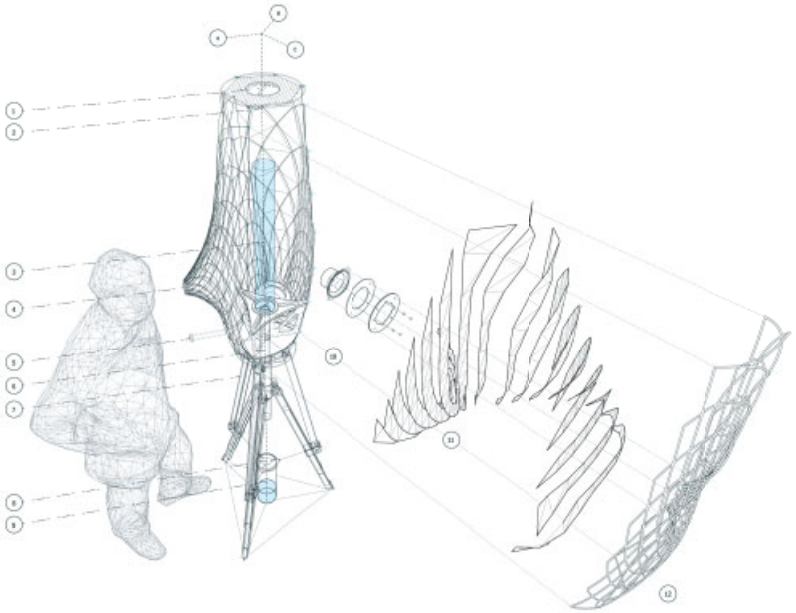
Philippe Rahm, Second Summer, Eybesfeld, Austria, 2005
below: The thermal energy of the earth is channelled into a subterranean, figural form of a swan. With a series of embedded lights, this transforms the centre of this island forest into an eternal summer, producing a territory that supersedes environmental givens.

Gilles Ebersolt, Sketches of the Raft of the Tree Crowns, 1980
right: In Ebersolt's work, territories of inhabitation are sites of knowledge and pleasure.

witness to *one* authentic reality (for example, 'the building revealing *the* site'); rather they are in a constant state of possibility. We have the power to create the territory of our own existence through the things (and territories) we conceptualise. Within this context the power of urban artefacts is in their ability to enable a deeper understanding of the possible realities lurking in the world.

Acknowledging these ideas, this issue of *AD* and its concept of territory attempt an intellectual and material *rapprochement* between the traps of contemporary variants of autonomy and a vacuous 'environmentalist' conception of the architectural object. We do not call for an architecture that is intellectually sublimated within socio-natural environmental givens or a last-ditch call for disengagement. Nor do we call for a simple anti-aesthetic illustration of empirical, environmental thought. Instead this issue attempts to move architecture beyond environment, through an expanded and geographically inspired idea of things articulating and producing complex artificial and natural worlds. In this context, a territory is a produced (versus given) environment generated by a combination of architectural concepts and architectural and natural matter that is always in a state of its own realisation. Territorial structures are the outcomes of other environments (or territories), but they are not mere extensions, or analogous visualisations, of environmental conditions. Rather, they performatively explore the very nature of environmental tissues as they attempt to recode their surroundings, ultimately painting the world their colour, and they therefore maintain a type of conditional isolation in the world. We see the beginning of these ideas in works throughout the issue; works that emerge from purely scientific utilisations of architecture, to those that are either completely discursive in character or fully programmed buildings.

One of the oldest projects featured is the early explorative work of Gilles Ebersolt, which is examined by the architectural historian Mitchell Schwarzer (see pp 20–7). In the 1980s, Ebersolt created works that were influenced by Buckminster Fuller and Banham (they speak of a world of environments), but with the mission of bringing researchers into the then unknown world of



DRAWING KEY
1. Opening for ice core insertion and extraction
2. Structural Plates with LED Arrays
3. Ice Core [18" tall, 3" Dia, 127 cu. inches]
4. Ice Core Viewing Aperture
5. IR Sensor [Sharp] and wiring
6. Tripod stem and armature
7. Polished Aluminum Tripod
8. Waterproof Contact Microphone
9. Water Collection Basin
10. Two Carbon Fiber 120W Speakers
11. Plastic Skin [Recycleable PET]
12. Stainless Steel Welded Lattice
13. Amplifier, Power and Arduino [not shown]

SPECIFICATIONS
Overall Height (inc. Tripod): 92" [2.33m]
Overall Height (not inc. Tripod): 42" [1.06m]
Overall Weight: 65 pounds [29.48 kg]
Ice Core Weight: 5 pounds [2.26 kg]

Jason Johnson and Nataly Gattegno, Aurora Project, Van Alen Institute, New York, 2009
The transformation of Arctic ice is codified, charted and transformed into a visceral visual and aural cartography.

forest canopies, his work became entangled in establishing new scientific concepts and networks within the natural environment. Ebersolt's strange structures were used to articulate an environment within the environment; when they first appeared in the 1980s they were understood as far more (or less) than utilitarian structures; empty platforms whose physical presence was representative of a strange yet possible foreclosure between science, nature and art.

Another strand of work within the issue offers a more intellectual take on that activity we might term 'terraforming' – the human production of human and animal environments. In this latter category are the works of Sean Lally (pp 14–19), AMID (cero9) (pp 40–5), Fritz Haeg (pp 34–9), The Living (pp 60–5) and R&Sie(n) (pp 46–54). These architects imagine how buildings actively produce or warp the socio-natural conditions around the architectural object. Unlike ecological work from the 1960s, here architecture does not metabolise its surroundings per se; rather the work builds a nature that is called into the world by the logic of design. Architecture becomes a material and theoretical 'genesis device' – a machine that makes environments but also ideas about nature and environments.

For those interested in the techniques of territoriality, the works by the architects Jason Kelly Johnson and Nataly Gattegno (pp 74–81) and Nicholas de Monchaux (pp 88–93) offer instructive concepts and examples. Their projects share an interest in creating new cartographic realities through architecture. The former take the great North – and its shifting landforms of water and ice – as their place for carto-architectural intervention; the latter work is situated on the 'useless' sites that typify so many late-Modern cities – sites that have a de facto autonomy relative to the city's real-estate economies. De Monchaux employs data from geographical information systems (GIS) within the contemporary techniques and discussions of architectural 'scripting' and uses this new tool to script architectural conditions into the peripheral urban cartographic structure that maintain these spaces as distinct counter-sites. Both his and Johnson and Gattegno's work result in a new geography for their chosen sites.

In concluding this issue of *AD* we invited Antoine Picon to reflect on the concept of territory. Picon may be one of the first historians of architecture to consider this concept within architecture in the manner in which it is put to use here. His writings on French architects and engineers of the 18th century or that on 'anxious landscapes' speak of new disciplinary 'enchantments' with the world that involve new cartographic visions of nature which have important implications for architectural things and practices.[7]

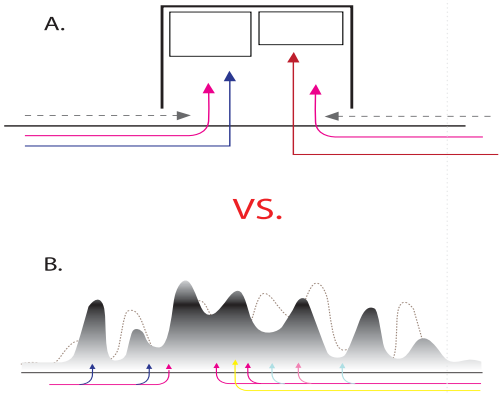
Will the ideas formulated within *Territory* recondition the autonomy/environment divide? Perhaps, perhaps not. But in positioning *Territory* within the difficult debates of the past, we should realise that this modest collection will not put us past irreconcilable differences (both then and now). If anything, *Territory* affords us a brief glimpse of a moment when we might have it all: when we might be able to have our autonomy cake and 'eat' environment too. As always, more remains to be done. There is always a worthwhile project in demonstrating that nothing is eternally given within architecture or its present natural and unnatural environment. AD

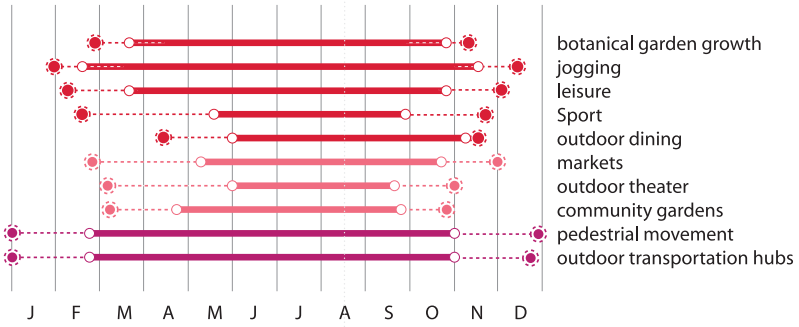
Notes
1. Reyner Banham, 'A Home is Not a House', *Art in America*, April 1965, pp 70–9 and Reyner Banham, *The Architecture of the Well-Tempered Environment*, University of Chicago Press (Chicago, IL), 1969.
2. See, for example, Manfredo Tafuri, *Architecture and Utopia: Design and Capitalist Development*, MIT Press (Cambridge, MA), 1979. One of the most intelligible analyses of Tafuri's difficult thought can be found in Nathaniel Coleman, *Utopias and Architecture*, Routledge (London), 2007.
3. This aspect of the environment/autonomy debate is explored in Reinhold Martin, 'Environment, *c* 1973, *Grey Room* 14, 2004, pp 78–101.
4. See, for example, *Log*, No 17, 2009 and Mark Foster Gage, 'In Defense of Design', *Log*, No 16, 2009.
5. Ibid.
6. See Matthew Gandy, *Concrete and Clay: Reworking Nature in New York City*, MIT Press (Cambridge, MA), 2002, and Erik Swyngedouw, 'Circulations and Metabolisms: (Hybrid) Natures and (Cyborg) Cities', 2004; http://socgeo.ruhosting.nl/colloquium/science.pdf (accessed 10 November 2009).
7. See Antoine Picon, *French Architects and Engineers in the Age of Enlightenment*, Cambridge University Press (Cambridge), 1991, and Antoine Picon, 'Anxious Landscape: From the Ruin to Rust', *Grey Room* 1, 2000, pp 64–83.

EAT ME … DRINK ME …

Sean Lally of WEATHERS lets out a rallying cry to all architects. He calls on them to make environmental conditions the subject of design rather than regarding them as a standardised part of a building's services. Here he highlights the potential of material systems, which are usually applied to conditioning the interiors of buildings, in the generation of new forms and activities; whether it is in the honing of the performance aspect of a building's function, as in the Water Cube at Beijing (2008), or in the seasonal planning that underpins the concept behind WEATHERS' Wanderings project (2008–9).

WEATHERS, Wanderings, 2008–09
Microclimatic zones are created with the aggregation of independent components that serve to manipulate (amplify or suppress) specific aspects of the climatic variables in their vicinity and introduce opportunities for augmented natures and environmental contexts.





This is the time for extreme speculation. Today begins an opportunity to build new environments, climates and contexts peppered with potentials for social interaction, activities and spatial organisations. These should be investigations into the creation of contexts and sites previously unseen and tested, presupposed to be either out of our range of implementation or simply discounted as being unable to absorb the responsibilities associated with architecture. This will result in the design of new microclimatic conditions imbued with spatial and organisational capacities, allowing activities and programmes that were thought to require building interiority. To move past the limitations of their conventional roles, these conditions, born from the materialities associated with landscape, should be explorations that acknowledge the demands of built architecture in order to construct new speculative environments yet to exist. They will push beyond the envelopes that we construct to encapsulate the activities and events we drop within them.

This discussion is an articulation and appropriation of material systems traditionally relegated to either conditioning our interiors or believed to be of little use as generators of activity or form. Architects and designers must not default to preconceived notions of their limitations, roles and possible responsibilities as they pursue the organisational implications these materials offer as they trickle down to influence our daily lifestyles. The intention is to foreshadow and draw out the spatial and organisational implications that stem from these endeavours. It is, however, equally important to remember that as the tool sets at our disposal seem to grow faster, stronger and more efficient every year, we need to remain mindful that our reliance on the most recently available technologies is often an excuse for a weak imagination. Our imaginations must lead, and technology will follow.

Climatic Context

As architects, we readily acknowledge that in the interiors of buildings exist climates that we manipulate and control. This is what essentially permits a near-standardised building construction of the domestic home in the US, as the interior, regardless of where the structure is located, can be maintained and controlled nearly equally, regardless of any geographic or climatic difference. A combination of skin construction and mechanical systems sees to it that our interiors, and our notions of the requirements for any interior activities, remain the same. With this focus on interior climatic homogeneity, it is little surprise that context is generally understood within architecture as little more than that of physical adjacencies to the external envelope of the structure. These physical adjacencies are, of course, tied directly back to either the primary infrastructural systems, whether river or road or existing resource (scenic, solar or otherwise). Climatic variables are otherwise simply mediated – either allowed in or reflected away – and are rarely investigated as a point of departure for design; because, after all, it is the common assumption that the envelope will do all the heavy lifting for this design profession.

This, of course, is far from the truth: we only need to look to heat islands created by cities, and to the resultant microclimates outside buildings as they exhaust heat and energy, to see we actually do augment and influence these local climates. It just so happens that these are accidental conditions, completely unintentional byproducts of the built environment with no real design intentions for garnering the responsibility of dictating organisational and spatial strategies.

Although it might not be obvious at first glance, some of the most interesting architectural examples of this alternative view of materiality can be found in the buildings of the 2008 summer Olympics in Beijing; for even though the colossal collection of buildings and stadiums seemed at times to be a showcase for curtain-wall and facade design, there were interesting solutions that developed. As the design projects focused on the structures that would house the events of the Olympics, discussions began to turn to the air quality of the venues and the potential implications this would have on the performance of the athletes. So many aspects of the sports are monitored and controlled, from the chemical supplements in the human body to the equipment used by the athletes, yet the environmental parameters are often left to existing conditions that the specified calendar day provides.

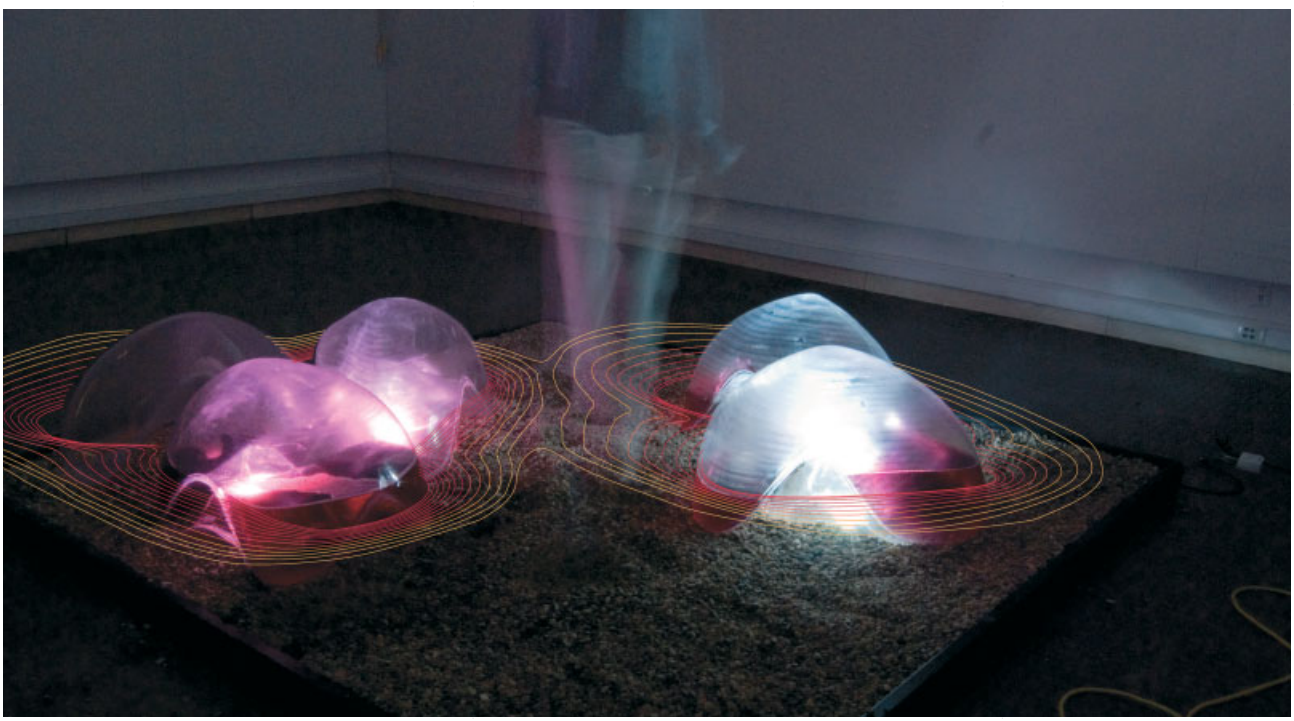
Such issues of environmental context are tackled in the broadest sense in the design of sports facilities, including track events, where elevation is so crucial due to the percentage of oxygen in the air. But it might be swimming where this environmental context is brought most clearly to the foreground as the 'active context'[1] of manipulation and control for the sport. In Beijing, even though discussions persisted regarding unfair advantages due to the sophisticated technologies of the swimsuits of particular swimmers, improvements in the actual medium and context in which all of them swim were constantly being sought with the aim of creating 'faster pools'.[2] Depth, extra swimming lanes and overflow gutters

WEATHERS, Wanderings, 2008–09
opposite left: Urban planning is generally associated with a process of programme allocation and siting. These programme volumes are tethered to a particular infrastructure (existing rivers or constructed highways) that provides access and resources. As a climatic infrastructure, Wanderings is able to manipulate these seasonal attributes into a system of organisation that rewrites the climatic lifespan of programmatic activities.

opposite right: Local climatic manipulations permit existing programmes and activities to extend beyond typical seasonal timelines and restrictions. Activities traditionally bound by environmental constraints such as temperature, precipitation and seasonal shifts in daylight hours thus become possible.

below: Microclimates can be implemented in a range of scenarios, from the humid summers of Houston as a means for pulling the humidity from the air to create usable space outside, to colder climates in which the forms can be sealed with heating filaments that warm the trapped air. Though each element might seem quite minimal in its production of increased temperature, aggregated together the units have the potential to make significant changes to local microclimates.

bottom: Though not always directly visible to the human eye, the physical boundaries associated with many 'material energies' are gradients of intensity (in this case, thermal intensities that radiate from the interiors of each of the Wanderings' nodes).

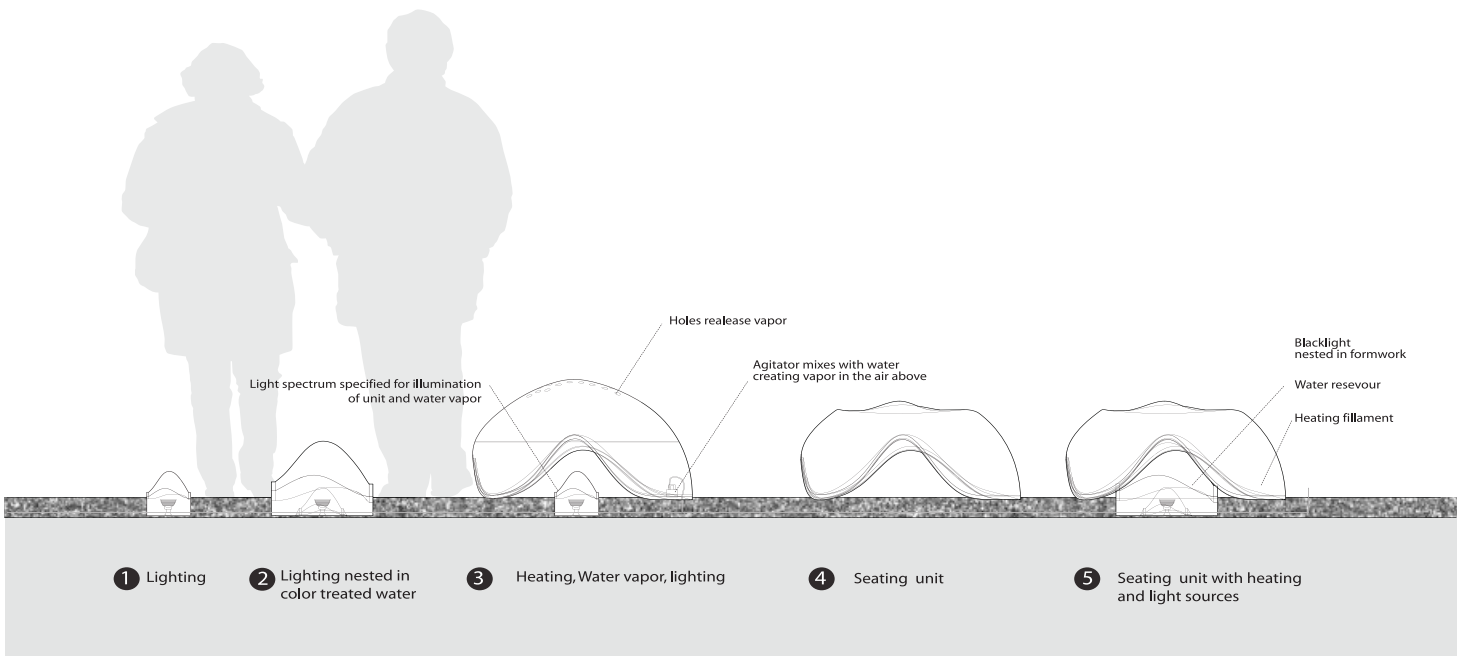


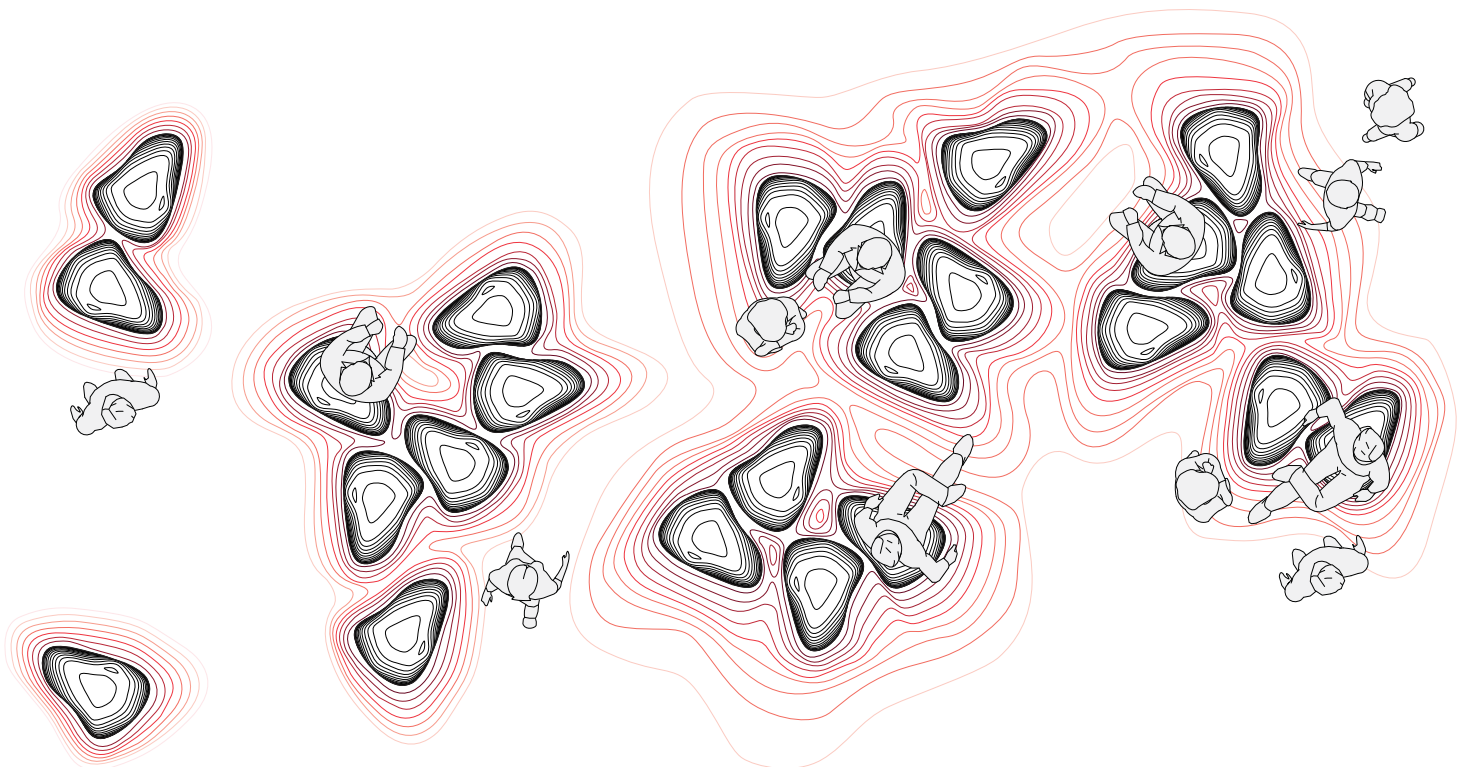
WEATHERS, Wanderings, 2008–09
below: The project consists of nesting components made of vacuum-formed PETG plastic, each acting as an armature for an array of mechanics that can be switched out and adapted to the specific climatic context of the site. The humid conditions of Houston, for example, would be addressed by copper coils that dehumidify the surrounding air; other locations might require heating filaments within one of the airtight units to provide tactile warmth.

bottom: The physical properties of the materials (thermal, spectrums of light, humidity) are of intensities, fallouts and gradients. The physical boundaries seen in plan here define spatial configurations and layouts as gradients that are as variable as the climatic context in which they are located, creating a feedback loop between the context and the design system itself.

opposite left: The height and shape of the units contour to the body for seating.

opposite right: Layout and distances between each of the units is determined by site needs for circulation and gathering as well as the performance demands of the desired microclimate.





are all factors with the potential to improve and reduce the interference from the waves and ripples of the swimmers moving through the water and returning off the bottom and sides of the pool. The environment the athletes are performing in is thus the subject for design. As advancements in pool technology continue to play out, and as they meet their full potential, a new frontier in swimming performance might exist in the chemical make-up of the water itself, in the salinity, buoyancy and chemical components of the water and its feedback relationship to the athletes' movement through it. Site and context are clearly seen as elastic and malleable, and open to the intentions of the designer as a design medium.

Seasonal Expansions

Activities at the urban scale, including recreational and commercial activities, and circulation, are directly linked to exterior environments; thus climatic factors are a crucial component of any development plan regardless of its geographic locale, and should in return be acknowledged as a viable, albeit untapped, material system. Activities bound by existing climatic variables and constraints such as temperature, humidity, precipitation and seasonal shifts in daylight hours need to be recognised as materials to be acted upon for expanding existing seasons, creating new ones and exploring potential programme overlaps and mutations. Such climatic materialities (artificial or otherwise) prove to be just as important in organisation as the structures built to house specific programmes and activities. An infrastructural system able to manipulate these seasonal attributes would essentially rewrite the climatic lifespan of the activities and create new opportunities for different uses year round.

This approach to seasonal planning underpins Wanderings, WEATHER's 'climatic infrastructure' that meets the needs of programme and activity required throughout the course of the year, creating opportunities for artificial extensions of these events. Wanderings operates on existing external microclimates, altering and controlling them for the use of programmatic activities. In this case the gradient boundaries of these materials are elastic and variable as the climatic context changes and external forces interplay with the project. The intention is to create multiple zones (microclimates) that pull from the existing climatic context, creating distinct and definable edges, boundaries and transitions of these materials. Operating as discrete nodes that build and aggregate together, Wanderings literally changes the temperature, spectrums of light and humidity levels within its climatic context so as to make external spaces usable for activities that might otherwise be assumed to need four walls and a 'conditioned' interior. An infrastructural landscape that is able to manipulate these seasonal attributes into a system of organisation would in effect alter the climatic lifespan of the activities. Local climatic manipulations could permit existing programmes and activities to extend beyond typical seasonal timelines. The intention of Wanderings is not simply to stretch existing and recognisable seasonal parameters, but to enable projections and speculations of environments and climatic contexts not previously seen or inhabited; and it would be these microclimates, in turn, which would become the catalysts for activity.

Climate control is typically, and often rigidly associated with building interiors. However, freed from spatial and programmatic limitations, these climatic materials could provide all sorts of new and unforeseen opportunities. With all that we are able to do today with environmental control, our definition of what constitutes public infrastructure could well be expanded to include climate and environmental materialities as catalysts for public activity. We need to do more than simply 'condition' exterior spaces, and instead seek new territories of design, infrastructure, texture and social interaction – not to simply move activities 'outside', but to tease out the spatial and social implications that arise when 'walls' and 'geometry' are no longer our primary means of spatial organisation. If a wall is no longer the primary organisational device that architects and designers turn to for spatial control, instead turning to these 'material energies' most closely associated to our exterior climate to garner with responsibility, it would take little imagination to understand the potential organisational opportunities afforded to our profession. AD

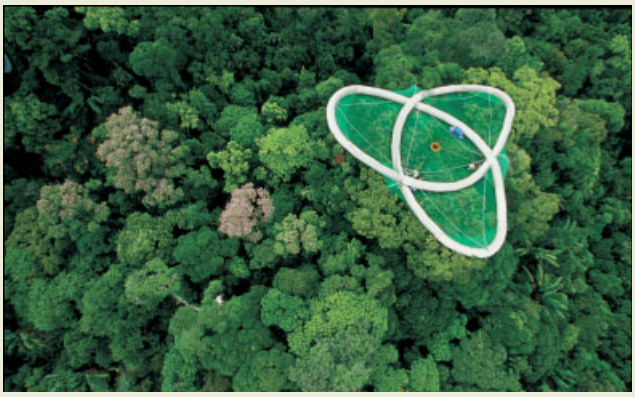
Notes

1. In *Animate Form*, Greg Lynn discusses an 'active context', but refers to it in relation to its influence on the envelope of the building – the envelope as an index of the active context. I instead discuss here the 'active context' as the design focus and medium. See Greg Lynn, *Animate Form*, Princeton Architectural Press (New York), 1999, p 10.
2. Beijing's National Aquatics Centre (the Water Cube) was a collaboration between PTW Architects, Arup and China Construction Design Institute (CCDI). See Howard Berkes, 'China's Olympic Swimming Pool: Redefining Fast', *Weekend Edition Sunday*, 10 August 2008; http://www.npr.org/templates/story/story.php?storyid=93478073.

Mitchell Schwarzer

THE TREE CANOPY AS BLUEPRINT

As the opportunities for new territories become more limited, the only way is up. **Mitchell Schwarzer** explores the dizzying heights of the 'last biotic frontier' of arboreal architecture with its high platforms, walkways and canopy craft. Challenging in construction and engineering terms, the tree canopy also requires engaging with a different atmospheric and climatic range to those conditions encountered at ground level.



Gilles Ebersolt, Solvin Bretzel, French Guyana, 2003
left: The human butterfly embracing the forest.

below: Lightly touching down on the forest's crown and walking on the leaves.

Gilles Ebersolt, Solvin Bretzel, French Guyana, 1986
below: A Zeppelin-like craft holding the canopy raft hovers in the clouds produced by the forest.

Marks Barfield Architects, Treetop Walkway and Rhizotron, Kew Gardens, London, 2008
bottom: Steel promenade through the trees of Kew Gardens outside London.

Imagine a time in the not so distant future when cities resemble the forest tree canopy. Oil has run out. Coal has been banned. Greenhouse emissions have so overheated the planet that surface temperatures in temperate latitudes match those of the tropics. The seas have risen. To escape the torrid inundation, society migrates skyward. Structures are reinforced. Additions pile up. Cantilevers strut into gaps. The rich claim the city's overstorey, safely beneath the blazing crown where roof gardens suck in sunlight and moisture, and energy farms harvest the winds and solar radiation. Below the wealthy the middle classes reside mid-canopy in a cooler, shadier, if less productive environment. On the lowest floors, their litter becomes the housing medium for the poor, the dark scabbard of scavengers.

For much of modern history the drone of a machine sounded sweet no matter what its effect on nature. No longer. Given widespread evidence that proliferating machines are engineering global warming and as massive species die off, architecture, often self-professed as a machine for living, faces a challenge. Practically every past architectural revolution sprang from the invention of construction technologies intended to advance societal transformations. The environment, from quarried stone to iron ore, was something to be used and abused for the betterment of humans. While many architects have responded to the current environmental crisis by touting green building technologies and sustainable development practices, it is worth asking whether we can build our way out of this predicament. Can the old stand-bys, better building machines, be the solution? Or do we need to contemplate a new blueprint for design?

Within the last 15 years one such blueprint has been grasped at by research in architecture and science that seeks insights from the forest tree canopy. Less understood than other terrestrial environments, the tree canopy has been described as the 'last biotic frontier'.[1] Because of its richness of life, scientists are avidly seeking out its secrets. As they have sought to gain a footing in the trees they have engaged architecture: literally, in the construction of high platforms, walkways and canopy craft; and metaphorically, through the ideas and associations the canopy provokes for rethinking the construction of human environs insulated from atmospheric variations in sunlight, temperature, rainfall and humidity.

In the tree canopy, change occurs within a set of parameters, many of which are understandable to an architect. Like a building, a tree canopy consists of structure, space and meteorological/luminary conditions. Its crown, the atmospheric interface, appears from the sky as a topography of

Forest canopy near Coca, Ecuador
The high, horizontal world of the tree canopy in an old-growth rainforest.

ridges and ravines. Its understorey, the vast area beneath the crown, demonstrates an increase in morphological size and complexity as one descends.[2] But whereas a building's systems are programmed to operate steadily for their human occupants, the tree canopy grows and changes its internal conditions in response to ongoing biotic and atmospheric fluctuations. The high zones of the tree canopy that seem upon first glance to be more precarious – small twigs that cannot support much weight – and less commodious, subject to intensive fluctuations of sunlight, temperature and moisture, sustain copious life.

In 1981, entomologist Terry Erwin's research on beetles in the Panamanian tree canopy launched a species rush. Erwin found so many new species he extrapolated that the number of potential species on the planet was not somewhere between three and five million as previously thought, but rather closer to 30 million.[3] A fantastic percentage of the earth's biodiversity occurred just below the location in the crown where sunlight was transformed into plant material. Comprehensive study was called for. How did the canopy's microclimates – caused by variations of temperature and humidity, rainfall and solar radiation – influence species diversity and creation?[4] How did spatial patterns on light transmittance within the canopy's strata impact plant growth?[5]

Historically, most scientific knowledge of the forest's upper reaches was gleaned from leaf litter, faunal droppings and fallen branches found on the floor below. A few intrepid scientists climbed freehand into the canopy to obtain living samples. Some researchers, wary of the shaky, unstable altitudes, sent up macaque monkeys as collectors. Others brought the ecosystem down to earth, chainsawing trees to study the otherwise inaccessible branches, twigs and leaves. After Erwin's tantalising projections, scientists needed to conduct more extensive work in the canopy's varied strata: the overstorey of crowns fully illuminated from above; the midcanopy of transition from light to shadow; the understorey of the lowest shady layers.

The simplest structures were assemblages of ladders, ropes and pulleys fixed by iron rods to trees. They were effective for moving scientists upwards, but insufficient for bringing down collected items. A better approach was to lift scientists into the canopy on hydraulic cranes or cherry pickers. But since such cranes functioned best at the edge of a forest, new types of towers – resembling those stanchions used for skyscraper window cleaning – had to be devised. Instead of moving diagonally, they could be raised vertically. Once within the chosen area of the tree canopy their long arms could be extended horizontally to afford a peek and grab at arboreal animals and insects, epiphytes (plants living on other plants) and lianas (or vines), and the morphology of tree and leaf.[6]

Yet another idea was to approach the canopy from above. In 1987, tropical botanist Francis Halle, architect Gilles Ebersolt, and Dany Cleyet-Marrel, a hot-air balloonist, unveiled Le Radeau des Cimes (the Raft of the Tree Crowns). Manoeuvered to any site by a hot-air balloon, a frame of inflatable rubber pontoons supported a synthetic-fibre structure that could gently rest atop the canopy crown without disturbing the vegetation. Ebersolt developed several variations of the structure, including the Solvin Bretzel used to study the canopy of rainforests in French Guyana. In the early 2000s, Ebersolt came up with the similar yet more durable Ikos Flexible Research Station, a 20-sided sphere (icosahedron) that hangs lightly from the branches accommodating three scientists for up to five days.[7] Not only was this cheaper than fixed crane structures; the station also focused attention on the least understood and most productive zone of the canopy – the top landscape composed of a bushy vegetation of small leafy twigs. Resembling a contraption from a Hollywood adventure flick, the mobile qualities of the Ikos station also recall the plug-in craft designed by Archigram and the Metabolists during the 1960s. But this lightweight, winged version is more elastic, flexible and adaptable to a variety of situations or sockets.

Scientific discoveries in the tree canopy stimulated efforts to take the general public up to the high climes. Endeavours of this kind have generated a new subset of building – canopy towers or walkways. In 1987, the first tree walkway in the world was opened to the public at Australia's Lamington National Park. In the years since, such arboreal high-wire acts have become a popular attraction at national and botanical parks – no doubt in part to inject a bit of dazzle into the public's experience of trees. In 2008, the Treetop Walkway and Rhizotron opened at the Royal Botanic Gardens at Kew, outside London. A circuit of 18-metre (59-foot) steel pylons support a 200-metre (656-foot) oval path set into a forest of chestnut, plane and oak trees. Designed by Marks Barfield Architects, the weathered steel structure seeks to blend into the forest; pylons arc gracefully like tree trunks and likewise branch, this time as supports, beneath the walkway.

A visit to the Treetop Walkway and Rhizotron begins underground in darkness and ascends to bright views of London that alternate with the confines of tree canopies. Its goal is to elevate the public into natural worlds (of leaves, epiphytes,

Marks Barfield Architects, Treetop Walkway and Rhizotron, Kew Gardens, London, 2008
Gazing where eyes have not gazed before.

lianas, butterflies, insects, birds and small mammals) they have rarely, if ever, encountered before and to allow them to experience the strikingly different atmospheric effects – like the decrease of shade and humidity – one experiences in the upper crown. This didactic encounter with 'wild nature' occurs in a forest planted by the 18th-century landscape designer Capability Brown. In his day, Brown revolutionised garden design by turning from rigid, geometric plans modelled on French palace gardens to those undulating curves, inclines and irregularities of the British countryside. A couple of centuries later, canopy architects went beyond these pleasantly spaced and picturesque vistas, and cast visitors into the claustrophobic, mysterious boughs of the tree canopy. Yet truly, this 21st-century ecological journey to a nature unknown harkens back to the spirit of 18th-century Romanticism; for it was in those days that adventurers sought inspiration for original creation in the otherworldly terrain of underground caverns and glacial peaks. Then, as now, the modern spirit finds nature most tantalising when in the throes of discovery.

Most treetop stations provide a neutral vantage point to view the trees. Most seek to disguise their architecture within that of the forest. In 2009, SeARCH took a different approach, merging perceptual conditions with those of the environment being perceived. The Bostoren, or forest tower, is a futuristic structure set within an arboretum on the Schovenhorst Estate in Putten, the Netherlands. Rather than a promenade about the high canopy, a single steel-truss structure supports a winding path up through a sequence of viewing platforms – branching towards the tree canopy's various strata. On one station, visitors look out through a wooden lattice that resembles a bird's nest. Upon reaching the top circular platform, they will be faced, when the trees grow, with a planted forest that filters their view of the tree canopy's crown. While walking skyward, a shiny copper plate at the bottom of the top platform reflects both the structure and surrounding woods, confusing artificial and organic. SeARCH's tower does not imitate the appearance of the forest and forthrightly asserts its formal presence. The correspondence with the environment occurs via perception, in that the built structure borrows from the tangled and sometimes glistening (when one sees leaves freshly coated with precipitation) world of the canopy to complicate and enrich vision. The mystery of visiting an alien world thus boomerangs back to one's own senses and the architectural armature through which they expand.

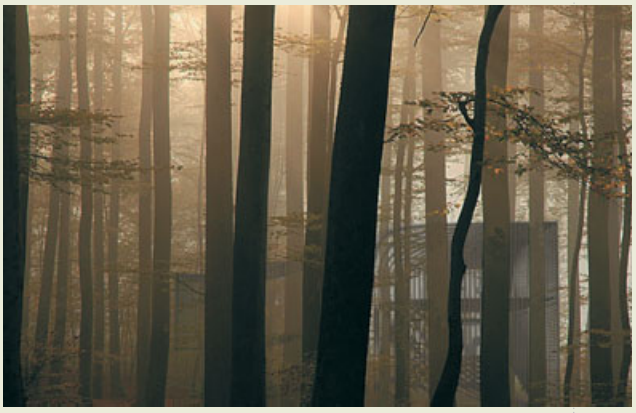
Walkways that weave into the canopy cause one to ponder the ways in which architecture crosses paths with trees. Usually when trees on a building site are preserved or planted, considerations revolve around their ability to enhance views or provide shade. Of late, environmentalists stress the benefits of shade for reducing indoor temperatures, on leaves for capturing and storing carbon dioxide, and on roots for harvesting storm runoff.[8] The results, alas, remain similar. Trees enhance building, but such improvements in architecture's rapport with nature do not go far enough in a time of escalating environmental collapse.

Most engagements of building and tree still tend towards obliteration – the use of bulldozers, chainsaws, lawnmowers and pesticides to create a *cordon sanitaire* between architecture and wild nature. In 1993, Roche DSV & Sie – now R&Sie(n) – reversed the line of attack and proposed strangling a house with trees in the Compiègne Forest outside Paris. House in the Trees envisioned a plastic-walled dwelling raised on steel piloti above 15 saplings. Instead of clearing the ground and disturbing the site, the architects elevated the building above it. Instead of surrounding the building with docile nature, they created circumstances where the trunks and branches would grow, contort themselves around the house, punch into walls, block doors and warp floors.[9] The project posed a vivid metaphor for how worldwide construction relentlessly destroys forest habitats. As a means for understanding how building might engage the ecology of the forest, however, it fell short; the architect's design of nature's ways determines the course of disturbance.

Learning from the forest has not come easily to architects. Architecture's *Urform* (its primal form), the primitive hut, epitomises what happens when architects consider trees philosophically. Seeking a basis for architecture in nature before recorded history, 18th-century theorist Marc-Antoine Laugier noted the resemblance of columns to tree trunks and roof gables to leaf-covered boughs. The resemblances were hammered into a Neoclassical design logic (of the post and lintel and pediment) in which arboreal elements were abstracted and ossified. In the 21st century, increased exposure to the ecology of the tree canopy has shown architects how its biodiversity results from myriad interactions of energy, material and organic life, but has not changed the way they tend to regard natural phenomena as formal models. In the project Holiday House on a Farm (2002), AMID (cero9) scattered the rooms of a house within a small forest, subjecting them to intensified atmospheric conditions.[10] Given that the residential shapes resemble clouds resting amid the tree canopy, one wonders whether the primary design aim was interaction within an ecological system or the fashioning of a tantalising message/image.

SeARCH, Tower Power tree-top observation platform, Schovenhorst Estate, Putten, the Netherlands, 2009
left: Split-screen: looking out at the forest with the forest reflecting back at you.

SeARCH, Tower Power tree-top observation platform, Schovenhorst Estate, Putten, the Netherlands, 2009
below: Soaring up through the forest, a trail of many viewpoints.



Philippe Rahm, Streamscape, Compiègne Forest, France, 2008
left: Atmospheres of the forest and its architectural double.

R&Sie(n), House in the Trees, Compiègne Forest, France, 1993
opposite: Attack of the tall trees.

More than most architects, Philippe Rahm has tried to shift attention from form to atmosphere, arguing that Modernism's asymmetrical buildings contain within paradoxically symmetrical thermal atmospheres deadening to the senses.[11] Rahm advocates architecture 'open to meteorological permutations and the passage of time, to seasonal changes, to the alternation of night and day and moreover to the sudden appearance of unanticipated functions and forms'.[12] To this extent, he builds from Le Corbusier's insight of architecture as the 'play of masses brought together in light' into a design approach where the play of building volumes is felt within heat distribution.[13] His critique of architecture's drift towards vision, to the neglect of the other senses – in particular, the haptic and olfactory – starts to map out how architecture might better engage ecologies like the tree canopy.

Once it was a given that the forest provided woodland societies with a site and materials for building as well as a source of symbols linking back to nature.[14] Nowadays, led by scientists and environmentalists, postindustrial societies are learning once more from the forest. Hopefully, the increasing role of architecture in structuring the ascent of the tree canopy will encourage architects to extend experiments beyond recent environmental projects in which trees and other natural elements appear as instrumental features, invasive elements or mere ornaments.

Time spent in the forest canopy confronts us with perspectives impossible within the media din of architectural culture, where each building endeavour flails its forms for our attention. Rising up from the forest floor we are pulled away from a sense of this tree or that tree, this shape or that shape. Above us are trunks surging to heights out of sight. Around us are branches angling out (and usually upwards) into an indistinguishable net. Sometimes the spread of foliage hovers overhead in a thick unified layer. Other times, especially during the climb into the canopy, we find ourselves passing, as in an arcade, through separate strata of leaves. For the birds, small mammals and innumerable insects up could just as easily be down. High twigs leap towards the bright yonder atop the crown; inside they are practically outside. Below in the understorey biotic communities content themselves in the moist shade; outdoors in this penumbra they are somehow indoors. The hard line between life and death in modern human society softens.

Detritus accumulates on the flatter surfaces and it is plain to see that dead trees stand for decades decaying – death not consigned beneath the ground or sawed and varnished into the building, but active within the living forest, and sustaining of it. Off the ground we forsake our grassland viewpoint of underworld, surface and heaven for a space tangled up in parallax. Like our simian ancestors we scramble on a path whose sky is rich in soil, the air dank with humus that reeks sweet and foul. No horizon line or long vista guides us. Sightlines peel into peripheries that seem to search, like shoots and stems, for spaces of illumination.

Where hierarchies, geometries and visibilities change, so too can mentalities. The tree canopy indicates a blueprint for design where plan is not drawn into a closed system or on a blank sheet, but rather set lightly into a living environment, where elevation does not lose face, and where section, instead of gobbling up space, realises that architectural design must be imposed into nature in a manner sustaining of each. AD

Notes

1. Nalini Nadkarni, 'Diversity of Species and Interactions in the Upper Tree Canopy of Forest Ecosystems', *American Zoologist* 34, 1994, p 70.
2. Francis Halle, 'Canopy architecture in tropical trees: a pictorial approach', in Nalini Nadkarni and Margaret Lowman (eds), *Forest Canopies*, Academic Press (San Diego, CA), 1995, p 32–6.
3. Margaret Lowman, *It's a Jungle Up There: More Tales from the Treetops*, Yale University Press (Newhaven, CT), 2006, pp 12–14.
4. David Fitzgerald and Kathleen Moore, 'Physical mechanisms of heat and mass exchange between forests and the atmosphere', in Nalini Nadkarni and Margaret Lowman, op cit, pp 45–7.
5. Robin Chazdan and Rebecca Montgomery, 'Forest Structure, Canopy Architecture and Light Transmittance in Tropical Wet Forests', *Ecology* 82, October 2001, p 2707.
6. Andrew Mitchell, Katherine Secoy and Tobias Jackson (eds), *The Global Canopy Handbook: Techniques of Access and Study in the Forest Roof*, Global Canopy Programme (Oxford), 2002, pp 35, 209.
7. Detail 12, December 2004, p 1454.
8. Linda McIntyre, 'Shared Wisdom', *Landscape Architecture* 98, February 2008, pp 88–9.
9. Philippe Rahm, 'Should Trees Have Standing', *Quaderns D'Arquitectura i Urbanisme* 217, 1997, pp 109–12.
10. Cristina Díaz Moreno and Efrén García Grinda, 'The Future is Not Barbarella', *El Croquis* 118, 2004, pp 117, 130, 155.
11. Philippe Rahm, 'Climatic Constructions: Thermal Asymmetry in Architecture', *Harvard Design Magazine* 30, Spring/Summer 2009, pp 32–6.
12. Philippe Rahm, 'Form and Function Follow Climate', *AA Files* 55, Summer 2007, p 3.
13. Elizabeth Evitts Dickinson, 'Experiencing Anxious Climates: A New Exhibit Examines the Gritty Side of Sustainability', *Metropolis*, 7 March 2008.
14. Joan Vastokas, 'Architecture and Environment: The Importance of the Forest to the Northwest Coast Indian', *Forest History* 13.3, October 1969, pp 14–16.

Matthew Gandy

THE ECOLOGICAL FACADES

The urban geographer **Matthew Gandy** explores the work of French botanist Patrick Blanc, who applies his scientific knowledge and preoccupations to urban design. After his invention of the *mur végetal* (green wall), a botanical and structural system for greening buildings, in 1988, Blanc's work has gone on to transcend the creation of merely living walls. Through his landscape schemes Blanc has recognised the city's rich potential for verdant metamorphosis, transforming fern- and moss-covered streets and buildings into unlikely ravines or rainforests.

OF PATRICK BLANC

11–21 rue
d'Alsace,
2008

Musée du quai Branly, Paris, 2006
right: A further collaboration with the architect Jean Nouvel.

Musée du quai Branly, Paris, 2006
bottom right: Street view of the museum exterior.

Fondation Cartier, Paris, 1994
opposite top: Blanc's early project gained international critical acclaim as a novel synthesis of nature and architecture.

11–21 Rue d'Alsace, Paris, 2008
opposite bottom: This detail from a major project in a run-down district near to Gare de l'Est shows the characteristic wave-like installations used by Blanc for his *mur végetal*.

The upsurge of interest in 'green architecture' and 'ecological urbanism' marks a distinctive shift in the cultural and political characteristics of the postindustrial city. The presence of new forms of designed nature are exemplified by increasingly radical combinations of architectural structures with living forms: earlier experiments with indoor vegetation and roof gardens in the 1970s have now been radically extended through the aesthetic appropriation of spaces and surfaces that were previously considered too marginal or technically challenging to warrant much in the way of sustained attention. The presence of nature in the contemporary city has intensified in two distinctive ways: firstly, nature has undergone a spontaneous expansion through its return to former industrial spaces, cleaner rivers and other ecological niches; and secondly, nature has been intentionally extended through diverse interventions ranging from new forms of urban agriculture to elaborate design innovations.

A leading figure in the greening of architecture and urban design is the French botanist Patrick Blanc. Blanc is a somewhat unusual figure since he combines an active research career as a scientist at the prestigious Centre National de la Recherche Scientifique (CNRS) in Paris with an increasingly successful design practice focused on the creation of vertical gardens.[1] His highly distinctive *mur végetal*, which was patented in 1988, comprises a combination of metal frame, PVC layer and polyamide felt, with an automated fertilisation and watering system which allows an assemblage of plants to be permanently maintained against a vertical surface. These living walls typically contain a mixture of indigenous and imported plant species that are carefully arranged in relation to vertical variations in moisture and temperature.

Blanc presents himself as a scientist with interests in urban design, and his association with various strands of 'ecological urbanism' stems in part from his scientific background as well as the aesthetic characteristics of the projects themselves. 'My scientific approach,' he explains, 'is essential for designing the whole system and for selecting the plant species suitable for each peculiar location.'[2] For Blanc, the modern city has structural similarities with rainforests that present underexplored possibilities for landscape design; the vertical surfaces of the city provide an ecological tabula rasa to be manipulated to maximum effect. Streets or buildings can become transformed into moss- and fern-cloaked ravines that resemble the lower canopy of a tropical rainforest partially shaded from the sky above. Indeed, the height of many buildings – especially the six-storey norm in much of central Paris – is comparable with many tree species that can be found in rainforests.

Blanc's first plant installation was created in 1988 for the Cité des Sciences et de l'Industrie, Paris, and was followed by other widely acclaimed projects in the city such as the Fondation Cartier (1994), designed by the architect Jean Nouvel, the Musée du quai Branly (2006), where he worked alongside Nouvel and the landscape designer Gilles Clément, and 11–21 rue d'Alsace (2008). Blanc's vertical gardens have been incorporated into a variety of projects ranging from embassies and museums to hotels and shopping malls: indeed, his work for French embassies is suggestive of the increasing significance of his work as a kind of 'cultural signature' to be added to the exterior of high-profile buildings. For the most part, however, his work is restricted to the quasi-public realm familiar to late-Modern urbanism with its corporate atria and display spaces.


EMPORIO ARMANI
HERMÈS
HERMÈS

Siam Paragon shopping mall, Bangkok, 2005
opposite: Blanc's retail projects suggest a contradiction between the aesthetic and ecological aspects of his work.

***robe vegétale*, 2002**
far left: Blanc's designs have now become a recognised 'brand', as signified by his links to fashion (in this case for Jean Paul Gaultier) and elite retail spaces.

BHV Homme, rue de la Verrerie, Paris, 2009
left: An example of Blanc's recent installations on behalf of exclusive retail outlets.

As with the German artist Joseph Beuys, there is a compelling biographical sketch that underpins Blanc's public profile. We are told that his interests can be traced to early experiments with aquatic plants growing out of aquariums followed by research expeditions in the early 1970s to the tropical rainforests of southeast Asia.[3] Photographs of Blanc suggest an intrepid figure perched high up in one of his own creations, or scaling steep cliffs to explore new design possibilities for the modern city. We encounter an active 'outdoor' persona that belies his skilfully crafted affinity with the latest fads in urban architecture and design.

In what sense, however, can the work of Blanc be regarded as ecological, or indeed part of a broader shift in architectural sensibilities? His projects represent not so much a metaphorical elision between art and science – that is now so pervasive in architectural writing – but a material synthesis of their contradictions. These ecological simulacra present a curious paradox since they are linked to advances in ecological science yet in themselves play no useful ecological role. While aspects of the structure and design of Blanc's *mur végetal* are derived from his research practice, these green walls play no clearly defined didactic or ecological function. The *mur végetal* is essentially decorative and bears little relation to the kind of simulated nature that we might encounter in zoos or botanical gardens: these walls are not intended as elaborate reconstructions of nature for educational purposes, but present a commercially driven synthesis of aesthetic and morphological elements removed from their original context.

Unlike other figures associated with the 'greening' of cities, Blanc does not link his projects to a clearly defined set of ecological objectives: these walls remain ostensibly non-political beyond a vague attachment to the enhancement of biodiversity, the improvement of microclimatic conditions or the enhancement of human wellbeing.[4] Yet the scientifically inflected 'impartiality' that pervades his work masks the increasing complicity of his design with the speculative dynamics of capitalist urbanisation. Projects for the Marithé & François Girbaud boutique in New York (2003), and the Siam Paragon shopping mall, Bangkok (2005), show that Blanc's work is fully integrated into the leading edge of elite consumption. In 2002 he even created a *robe végetal* for Jean Paul Gaultier as if to underline an easy oscillation between high culture and haute couture.

Recent years have seen a resurgence of scientific ideas and metaphors in urban discourse engendered by changing tastes in urban design, an eco-political *Zeitgeist* and a variety of technical advances in fields such as computer-aided design and materials science.[5] This current upsurge of nature-based urban design can be criticised as a regression towards pre-Kantian forms of mimetic adaptation or simply an elaborate architectural mask.[6] In the case of Blanc, however, his living tapestries lie closer to the second line of critique since they literally cloak the exterior of buildings and lend them some degree of eco-lustre irrespective of their actual functions.

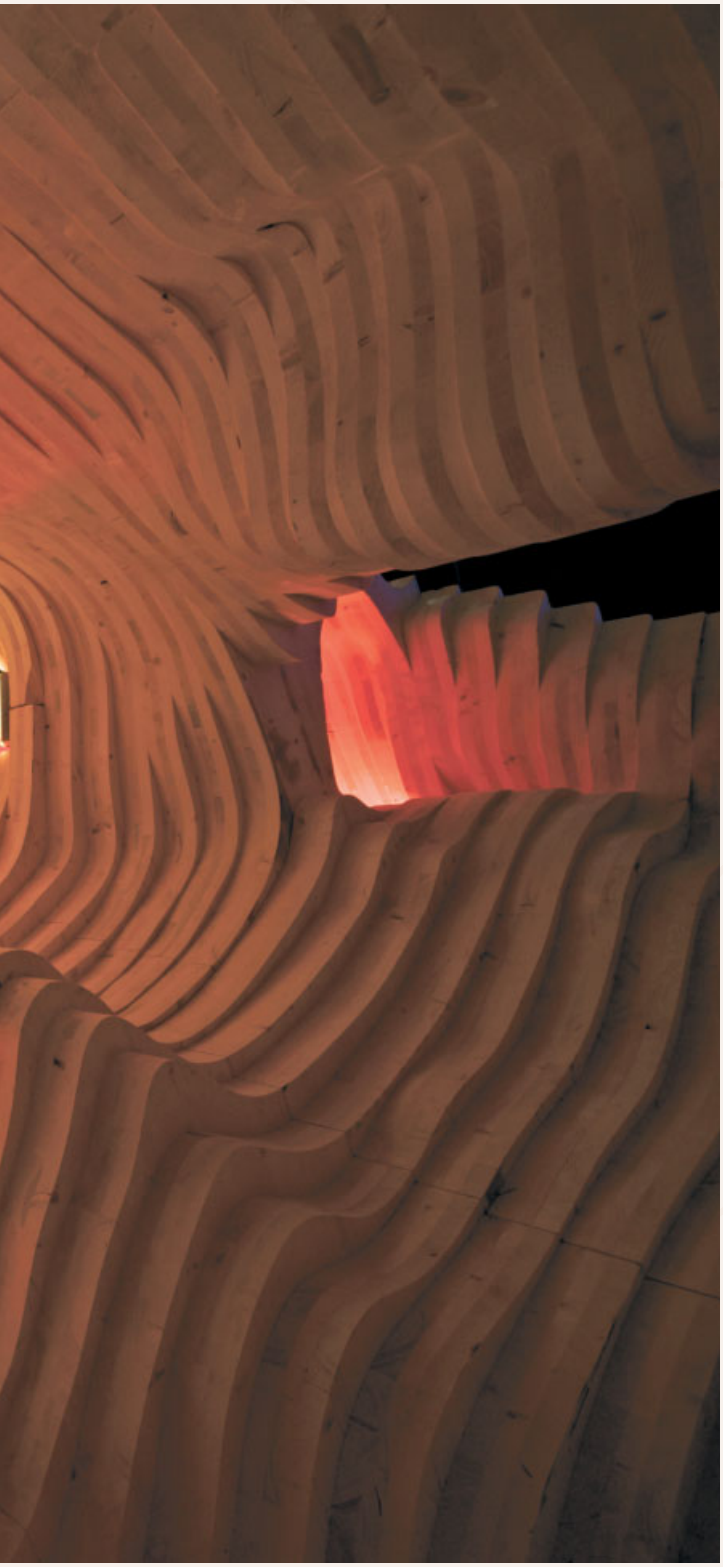
What are the implications of ecological science – or more specifically botany – for urban design? Botanical knowledge is used for the *mur végetal* quite differently from the ecological interventions and experiments that work with the already existing biodiversity of cities. The artworks of Paul-Armand Gette or Ulrike Mohr, for example, present a radically different approach to the reading of urban nature where the emphasis is on a closer engagement with what is already there. Plants can and do colonise vertical surfaces in cites and these spontaneous examples of vertical gardens are more ecologically significant than Blanc's simulacra. Unlike the *mur végetal*, these spontaneous green walls require no additional inputs of water or energy to survive and are a haven for wildlife in the heart of the city. We need a better analytic frame through which to examine the greening of cities: though the *mur végetal* is derived from scientific insights, its actual role within urban space has received little critical attention. AD

Notes

1. See Patrick Blanc, *Le Bonheur d'être plante*, Editions Maren Sell Editeurs (Paris), 2005, and Patrick Blanc, *The Vertical Garden: From Nature to the City*, WW Norton (London and New York), trans Gregory Bruhn, 2008 [2007].
2. Patrick Blanc, interview in *Pingmag*, 8 December 2006; see http://pingmag.jp/2006/12/08/vertical-garden-the-art-of-organic-architecture/, accessed 29 October 2009.
3. See, for example, Kristin Hohenadel, 'All His Rooms are Living Rooms', *New York Times*, 3 May 2007.
4. Patrick Blanc, interview with Sophie Rousseau and Danièle Weiller for *Biotope City Journal*; see www.biotope-city.net/artikelen%20editie1/francais/Interview.P.B.fr.htm, accessed 28 October 2009. The need to consider the ecological impact of entire buildings rather than their surfaces alone is raised by Rodolphe Deborre, 'La biodiversité au service du bâtiment … et vice versa', *Le Moniteur*, 2008; see http://www.becitizen.com/pdf/LemoniteurLa_biodiversite_au_service_du_batiment.pdf, accessed 28 October 2009.
5. See, for example, G Feuerstein, *Biomorphic Architecture*, Axel Menges (Stuttgart), 2002; M Hensel and A Menges (eds), *Morpho-Ecologies*, Architectural Association (London), 2006, and P Portoghesi, *Nature and Architecture*, Skira (Milan), 2000.
6 See M Vercelloni, 'Mimesis, Design and Nature', *Lotus* 135, August 2008, pp 86–95, and F Repishti, 'Green Architecture/Oltre la metafora', in ibid, pp 34–41.

BUGS, BATS AND ANIMAL ESTATES

THE ARCHITECTURAL TERRITORIES OF 'WILD BEASTS'



For architecture, animals and insects have conventionally represented the threat of infestation – a parasitic and insanitary uninvited presence. Could the animal world, however, offer previously untapped opportunities for design innovation? At a time when the relationship between architecture and nature is coming under question, **Ben Campkin** takes the opportunity to bring attention to the wider social and geographical processes lying beneath the occupation of the man-made environment by insect and animal life.

Termite Pavilion, 'Pestival', Southbank Centre, London, September 2009
The design was a collaboration between Softroom Architects and Freeform Engineering, Atelier One, Chris Watson, Haberdasherylondon, KLH and Pestival Southbank. Its scaled-up termite-mound forms are based on 3-D scans of Namibian mounds created by scientists as part of the Termite Emulation of Regulatory Mound Environments by Simulation (TERMES) project.

In his recent discussion of weather in relation to domestic environments, Jonathan Hill quotes Banister Fletcher on the origins of architecture. Hill writes:

> The purpose of the home is to keep the inside inside and the outside outside.
>
> Traditionally, threats from outside come in a number of guises, notably inclement weather and undesirable people. Both are associated with the formless, fluid, unstable and unpredictable. Banister Fletcher writes that 'Architecture … must have had a simple origin in the primitive efforts of mankind to provide protection against inclement weather, wild beasts and human enemies'.[1]

Between 'inclement weather' and 'undesirable people', non-human organisms – Fletcher's 'wild beasts' – act as illicit architectural authors, materially shaping (or misshaping) the built fabric, occupying the most intimate cores and liminal edges of buildings, disrupting conventional notions of architectural materiality as 'solid, stable and reassuring',[2] and directly influencing the perception and experience of inhabitation. Seen in a positive light, setting aside Fletcher's evocation of animals as a threat, it is also clear that they, their habitats and their infestations have consistently prompted technical, material, formal and spatial innovations in architecture and urban planning. Think of London Zoo, with its numerous enclosures, celebrated for their formal and structural invention, by architects such as Berthold Lubetkin, Denys Lasdun and Cedric Price. Contemporary architects are increasingly collaborating with zoological and entomological specialists in designing animal habitats. In such projects they establish new modes of working which challenge disciplinary and epistemological territories and suggest a shift away from the historical architectural positioning of urban animals as either pests to be controlled or eliminated, or curiosities to be admired in the spectacular structures of zoological institutions.

At the present moment – in which radical reconceptions of relationships between architecture and nature are called for – attention to animals, their habitats and their occupation of man-made environments, has the power to reveal architecture's place within wider social and geographical processes. Extending Hill's arguments about weather, animals complexify a binary understanding of the relationships between architecture and nature. Considerations of the exchanges between animals and architecture take us beyond the isolated architectural object, and of context as site, helping us to understand the architectural production of nature and to rethink architecture's and architects' zones of influence, connecting buildings to their environs in dynamic ways.

Architecture's Infestations

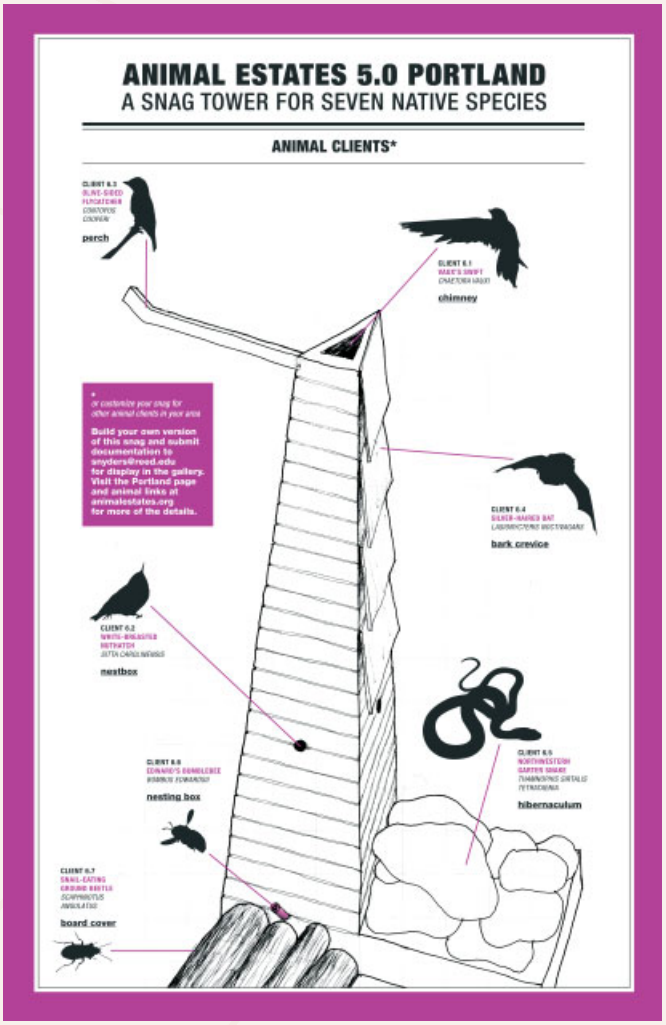
Fletcher conjures large mammals as potential invaders of human settlements. Yet we can alternatively think of microscopic parasites that threaten to infest our homes and cities. The common bed bug, *Cimex lectularius*, is one such case deserving of our attention given the well-documented recent rise of this species in places such as London and New York. Bed bugs cause considerable physical and psychological suffering, through their bites and the extent to which they infest homes, hostels, hotels, upholstery and furniture. As unwanted, 'bad' nature associated with unsanitary conditions, these species threaten in particular to destabilise the security of domestic environments. In such contexts they constitute an *unheimlich* intrusion of nature,[3] lurking in the hidden services and structures of houses, and adversely affecting the perception of the home as a secure place.[4] To get a sense of this we can turn to George Orwell's famous description in *Down and Out in Paris and London*, published in 1933, before the widespread use of insecticides:

> The walls were as thin as matchwood, and to hide the cracks they had been covered with layer after layer of pink paper, which had come loose and housed innumerable bugs. Near the ceiling long lines of bugs marched all day like columns of soldiers, and at night came down ravenously hungry, so that one had to get up every few hours and kill them in hecatombs. Sometimes when the bugs got too bad one used to burn sulphur and drive them into the next room; whereupon the lodger next door would retort by having his room sulphured, and drive the bugs back. It was a dirty place, but homelike.[5]

Mobilising the military and sacrificial metaphors commonly deployed by modernising hygiene reformers, Orwell emphasises the intimately close relationship between neglected, dilapidated and overcrowded buildings and bed bug infestations. After being all but eliminated by the use of environmentally damaging insecticides such as DDT (dichlorodiphenyltrichloroethane) in the mid-20th century, these insects have now re-emerged, more resistant to poison and more widespread due to increased international travel. The passage, and the modern story of the bugs' resurgence, emphasise that certain styles of construction, maintenance, management and inhabitation favour particular pest species.

In the 1930s, when Orwell wrote his evocative account, the main way in which architects conceived of animals was as vermin. Along with other built environment professionals and public health reformers, they were directly engaged in the pursuit of pest-free environments through slum demolitions, new housing projects, and design and material tactics to prevent

Fritz Haeg Studio, 'Snag tower' poster, Animal Estates 5.0, Portland, Oregon, 2008
Modelled on the incidental habitat of a dead and decomposing tree, the tower is designed to accommodate seven native Portland species according to their needs.



or discourage infestations. Yet in the context of contemporary industrialised cities, architects have largely disconnected from matters of pest control. In what other ways are they currently engaged with the territorial interactions between humans, animals and insects?

Three recent projects which see architects working with zoological experts – Fritz Haeg's Animal Estates, artist Jeremy Deller's Bat House Project, and London's 'Pestival' Termite Pavilion, designed by Softroom Architects – provide some clues. Haeg explores animal habitats to prompt engagement with questions of local ecology and the role of the architect. Similarly, Deller's competition required architects to reconceive a place for creatures excluded from spaces they have traditionally inhabited. Finally, Softroom's Termite Pavilion re-creates scaled-up termite habitats through 3-D scanning, providing a performative space for experiencing nature in the city, overcoming the traditionally passive and predominantly visual reception of knowledge about animals and their habitats through zoo displays.

Animal Estates

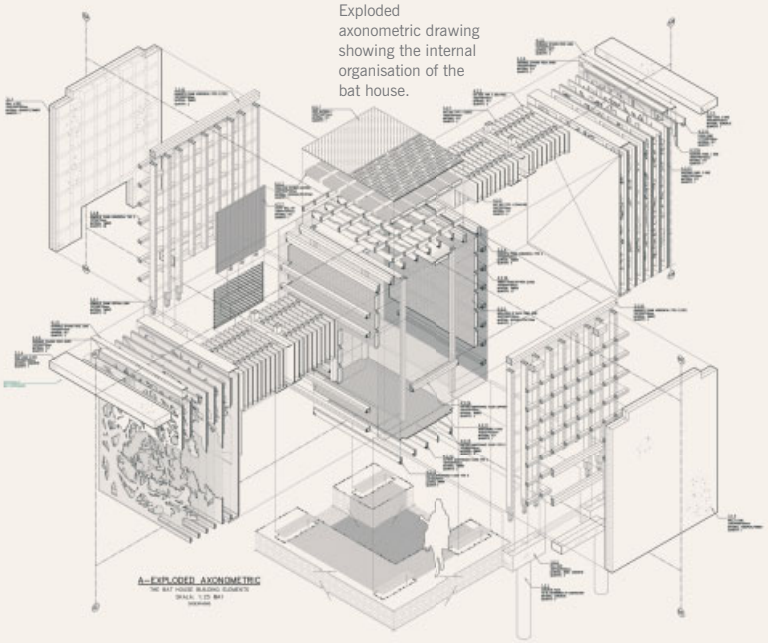
In his ongoing Animal Estates project (2008–), architect Fritz Haeg designates animals as 'clients'. Haeg has collaborated with wildlife experts in multiple cities to construct a series of structures, performances, installations, workshops and 'field guides' – documents explaining the species and habitats particular to each project's site. The interventions reinsert spaces for native animals, excluded – sometimes permanently – through human presence, activities and forms of development. For Haeg, spiralling pest populations are a lesson:

> Humans are one of many territorial creatures that occupy the planet, but we are the only ones who, when establishing territory, preclude the existence of most other life forms that we have not domesticated. Thus, most creatures not a part of the human plan are either considered a threat or a pest. As natural predators are eliminated, the populations of pigeons, cockroaches, rats, ants and mice spiral out of control. In fact, this may be the only 'wildlife' remaining in most cities.[6]

Animal Estates parallels projects such as the High Line in New York City (James Corner Field Operations with Diller Scofidio + Renfro, 2009) in its desire to reintroduce human-controlled, semiwild forms of nature into urban environments – however, here at a more abstract level, through interventions in various art institutions such as the Whitney Museum of American Art in the same city. It critiques the figure of the architect as primarily an inventor of formal, aesthetic, technical or material novelty, instead prioritising curatorship, collaboration and public engagement. Haeg also self-consciously favours simplicity and a

Jorgen Tandberg and Yo Murata, Bat House Project, WWT London Wetlands Centre, London, 2009
The winning design in Jeremy Deller's Bat House competition, Tandberg and Murata's building has an expressive facade of naturalistic forms set within its white Hemcrete box structure.

Exploded axonometric drawing showing the internal organisation of the bat house.



low-tech aesthetic – an approach that contrasts with biomorphic architectures that look to find architectural analogies from animal bodies and habitats, and complex natural systems, primarily as a source of technical, structural and formal innovation.[7] It also juxtaposes the elaborate bespoke architect-designed structures associated with certain zoological institutions.

Haeg either literally re-creates nests in incongruous contexts or constructs model homes for animal clients which non-architects could easily reproduce. In Portland, Oregon, he built a 4.2-metre (14-foot) tall residential 'snag' tower, modelled on a dead and decomposing tree, in order to accommodate seven native Portland species. This object acts as a metaphorical invitation for the displaced species encountered through site research to return. In representing a decaying tree – idealising it as a model home for multiple species – and in pointing to ecological loss through extinction and overdevelopment in cities, Haeg's snag tower and other interventions raise questions of time, nature and the origins of architecture that were once the prerogative of follies in landscape architecture.

Bat Houses

Designs produced for Deller's Bat House Project (2009) offer further trajectories in examining architecture's interactions with animal habitats. This project asked entrants to design a bat house for the WWT London Wetlands Centre nature reserve site.[8] This was in response to the gradual elimination of bat habitats through the redevelopment of derelict buildings, and diminished opportunities for nests in houses through changes in patterns of occupation, such as increased attic conversions. As with bed bugs, which evolved into human parasites from the cave-dwelling bat parasite *Primicimex cavernis*, close coexistence with humans is a defining feature of many bat species. Through its conservationist slant, and as a platform for collaboration between architects and wildlife experts in building design,[9] this project connects with Haeg's critique of the territorial claims made by humans over animals. The winning design by Architectural Association students Jorgen Tandberg and Yo Murata, and another of the entries – Bat Spiral, now being developed for three different sites by Friend and Company Architects and Designers – are indicative of some key issues raised by the competition.

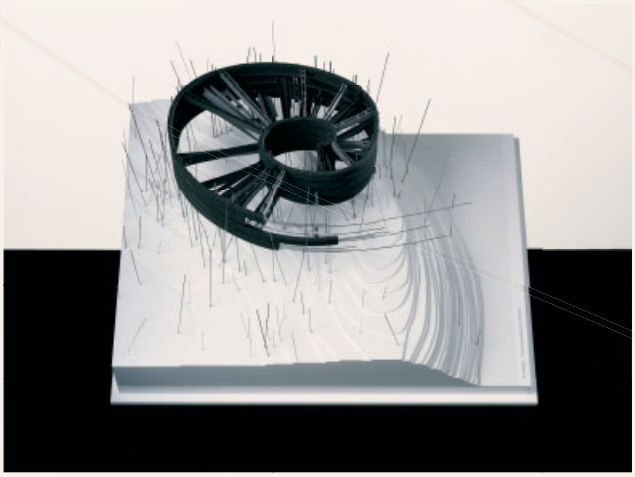
For Tandberg and Murata it was important, through naturalistic representation, to heighten awareness of the constructed nature of the wetlands reserve:

> The Bat House was designed … in a period where we felt that *simulation* of nature had a key role in architecture (perhaps it still has): abstract models meant to recreate a certain performance, but that most often were judged not on how well they performed, but rather on how well they expressed that performance in beautiful geometry. We wanted to use *naturalistic representation* in our proposal … rather than simulation, in order to put expression first, and the intention of expression as a key feature, rather than expression as a by-product of something else. The ornamental plywood panels covering two facades are made through a process of overlaying photographs of shapes found in nature, and are *images of nature* for the bats to live within, rather than *simulations* of nature [original emphases].[10]

Completed in 2009, this structure, with its delicately layered CNC-cut facade panels, is designed to embed within its environment – even while it stands out visually, as a distinctive white Hemcrete box with sculptural qualities. The intriguing facades evoke the bat as a creature of myth – nocturnal, rarely seen, but closely cohabiting with humans, and often represented in popular culture. Internally the building provides roosts for pipistrelle and Daubenton bat species in separate micro-territories, where they can coexist without disturbing each other. Expressive and functional, the bat house provides a subtle response to its environment.

Tandberg and Murata's interest in exterior figurative expression is paralleled by Friend and Company's evocation of spinning flight in their Bat Spiral, a wheel spoked with timber roosts, exhibited at the 2009 Royal Academy of Arts summer

Friend and Company Architects and Designers, Bat Spiral, London, 2009
Adrian Friend's design evokes the energy of bats in flight through its spinning form. Exhibited at the Royal Academy of Arts, London, in 2009, the design is now in development for three different sites.



Softroom Architects, Termite Pavilion, 'Pestival', Southbank Centre, London, September, 2009
The design was a collaboration between Softroom Architects and Freeform Engineering, Atelier One, Chris Watson, Haberdasherylondon, KLH and Pestival Southbank. Its scaled-up termite-mound forms are based on 3-D scans of Namibian mounds created by scientists as part of the Termite Emulation of Regulatory Mound Environments by Simulation (TERMES) project.

exhibition in London. 'It's not about the bat. It's about the location and context,' Adrian Friend argues – this micro-architectural concept can be transposed to different locations and scales, continuing its exploration of stacking and slotting.[11] However, as with Haeg, and Tandberg and Murata, close attention to the biology, habitats and spatial habits of particular species is evident here. The architect worked with bat and moth specialists (bats eat moths), observing these creatures' sensitivities to subtle changes in environmental conditions and architectural processes, and developing an intricate typology of roosts for 17 British bat species. These provide a response to the bats' gradual eviction through modern construction methods and bat-unfriendly building regulations instrumental in producing buildings with tightly enveloped facades, and cavities fuller with insulation.

Termite Territories

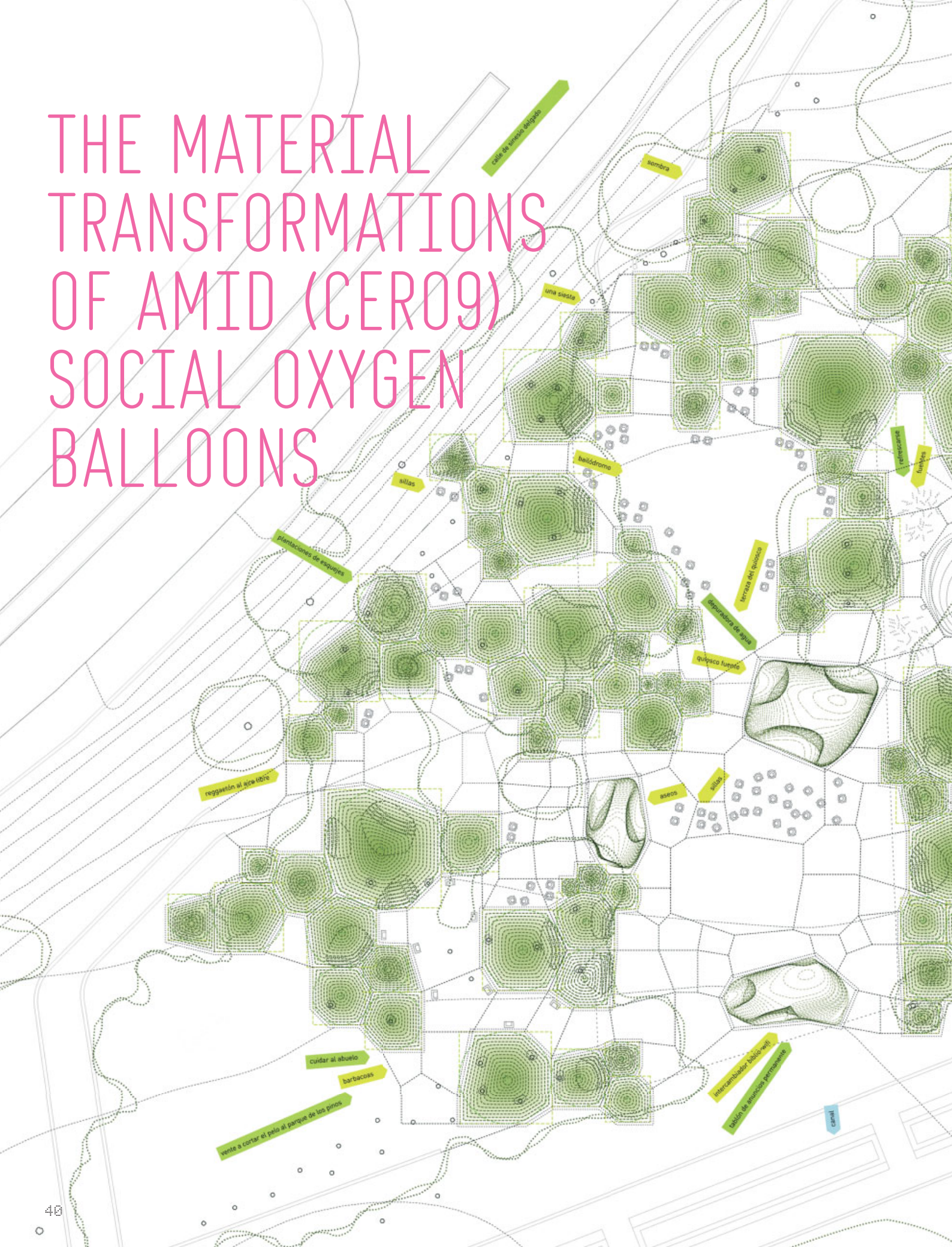
Paralleling the architect–scientist collaborations instigated through the Bat House Project, in September 2009 London's Southbank Centre hosted a weekend-long interdisciplinary 'Pestival', billed as 'a festival celebrating insects in art, and the art of being an insect'. An eclectic line-up of exhibits and events included Softroom Architects' Termite Pavilion, wherein visitors could experience walking through the contoured laminated-timber forms of a scaled-up termite mound model. Based on 3-D scans of Namibian termite mounds recently produced by scientists,[12] the pavilion has since been relocated to London Zoo, the site, as mentioned earlier, of many zoological structures which have become canonical in the texts of British architectural history. This project is closer to conventional zoo display architecture, but is set apart by its sophisticated formal biomimicry, resulting in access – beyond passive spectatorship – for humans to experience some of the spatial qualities of termite mound interiors. Visitors were thus connected with the original site of the mounds in Namibia, as well as the immediate environs of 'Pestival' as an innovative network of social and educational events for the exchange of knowledge about insects.

In summary, these bespoke microprojects complicate the neat boundaries of the architecture–animal dialectic evoked by Fletcher. In so doing they engage larger issues of architectural territory. Instead of an inside for man and an outside for wild beasts – or an inside for beasts to be viewed in the context of a zoo – they invite us to speculate on the interdependent nature of human–animal–architecture relationships, and the intimately overlapping and corresponding spaces of animal and human habitation. In the interactions they explore, and their emphasis on architecture's active role in influencing animal and insect species, they suggest the potential for animals to situate architecture within wider social and environmental contexts. AD

Notes

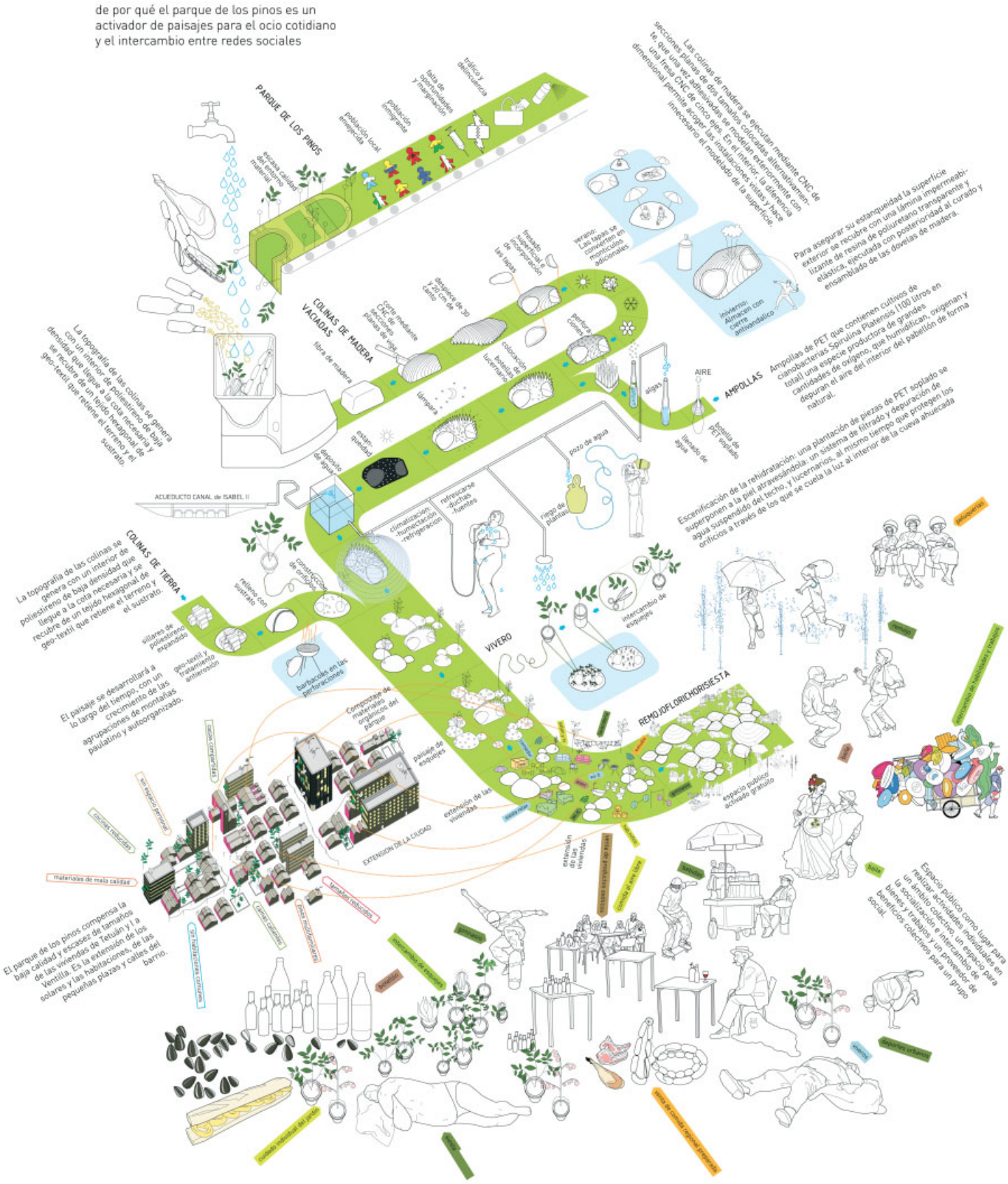
1. Jonathan Hill, *Immaterial Architecture*, Routledge (London), 2006, pp 8–9.
2. Ibid.
3. Anthony Vidler, *The Architectural Uncanny: Essays in the Modern Unhomely*, MIT Press (Cambridge, MA), 1992.
4. For a more detailed discussion of this passage, the bed bug problem and recent geographical writings about the spatialities of animal–human relationships see Ben Campkin, 'The cleansing of slumland and the return of the bed bug: pest control and the shaping of London' in Trenton Oldfield and Deepa Naik (eds), *Critical Cities: Ideas, Knowledge and Agitation from Emerging Urbanists*, Myrdle Court Press (London), 2009, pp 258–79.
5. George Orwell, *Down and Out in Paris and London*, Penguin Books (London), [1933] 2003. For a cinematic scene which echoes Orwell's, see *The L-Shaped Room* (1962), directed by Bryan Forbes in an adaptation of the novel of the same name by Lynne Reid Banks (1962).
6. Interview with Fritz Haeg, 2009.
7. For example, see Alejandro Bahamón and Patricia Pérez Rumpler, *Animal Architecture*, Paramón (Barcelona), 2009. For a discussion of matter and form in architectural design in relation to biological theories of complexity and evolution, see Peg Rawes, 'Animal Architecture' in Jonathan Hill (ed), *Architecture: The Subject is Matter*, Routledge (London and New York), pp 207–23.
8. See http://www.bathouseproject.org/aboutus/about/ (accessed 26 September 2009).
9. Ibid.
10. Interview with Jorgen Tandberg and Yo Murata, 2009.
11. Interview with Adrian Friend and Tom Hillier, 2009.
12. The Termite Emulation of Regulatory Mound Environments by Simulation (TERMES) project, see http://www.sandkings.co.uk/ (accessed 26 September 2009).

THE MATERIAL TRANSFORMATIONS OF AMID (CERO9) SOCIAL OXYGEN BALLOONS



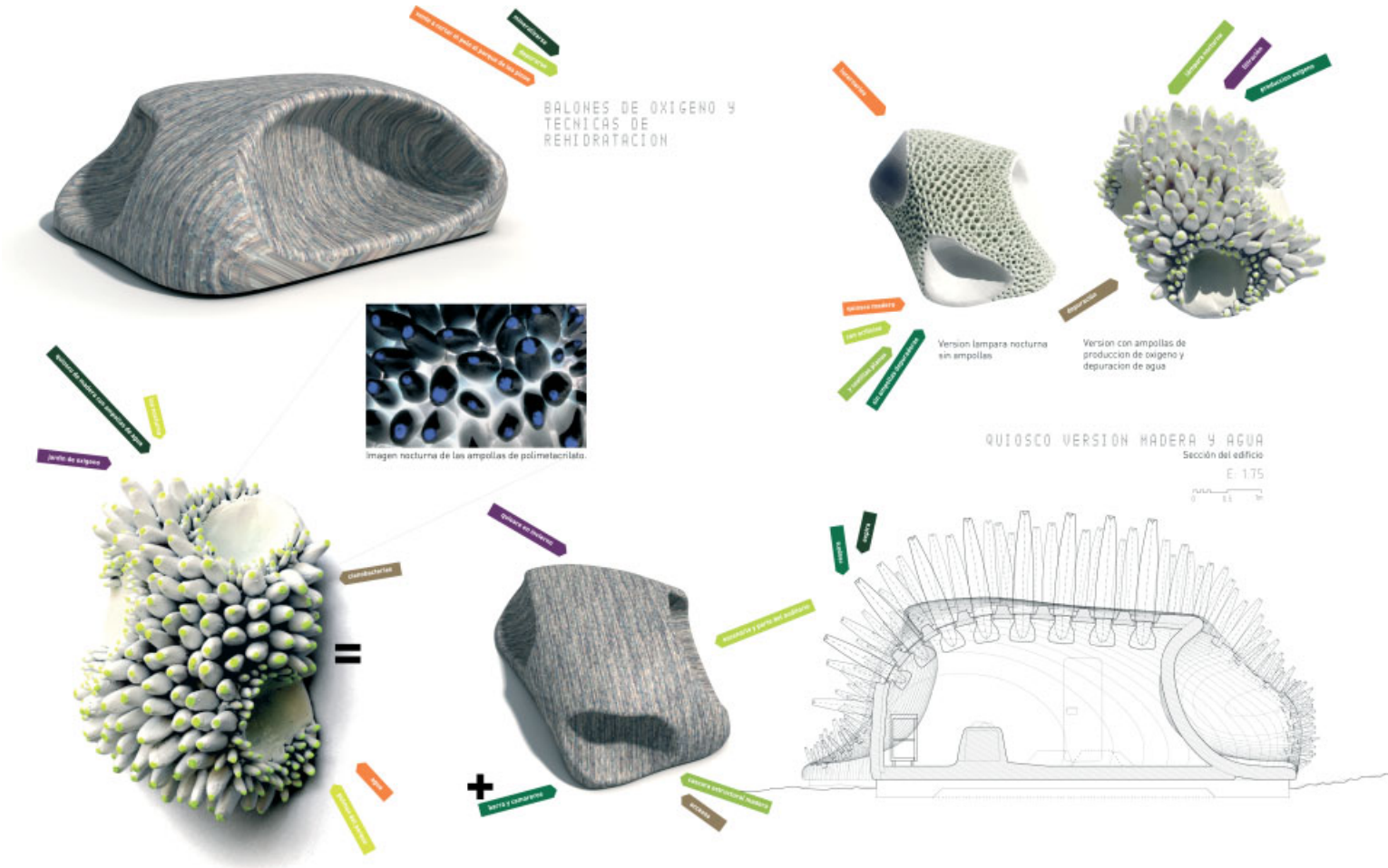
For Spanish practice AMID (cero9), the proposal for an urban park on a restricted site in the Ventilla district of Madrid offered the chance to reconnect with nature through an experimentation with material metamorphosis. Guest-editor **David Gissen** describes how the project Social Oxygen Balloons with its 'metabolisms' or matter-changes, most apparent in the wall structure, stem from Gottfried Semper's concept of *Stoffwechsel*.

AMID (cero9), Social Oxygen Balloons, Pinos Natural Park, Madrid, 2008
Plan and section.

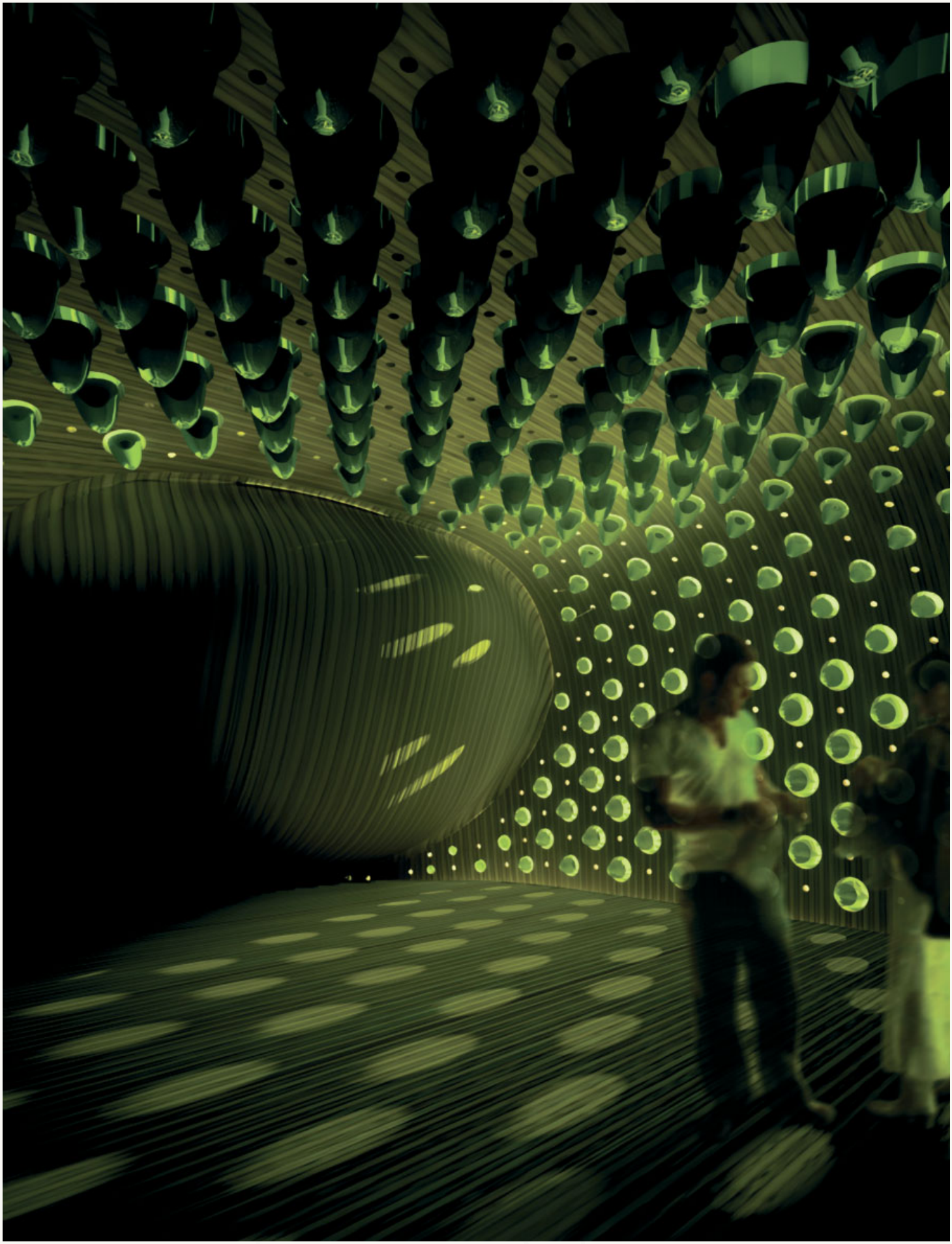


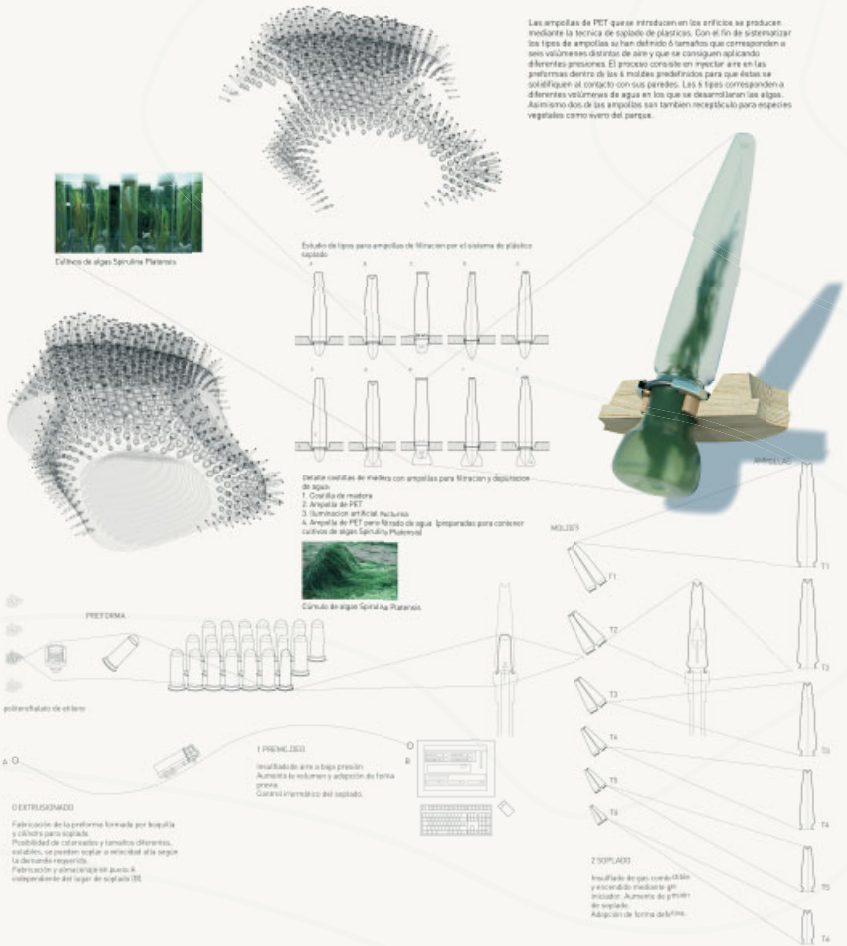
Concept diagram showing planning, hydration and recycling strategies. AMID (cero9)'s strategy proposes a series of physical and programmatic transformations in the park to realise immersive and surreal leisure environments:

- *Bowl*. Regularisation of the original stream bed that deletes and partially replicates the existing auditorium in order to create a topographical bowl; an almost imperceptible basin that underlines the importance of the natural stream bed, the depressed position on the street and the presence of existing trees.
- *Rash one: Replacement of the substrate*. Assess each and every one of the trees in the area. The bases of the trees are surrounded with new substrates in order not to reveal roots, creating an inverted topography with a smaller scale of the original bowl.
- *Rash two: Stretching*. New deformations are added to the previous deformations, defining leisure spaces with different dimensions and characteristics between them.
- *Rash three: Deformation.* The hills are dotted with deformations of different sizes. The adaptation of their scale allows the planting of mid-size trees in the hills, serves as a receptacle for containers, and forms areas for lying down or sitting, or to store water.



The kiosk and the two pavilions designated for storage and toilets, and wi-fi, are three more hills in the public space defined by operations of stretching the surface; but these hills are built with wood instead of land. The construction system is based on wooden dowels consisting of flat sections cut by CNC. The exterior is modelled with a three-axis milling machine of assembled sections, while the interior sections are offset to prevent surface milling.





Details of pavilion skin system. The kiosk becomes the staging of rehydration: a plantation of blown pieces made of PET – a similar system to that used for soft-drink bottles – are placed in the external surface and cross the wood. They protect the holes, enabling light to seep in, and at night they illuminate the exterior. In the lower tank, some contain cultures of the micro-algae *Spirulina platensis* that produce large amounts of oxygen, which naturally humidifies, oxygenates and purifies the air inside the pavilion.

In projects such as their Endesa Offices (Valladolid, Spain, 2002), Magic Mountain (Ames, Iowa, 2002), or the one featured here – Social Oxygen Balloons – Spanish practice AMID (cero9) explore the surfaces of architecture as the site for the transformation of matter. In doing so, they extend one of the key narratives that makes Modern architecture modern, but their pursuit of material transformability may also be key to understanding how architecture may unfold into something else that suggests interrelated, double or triple transformations of materials and ideas.

The origins of the above concept lie not in a Spanish thought but in Germanic concepts and language. Theories of material transformation include the conceptual, material transformation of the architectural wall – what German architect Gottfried Semper (1803–79) called *Stoffwechsel* (literally, 'matter-changing).[1] It can also be found describing the transformation of ecological matter – what the German scientist Justus von Liebling also called *Stoffwechsel* (using precisely the same word as Semper).[2] The former, Semperian matter-change, entails the metamorphosis of objects from one material to another over historical time; from knots to mats, to bricks to ornament, in an endless change of material reference. The latter, scientific concept of matter-change was translated in English as 'metabolism' (and into Spanish as *metabolismo*). It involves the immediate exchange of ecological matter; for example, the processing, by plants, of carbon dioxide into oxygen. The concept of *Stoffwechsel* was central to Semper's concepts of the historical evolution of architecture and the role of the wall in demarking a territory for human society. For von Liebling, *Stoffwechsel* was crucial in determining the workings of ecology, but also the natural territory of a species. Our metabolisms invoke environments and spheres — of oxygen, sunlight and water.

In Social Oxygen Balloons we begin to see how the various forms of material transformability might work together. The project, a proposal for an urban park in the Ventilla neighbourhood of Madrid which has a sizable and young immigrant community, but which lacks the public spaces typical of most Spanish neighbourhoods, attempts to establish a connection with nature. Here the architects (Cristina Díaz Moreno and Efrén García Grinda) present the triple transformation/metabolism of the site: the physio-aesthetic metabolism of the wall construction in the garden pavilions; the metabolism of oxygen within the wall; and the metabolism of the landscape's varying natural components. Thus nature, architecture and society all metabolise the ecological and social matter coursing through the Ventilla.

German economic philosopher Karl Marx also used the term *Stoffwechsel*.[3] He believed that we should strive towards a more just socio-natural *Stoffwechsel* – one that could change us and our conditions of social exchange. Who knows whether the metabolisms suggested in AMID (cero9)'s architecture can offer such grandiose possibilities, but looking at the images of their work, one can certainly dream of this possibility and hope so. AD

Notes

1. See Mari Hvattum, *Gottfried Semper and the Problem of Historicism*, Cambridge University Press (Cambridge), 2004.
2. See Erik Swyngedouw, 'Circulations and Metabolisms: (Hybrid) Natures and (Cyborg) Cities', 2004; http://socgeo.ruhosting.nl/colloquium/science.pdf, accessed 10 November 2009.
3. Ibid.

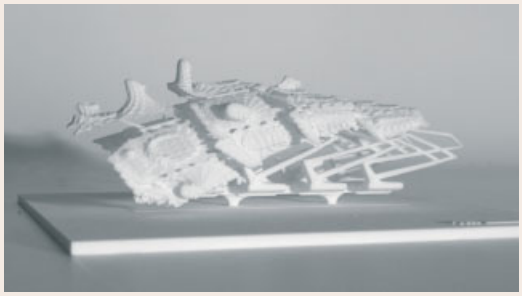
IT'S IN YOUR NATURE I'M LOST IN PARIS

Javier Arbona

R&Sie(n)'s installation I'm Lost in Paris (2008), a disturbing take on the ecological house, epitomises the preoccupation of the French architect François Roche with the contradictions of modern nature. **Javier Arbona** tracks how Roche's notion of nature as 'a partly human artifice' which is both alien and personalised play out in his various projects, capitulating between attempts at overcoming alienation and heightening it.

R&Sie(n), I'm Lost In Paris, Paris, 2008
From some social-class perspectives, this fern-covered private house may seem like wild nature.

R&Sie(n) and Pierre Huyghe, Broomwitch, Meudon, France, 2008
In this unbuilt proposal for the Seroussi family house expansion (detail model), robotic technology is another form of nature that extends the house into a garden space.



Over time, hydroponic tentacles covered in plant material would cover the yard, giving the house a monstrous appearance.

'One touch of nature may make the whole world kin,' famously wrote Raymond Williams, adding 'but usually, when we say nature, do we mean to include ourselves?' Of course not, he argued. On the contrary, a more precise encapsulation of the human condition may sound more like this: 'One touch of *alienation* may make the whole world kin,' though as Williams warned, neither alienation nor nature are ever experienced by all people exactly the same way in a stratified world. Thus, 'If we alienate the living processes of which we are a part, we end, though unequally, by alienating ourselves.'[1] According to this and other subsequent theories of historical eco-materialism, this life-sustaining role of nature collides in various ways with the configurations of the social world, especially under the unevenness of capitalism. This makes our contacts with the natural a contradictory mixture of contemplation, dread, exploitation and withdrawal, to name a few.

François Roche's work fits, albeit uneasily, into the production of a milieu of artists and architects (several featured in this number) united by a Williamsonian enquiry into the contradictions of modern nature: a partly human artifice upon which we materially depend, extending our being and life, but also foreign and strange, not to mention privatised in myriad forms.[2] Giant water systems are a classic example of this. The creations of Roche, along with Stéphanie Lavaux and various other design partners over the years – most recently operating under the R&Sie(n) moniker – seesaw between attempts at overcoming alienation (the condition of being expropriated from our very own means of labouring in and with the earth), and also heightening it.[3]

Sometimes R&Sie(n) emplace the subject face to face with what Roche calls 'local scenarios'. These expose an obscured human history in nature, but then troublingly reveal a decayed state and a global collapse of life-sustaining exchanges.[4] Projects such as Aqua Alta 1.0 and 2.0 (1998 and 2000), for example, transform Venice's polluted and smelly water into a building envelope and a clean, consumable product, respectively. At other times they adopt a chilling, callous meta-alienation that exploits the futility of common tropes of human progress over nature in order to derive their meaning. Mosquito Bottleneck (Trinidad, 2003), a house that harbours virus-laden mosquitoes, pulls from a larger context – the animal's habitat and its harmful evolutionary trajectory – to express the absurdity of trying to conquer nature.

Or, it could be all of these conceptual means at the same time, as the house they've dubbed 'I'm Lost In Paris' (2008) helps evince. This planned experience of architecture is fraught with oppositional experiences of alienation's amelioration and intensification for the subjects – real or imagined – of these spaces. In their projects, the architects provocatively leave open the possibility that the experience of architecture could be irregular across the span of race and class, as in the Soweto memorial-museum and library to Hector Pieterson (Soweto, 1997), where postcolonial researchers would confront the grave of a martyr, perhaps questioning their capacity at remediation for the past through contemplative research.

Small wonder that this outfit has been considered *outré* in the profession. It does not help that much writing about R&Sie(n), and no less Roche's own texts, tend to mystify rather than elucidate the practice.[5] However, what they have accomplished is nothing short of a restoration of an age-old philosophical materialism, long absent from mainstream architecture, caught up in the faux references of Postmodernism, the intellectually devoid Neomodernisms, the semiotic escapism of Deconstructivism, and the recent positivism of digital fabrication. No surprise, then, that R&Sie(n) shock sensibilities – even of those who claim to practise a ne'er-do-wrong ecological architecture.

Strains of sustainable and green design merely reaffirm that separation between humans and nature, even while seeming to close it.[6] These entities enshrine a benevolent natural cycle that they rationalise – with a full array of industrial technologies – based, ironically, on an already domesticated (and degraded) first-world nature.[7] On a basic level, most green architecture spatialises nature either as a neatly bounded territory where, in isolation, it shall regenerate. Think of Shuhei Endo's otherworldly shrooms, or of Michael Sorkin's deterministic eco-footprint cities that supposedly leave a larger wilderness space alone.

Alternatively, other strains spatialise nature as a series of diverging territories where only some are reserved for certain

R&Sie(n), I've Heard About, Musée d'Art Moderne de la Ville de Paris, 2005
In this speculative proposal, pneumatic tentacles secrete layers of material to contingently build an ever-changing social structure.

R&Sie(n), Aqua Alta 1.0, Venice, Italy, 1998
Algae and water are here drawn into the building envelope through capillary action.

R&Sie(n), I'm Lost In Paris, Paris, 2008
opposite top: The ferns receive nutrition from a seemingly unnatural, yet also human, source.

opposite bottom: Positioned from within, the occupant is privileged with a vision of the intermixing of the artisanal labour that went into the glass beakers and the Promethean mechanics of the home.

privileged humans, freed of most wild dangers and noxious uses (not to mention financed in Faustian bargains with corporate developers). Much of the work under the 'landscape urbanism' rubric comes to mind here.[8] In such ways, nature is made out to be mostly independent from other realms in which society, policy, legislation or the economy then reproduce themselves in all their exploitative glory, though certainly nature is called upon when it can be best commoditised to fuel the rest.

In addition, much of the green practices treat technology as another entity with an ambiguous relationship to idealised nature, obfuscating the long lineage where we humans have ensnarled nature and technology with each other. Take early genetically modified seeds over a hundred years ago, for instance.[9] Best left as a fetish embodied by the easily grasped gizmo like a Mac, a Blackberry, or a wind turbine, green architecture prefers to pare technology away as something extra-natural, if not extra-terrestrial. In R&Sie(n)'s work, by contrast, technology is woven throughout, both visible and invisible, in nature and outside it, obvious and not.

Oddly, it is capturing the seemingly bizarre, cyborgian ways in which nature and technology merge that has given R&Sie(n) the imprint of heretics, a label they gladly embrace. One of the practice's most sci-fi proposals, I've Heard About (2005), is quite literally a building that receives social response in a contingent way, and uses it as code to continually change and rebuild itself robotically through a layering of polymer secretions. Although it sounds weird, this is no more bizarre than trying to stop global warming by reducing carbon emissions (and highway clogs) using traffic cameras and automated signals, as the California Transit Authority attempts to do. In some of their more recent projects, what R&Sie(n) do is look for scenarios that simply heighten the latent cyborgian character of actual material reality.[10]

One such case is I'm Lost In Paris. Here, a single object (a house, in this case) is conceived as an amalgam of larger macro-territories and smaller human-controlled systems that nonetheless feed back into each other, somewhat analogous to Richard White's concept of the 'organic machine'.[11] However, all is not peaceful in this feedback, and this sets R&Sie(n) apart from other green architects who are invested in ideas of a platonic natural balance. The house can be interpreted as exemplary of how this cohort negotiates a series of opposing territories in one single work. By the way, perhaps by accident, the title evokes a short film of the same name by Julio Cortázar that shows a sneaky Cortázar playing hide and seek with Carole Dunlop through streets, parks and bridges.[12] This might already hint at how the city conceptually becomes a living territory in which to manoeuvre and avoid capture, but working inside the organism – its rules – rather than overtly turning against it.

I'm Lost In Paris, at first, looks like the cliché of the ecological house – no facades, just plant walls – except that, already, something is a little off. In this case, the plants seem more exaggerated, fertile and wild. It could resemble a potted plant averting trouble with the neighbours, or an animal that plays dead, but then grows into a monster. 'We evaluate in our work how it is interesting to be dominated,' says Roche, 'to be dominated by a situation.' Before construction, the stealthy plans for a bunker-like box were reluctantly approved by over 70 per cent of the surrounding neighbours, who were only later confronted by this house that cannot stop growing, like a Chia pet. Oh yes, it is natural, but not in the spatialised ways in which urbanites have come to expect.

The plant that grows around the house is a fern, which Roche describes as a 'dinosaur plant', a primitive biological body. The neighbours are forced to react to a fear of a primeval nature without humans. Here, once again, we have R&Sie(n) transgressing boundaries, but doing so by confronting society with its own paranoia, rooted in a division from the natural realm. And then the opposing signs continue. It turns out that the ageless fern is not as natural as it seems; it cannot live on its own. Behind the topiary we discover that it must survive by feeding off a nutrient mixture combined with harvested rainwater (another climatological territory tapped into to by this being), controlled and monitored by the inhabitants following an instruction manual, like hydrological engineers.

The hydroponic system folds back on itself yet again. The glass beakers for the plants are oddly bulbous and sinuous – and beautiful, like gems. They instantly give away their breeding with artisan human labour, not produced in a mechanical way. R&Sie(n), in fact, seem to also be intent on highlighting this process of making as much as possible through the images

R&Sie(n), I'm Lost In Paris, Paris, 2008
left: Exterior view of the cladding, a membrane that mediates between the city's politics and the 'mechorganic' system within.

opposite: A detail view of the blown-glass vases where the ferns receive their nutrients.

of glassblowing they disseminate for publication and on the Internet. The house is nothing else *but* the deeply intertwined – sometimes conflictive – relations between all these agents: prehistoric photovoltaic entities, the mechanical systems, neighbours, the human inhabitants, labour and the architects themselves, to the point where it is not clear who spun all of this. The sustenance for the ferns happens inside the unbelievable vases. The nutritional system itself is a hybrid of manual labour (the artisan creation plus the manual operation of the house), and nature's own labour mixed in too. It seems that the architects wanted the structure to be simultaneously a mechanised delight and an organic fright. But the perception of the house is also contingent upon being within one's social and class position, not outside of it (an existential impossibility). Some might feel alienated; some might not.

Staring out from within – symbolic of a larger inescapable social reality, in effect – the subject confronts another scale of nature, different from the one that the neighbours perceive. It is as if someone pulled a curtain to reveal that which wanted to be forgotten – an odious 'mechorganic' cyborg – but is always there. And our lives hang from it, like these ferns.

For Roche, Lavaux and R&Sie(n), there is no choice but to make architecture by coiling and blending together a series of conceptualised territorial spaces, even some that are temporally broken apart (for example, the prehistoric plant's ecological niche versus the neighbourhood's idealised image of itself). This makes their work all the more revealing because they offer to show us how geographies have been produced in particular historical and political ways. Meanwhile, most architects and planners today, sustainable or otherwise, remain comfortably oblivious to a whole array of geographical metaphors that they nevertheless apply and reaffirm. In the more common practices these metaphors are based on imaginative and ideal abstractions of one territory from the other, concealing the conflicts of their production behind the moral robes of concepts like 'responsible consumption'. Thus, sustainable architecture restricts itself to the visible territories of a neatly defined and mapped environmental crisis (brownfields, plumes, receding glaciers and high-tide lines) while conveniently circumventing the social and geopolitical crises that are also there, if we just choose to look for them. AD

Notes

1. Raymond Williams, *Culture and Materialism: Selected Essays*, Verso (London), 2005, pp 67, 84. Emphasis added.
2. John Bellamy Foster, *Marx's Ecology: Materialism and Nature*, Monthly Review Press (New York), 2000, pp 73–8.
3. Bertell Ollman, *Alienation: Marx's Conception of Man in Capitalist Society*, Cambridge University Press (London), 1971.
4. François Roche, '(Science) fiction and mass cultural crisis', in Andreas Ruby and Benoît Durandin (eds), *R&Sie Architects: Spoiled Climate*, Birkhäuser (Basel), 2004, pp 56–9.
5. R&Sie(n) have been complimented for distinguishing themselves from more traditional practices in what seem like unconventional ways. Meejin Yoon explains their method as 'situations over form', in 'Programming Scenarios', *Praxis: Writing and Building* 8, 2006, p 73. Likewise, K Michael Hayes discusses that they privilege 'effects' over 'modern forces' in '20 Projects', *Perspecta* 33, 2002, pp 54–71. Meanwhile, Nicoletta Trussi goes as far as calling them 'post-radical' because, it seems, they do not get caught up in the moralistic politics of, say, contemporary environmentalism, which is to say (erroneously) that they are a-political; see 'Agora – Dreams and Visions: R&Sie …', *L'Arca* 170, May 2002, pp 36–47.
6. The following paragraphs on sustainability borrow and revise from my own more extensive critique of eco-architecture that appeared in Javier Arbona, 'Una arquitectura que se imagina verde', *Diálogo* 216, March/April 2009, pp 20–21.
7. David Gissen, 'Anxious Climate: Architecture at the Edge of Environment' (handout), Maryland Institute College of Art (MICA), 2007, downloaded from: http://htcexperiments.files.wordpress.com/2009/01/gissen_anxious-climate.pdf. Neil Smith also succinctly explains how the romanticism of nature is only possible after its major dangers have been pushed back beyond a frontier. He says: 'One does not pet a rattlesnake until it has been de-fanged; only then does one take it on the road where one and all can marvel at its natural beauty.' See Neil Smith, *Uneven Development: Nature, Capital, and the Production of Space*, Blackwell (New York), 1990, p 26.
8. For some context, see an especially concise and valuable historical critique: Frederick R Steiner, 'The Ghost of Ian McHarg', *Log*, Fall, No 13, 14 (special double issue), 2008, pp 147–51.
9. Jack Ralph Kloppenburg, *First the Seed: The Political Economy of Plant Biotechnology 1492–2000*, University of Wisconsin Press (Madison, WI), 1990.
10. See also Matthew Gandy, *Concrete and Clay: Reworking Nature in New York City*, MIT Press (Cambridge, MA), 2002.
11. Richard White, *The Organic Machine: The Remaking of the Columbia River*, Hill and Wang (New York), 1996. White discusses the Columbia River as an 'organic machine' assembled of different human, animal and natural scales of production in various historical periods (hydropower dams, industrial fisheries, indigenous subsistence fishing, nuclear cooling) that together form a hydro-being that is almost impossible to disentangle without causing major social disruptions.
12. Eduardo Montes-Bradley, *Cortázar: apuntes para un documental*, Patagonia film Group LLC/Contrakultura, 2007.

R&Sie(n), Curtain Wall System, B_mu Tower, Bangkok, 2005
Interior view of the tower and its polluted skin.

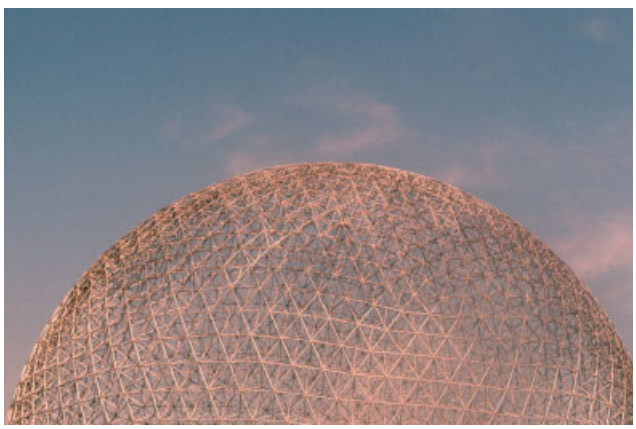
As half of the world's population has become urbanised, toxic or at least previously built-up land has become more like the norm. Guest-editor **David Gissen** considers the reality for architecture of toxic territories, in which the relationship of architecture with pollution needs to shift from one in which architecture is wholly regarded as a means of separation from a noxious external environment to one of interaction.

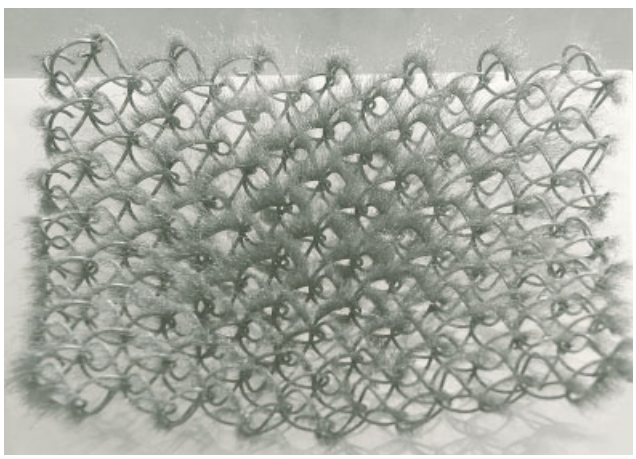
TOXIC TERRITORIES

OMA, CCTV Tower, Beijing, 2008
top: Numerous photographs show the CCTV Tower within a polluted atmosphere. As startling as the pollution is, the contrast with the tower's 'late-Modernity' is dramatic and disturbing.

Buckminster Fuller, US Pavilion, Montreal, 1967
centre: Building skins always represented the urban conditions of their time. The dome invokes a city of environmental risks.

R&Sie(n), Curtain Wall System, B_mu Tower, Bangkok, 2005
bottom: The curtain wall of the B_mu Tower draws pollution towards it.





It is difficult to imagine the toxic matter coursing through cities as a type of site within which an architectural aesthetics might emerge; and to even make such a claim requires a significant qualification relative to the aims of such a project. But, sadly, this is a de facto condition, before it is even a considered one. The dense, smoky atmospheres of cities appear as the troubling anti-environment within which many contemporary buildings materialise. What are these endless photographs of post-industrial surfaces standing within industrial atmospheres but acknowledgements of the industrialisation that always plagued those urbanites living outside 'postindustrialisation?

These images, from around the world, reveal the contradictions of post-Second World War Western cities, as much as the pollution elsewhere. But now that the late-Modern forms and the high-Modern environment appear together, they suggest that the city's architecture (not to mention its life, management, etc) no longer aggregates links between technical forms of expression and technological regimes. The Modern machine-era of coal and steam and the late-Modern's dustless, digitalised realm now appear together. The architectural techniques of the latter now find themselves in the environmental realm of the former. What could possibly illustrate this more than a glassy, computer-modelled reflective surface open to an urban atmosphere consisting of coal smoke and ash? This historical disconnection should be the cause of a new sense of unease, but it may also hold the future of a new consideration of architectural interactions with pollution; a resurrection of a modern project but in a completely altered form.

Architecture has been and remains a significant feature of our perception, interpretation and interaction with pollution. The technological components of architecture – from ventilation systems to curtain-wall systems – have historically protected the inhabitants of buildings (lucky enough to be within them) from troubling atmospheres. They have also opened that world to a type of reflection. This is not limited to those technical buildings such as hospitals and institutions, but extends into virtually every feature of Modern architecture.

The language of Modern architecture was a conceptual and technological marvel, but it was also an environmental marvel, conceptualised as a counter-environment to the disgust produced by a 19th- and early 20th-century industrial city. Reyner Banham, the great theorist of architectural environment, proclaimed that we must consider the 'atmosphere' within which modern building technology developed; and he meant this literally.[1] Office and apartment towers were conceptualised as places offering something else (light, air, greenery) to the vile soup of industrial cities. The spheres and bubbles of postwar architecture explored how surface and structural ideas conjoined

to offer an environment unlike the one that gave birth to its very materiality. These latter structures often invoked an apocalyptical dimension in their safety from the violence of a postwar atmosphere. Lurking in the surfaces of the geodesic dome or the inflatable was an invocation of the type of visual interpretation of the atmosphere of its particular time.

The architectural technological reflection on atmosphere is revived in recent work, but due to the atmospheric disconnections described above (the clashing of industrial environments and postindustrial forms), it appears in a suddenly radicalised form. We see this more radical technological direction in a new type of consideration of building skins that search for new relations with environmental pollution. One approach, represented by R&Sie(n)'s B-mu Tower in Bangkok (2005), effectively inverts architecture's given role in polluted environments. The building literally pulls the ferrous-laden dust particles of the city's atmosphere towards it. In this project the building skin is reconceptualised to breed the dust of its surroundings. The project represents to its potential inhabitants the absurd position of the architect in this context – asked to produce enclave-like interiors within abject environmental pollution.

More generous are those contemporary 'green' architectural efforts that also invert modern relationships between technology and the urban environment. Several new environmentalist buildings and technologies not only protect inhabitants; they promise to scrub both the interior and surrounding atmosphere of its harmful contents. For example, in a recent proposal for the Bank of America building by Cook + Fox Architects (New York, 2007) or the work of Anna Dyson and Skidmore Owings and Merrill's Center for Architecture Science and Ecology (CASE) also in New York (2008), we see a type of skin that cleans air (with plants, chemicals or more normative filters). Such systems not only clean polluted air for the inhabitants of a building, they also expel air from the building that is cleaner than the air that entered it. Here architecture terraforms the interior and exterior spaces of the metropolis into something more atmospherically akin to a postindustrial city. With these projects Modern architecture is not only a refuge; it rebuilds the city's environment in its own image, an image of health, but also one of contemporary architectural renderings, replete with a fixed and smokeless sky.

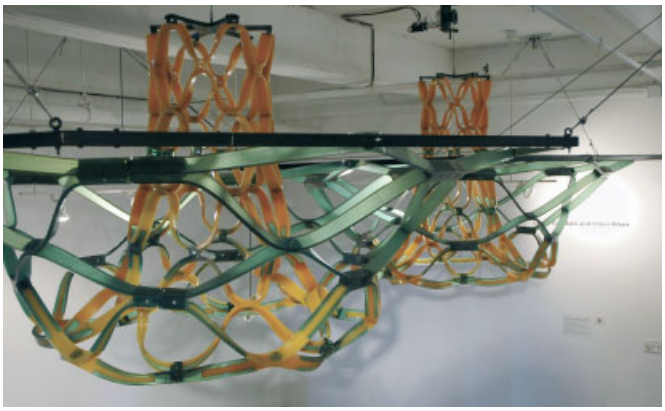
These technical developments are intriguing, but also reveal how the entire discussion of pollution and its relationship to architecture requires much more thought. We should reflect more carefully on how the realisation of buildings impacts our understanding of what pollution is and its larger sphere of operation, and vice versa. Before images of these new smog-ridden, developing cities appeared, most Westerners considered 'sick building syndrome' to be the most significant atmospheric danger befalling late-Modern architecture.

Within this context, the skin of large-scale building entered a new type of de-operationalised relationship with its surroundings as the environmental dramas were played out inside. Within this 'envelope', mechanical engineers have sought (and still seek) ways to mitigate the problems of a completely technified interior, while office workers sought futile solace in air purifiers or potted palms. As Reinhold Martin (another significant conceptualist of environment) suggests, every building contains an image of the city within it;[2] and just as the Fullerite sphere invoked a city full of atmospheric risks, the Postmodern tower effectively represented a city without external atmospheric dangers. Nothing could be further form this than the images of these new dust-breeding or terraforming building skins.

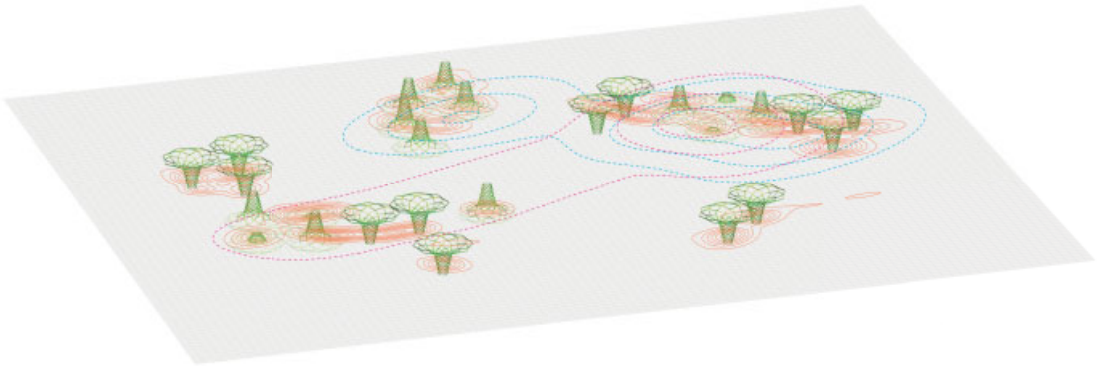
Although some buildings begin to engage with pollution in startling new ways, we still visualise the thing itself – atmospheric pollution – in much the same ways we have before. This is curious considering that we now understand pollution to be much more than its particulate counts. It is more than hydrocarbons or CO_2. Today, pollution appears more geographically and historically mediated by a society, its products (namely architecture) and its subjects. The cleansing of certain precincts marks victories for health and urban institutions, but also for those who wish to transform the dynamics of urban zones. When we enter a smokeless area of a contemporary city (for example, a gallery that was once a turbine hall), we understand that certain class formations and institutions have disappeared with the pollution. We might consider this connection between detoxification, social transformation and urban change to be completely played out; a relic either of a massive postindustrialisation or an even earlier Victorian urban transformation. But these desires to link urban change to changes in the air continue.

For example, in 2004, a study of air movement in Times Square (commissioned by the US Department of Homeland Security) was part of a larger effort to consider how building skins might be armoured from atmospheric, terrorist attacks, but also to further transform Times Square into a safe neighbourhood dotted with polite adornments. The remediation of the toxic territories of the city continues to be a significant aspect of contemporary urban discourse despite the historical pitfalls and the potential neutralisation of urban difference when such efforts are taken to extremes. There is a significant difference between a concerted effort to decommission a local polluter, to protect a populace by distributing environmental risk, and cleansing the surrounding biological environment as a matter of course.

Omar Khan, Open Columns, Buffalo, New York, 2007
right: The Open Columns were initially developed to remediate high levels of carbonised air. However, the project suggests new diagrammatic interactions between pollution and space.



CASE/Rensselaer, Active Modular Phytoremediation (AMP) System, 2008
above and right: In this project architects, scientists and botanists developed a building skin that scrubs the urban atmosphere of harmful pollutants.



left: The atmospheric map of the Open Columns demonstrates how harmful pollutants might be redistributed relative to aggregations of people in open space.

In response to all of these developments, we might initiate a contemporary project that offers a more incisive and self-reflective approach that embraces our understanding of pollution's true territorial dimension. Architects interested in more critical concepts of environment should not necessarily subscribe to the instrumentalisation of an individuated architecture acting as a counterpoint against the potential dangers of its surrounding environment. How architects engage with atmospheric toxicity might be cause for an intense and new form of reflection beyond the isolation of the modern subject. Claiming some space for architecture's autonomy from environmental clean-up efforts, yet acknowledging the obvious horrors and problems of a toxic atmosphere, architects might increasingly use architecture's technological capacities as a more explorative tool. Here the architect would explore our troubled atmospheric milieu while refusing to position buildings as part of larger unstated urban expulsions or the dystopian opposite. Rather, they might reveal the intimate relations between concepts of environment, pollution and population; or better yet, they may attempt to close the historical fissure of today by either laying bare its contradictions or rethinking the problem itself. Perhaps the surface is an exhausted medium when it comes to this architectural/atmospheric dialectic. We might begin a new architectural journey that visualises how atmospheric pollution haunts a digitally modelled city.

In understanding where we go from here, we should consider a project by the architect Omar Khan that illustrates the simultaneous charting and manipulation of atmospheric toxicities in a manner cognizant of contemporary techniques and historical failures. In his Open Columns (2007), Khan developed and built a matrix of rubber conical elements interspersed with sensors that both map and respond to atmospheric pollutants. The system produces both a cognitive image of architecture's territorial interaction with pollution – a type of cartographic aesthetic reality (à la Fredric Jameson) – while nonetheless interacting with pollution in a manner beneficial to a population. The columns respond to set levels of toxicity by dropping from the ceiling and dispersing both people and the contents of the atmosphere. When the atmosphere returns to a more usable state the columns rise. In the most recent iteration of the project, Khan rigged the columns to detect levels of carbon dioxide, primarily produced by our respiratory systems. The project not only operates outside the dialectics of inside and outside, but enables us to see how concepts of pollution and population appear simultaneously. In this project, everyone is de- and re-territorialised in the presence of environmental trauma; and these processes are laid bare.

As intriguing as this project is, we might also read Open Columns in less literal ways. Could it be a diagram of a new type of subject/environment interaction beyond the modern dynamics of interior and exterior environments, extreme and neutral environments? Could it be a representation of the aesthetic of digitally distributed risk – a counterpoint to the curtain wall? In this case, Open Columns illustrates how the urban atmosphere may be displaced and reworked into a new form, free from intimate entanglements with people yet wholly present. The difference here is that the harmful contents of the environment retain a relative position to those who navigate the spaces of the project. If anything, the project enables us to reflect on the relationships between social aggregation, pollution and architectural technology without the fantasy of a completely pollution-free architecture as some bubble against the city. It reworks what we understand a safe environment to be.

More remains to be done, but Khan's project offers some thoughts towards a more prolonged exploration of how architecture is implicated in our perceptions of pollution and toxicity. It offers a role for architecture, as much as planning, in the future debate on urban pollution. Nevertheless, it is not clear how critically architecture can engage with pollution, especially as polluted landscapes increasingly appear with emerging crises in impoverished sections of developing cities. The neo-Dickensian or (at best) Engelian reading of our contemporary world (evident in books such as Mike Davis' *Planet of Slums*),[3] may inhibit a more complex discussion of environment, health and architecture. Any possible architectural reflection on environmental destruction (as often happens after periods of war) will be displaced for a more purely scientific and hygienic operationalisation of architecture relative to the urban socio-natural environment. In an effort to make architecture ethically good, the field becomes an ever more technocratically utilitarian discipline and therefore a more easily manipulated tool of any and all formsof urban development. Explorations of the mediation of pollution (in all its meanings) may appear as luxuries versus a very real necessity. AD

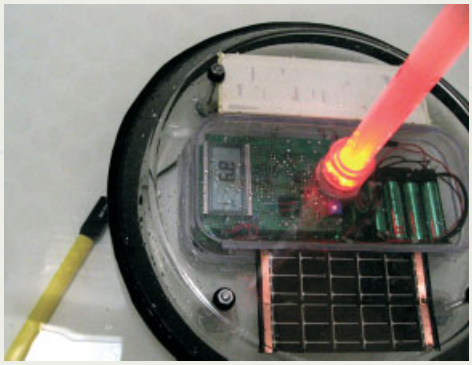
Notes

1. Reyner Banham, *The Architecture of the Well-Tempered Environment*, University of California Press (Los Angeles, CA). 1969.
2. See Reinhold Martin and Kadambari Baxi, *Multi-National City*, Actar (Barcelona), 2007.
3. Mike Davis. *Planet of Slums*, Verso (London), 2007.

THE LIVING

SURFACE TENSIONS

'Our work begins with the premise of a dynamic world. Political and cultural conditions change: what if the walls and windows morphed in response?' New York-based team The Living, led by David Benjamin and Soo-in Yang, have developed a practice of deep, open-source interfaces of participation. **Jordan Geiger** describes how for The Living their home city and its environs is a site of evolving forms of public space whether on land, air or water.



left: Rendering of a proposed installation near New York's Brooklyn Bridge.

The Living, River Glow, Copenhagen, 2007
above: The fibre-optic and light-emitting diode (LED) buoy at the heart of River Glow switches from green to red based on the pH levels of the water. The Living hacked simple components found off the shelf, and tested their prototype in their bathroom tub.

The Living, Living City, San Francisco and New York, 2008
The full-scale prototype has been variously installed in gallery spaces and within the Empire State Building, giving a palpable sense of the project's relationship to both the body (as visitors could cause the skin to open its gills with a puff of breath) and the existing city.

What if the surfaces of the city were all interfaces for civic engagement? What if the terms of engagement were public health, the air we breath, the water around us? In projects such as Living City, River Glow and the recently completed Amphibious Architecture (with Natalie Jeremijenko's xDesign Environmental Health Clinic), New York architecture team The Living poses questions such as these with works located in the built environment as we already know it. By embedding simple electronics in familiar materials of the city, the team builds social networks between humans as well as buildings, rivers and fish. In so doing, they assert models of interactivity based on an intertwining of aesthetic, ecological and social programmes rather than spectacle or play. These works define existing surfaces of the city – building facades and waterways – as deep, open-source interfaces of participation; and air and water themselves as evolving and contested forms of public space.

Ubiquitous computing can reset relationships between the city's built landscape, its residents, and the water and air they share. It is on this basis that The Living, founded by David Benjamin and Soo-in Yang, seek to identify familiar sites for projects within their home city. The team's work and working methods are born of late-night conversations, big questions and unsanctioned experiments when time and limited funds permit; in short, of their origins as student collaborators. 'Our work begins with the premise of a dynamic world. Political and cultural conditions change: what if the walls and windows morphed in response?' they wrote in their 2006 pamphlet/working notebook *Life Size*.[1]

Benjamin and Yang have thus conducted a series of starter projects, first guided by their notion of 'flash research' but quickly growing in scale, ambition and sophistication. Under the rules of flash research, a question is posed that must be answered within three months of work, within a thousand-dollar budget, and with the realisation of a full-scale working prototype. Where this might sound like garden variety entrepreneurship, their work reveals itself to have goals other than mere invention or product development.

Between the Walls

The first of The Living's flash research projects, Living Glass – and its outgrowth, Living City – began with the seemingly innocuous question: 'What if architecture responded to you?' The project yielded a building skin that operates on gills thanks to Flexinol wire and a pliant glazing. The glass self-governs in response to a network of air-quality sensors that measure indoor as well as outdoor air quality. More importantly, these sensors communicate with live data from sensors in nearby buildings, forming a sort of social network of urban architecture. As buildings communicate with one another they become capable of nimbly regulating airflow within and between themselves in response to local and dynamic changes in air-quality conditions.

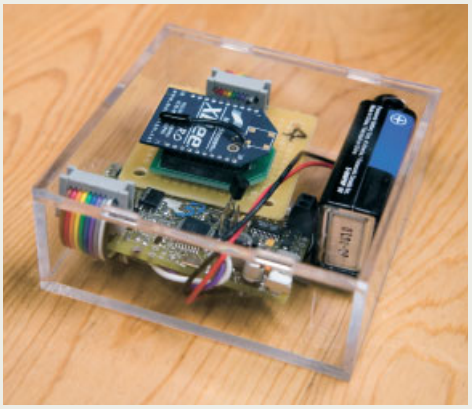
Where the project becomes intriguing is in its subtexts: that, for example, the air pollution generated by buildings is accountable to civic engagement and oversight in the same way that building facades have long been controlled for aesthetics under zoning codes. Or that air itself is a building material, neither pre-existing nor purely a result of mechanical systems but instead in a constant process of formation in concert with architecture and with us.

The project also serves as a platform for the air contained within the space of urban buildings, and the huge volume of air between them. This stands in some contrast with the supporting imagery, produced by François Dallegret, to Reyner Banham's 1965 seminal essay 'A Home is Not a House',[2] in which he suggested an inversion to understood orders between buildings and the support systems they contained. While Banham's essay challenged the role of building enclosure as being supported by the mechanical systems it contained, Living City instead brings all actors to perform either as input, as processing or as output at different moments. The project's use of sensors and wireless networks also releases a tension between building skin, mechanical systems and human inhabitant in an urban context.

Reading a Data Set in Flux

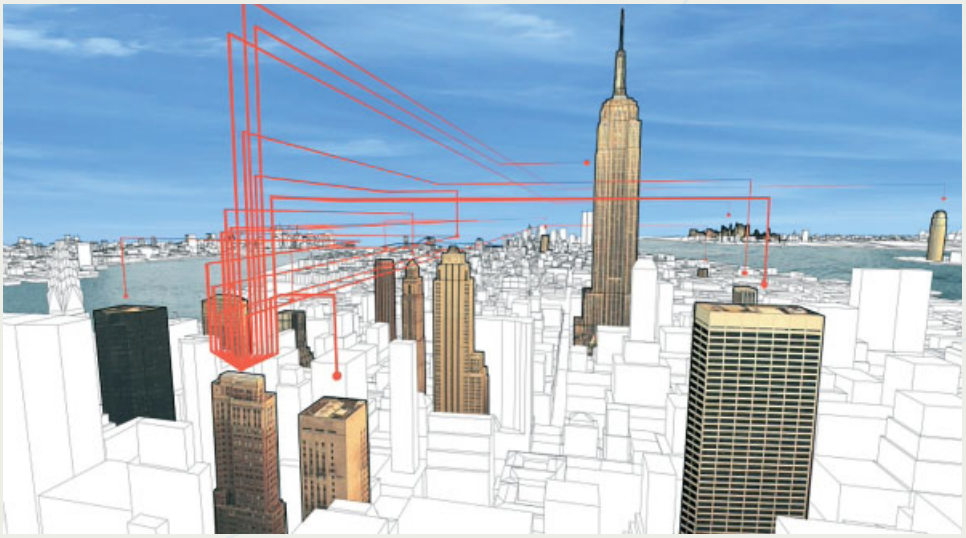
The Living's second flash research project, River Glow, turned attention to the creation of a public interface to water quality. It is composed of floating constellations of LED fibre-optic-illuminated buoys, each self-charging on thin-film photovoltaics and each self-reporting as it reads a city's waters for

At its heart the project relied on simple, easily accessible, open-source microcontrollers coming into rapid use among artists and designers (such as the popular Arduino) and low-cost air sensors.



contaminants. With simple devices that turn red or green depending on pH levels – hacked, at that, from off-the-shelf consumer products – River Glow shifts the roles of a city's water bodies. Urban waters no longer serve as infrastructure, nor the pictorial role as a reflection of our projected notions of nature. Instead they become a medium for 'citizen science', a movement dating back to the Audubon Society's Christmas bird count and now taking myriad forms, which invites the contributions of any number of untrained, interested participants for essential scientific tasks such as observation and measurement of observable phenomena.

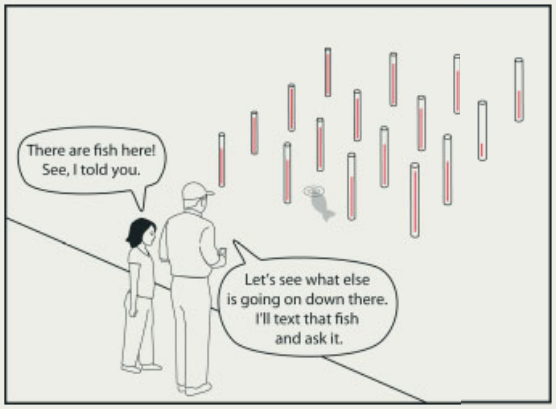
In the case of River Glow, the water renders its status locally, and leaves interpretation and response open to undetermined passers-by. The ironies of such a project are multiple. Aesthetically deceptive, River Glow produces a warm sparkle of red light across the dark surfaces of the waters indicating changes below, for example that fish are unsafe to eat. But the interaction this work catalyses raises larger questions of participation and responsibility. In 2008 the city of New York proposed the Intro 650 law that would render it illegal for citizens to monitor air quality, under the defence that such data could be used towards eco-terrorist acts. While citizen monitoring of water conditions has not yet fallen under such law, River Glow provokes reflection on the very ownership and representation of data sets that underlie public discussions of urban environments and public health in the first place.

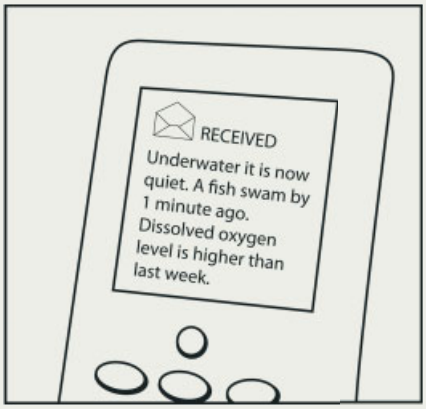


Video still illustrating the team's vision for a social network of buildings, in which communication between buildings locally can have a big impact on indoor and outdoor air quality for an entire neighbourhood. Neither a vision of artificial intelligence nor of optimised performance, the network suggests rather a way that known technologies we commonly use for entertainment can be applied to the more pressing concerns of the city's life and material evolution.

The Living with Natalie Jeremijenko, Amphibious Architecture, New York, 2009
below: Diagrams explaining interaction with fish. The project's website directs visitors on a short tutorial on how to SMS the fish (and even names them as collaborators, with monikers such as Mark Bain).

bottom: Installation view, live on the opening night at the East River.





Rendering showing the proposed new development by SHoP Architects in the background and imagining the project within the context of a new life for New York's East River waterfront. The new promenade aspires to solve years of blight and pollution, a fitting setting for one of the first realisations of Amphibious Architecture.

An Interspecies Communications Interface

Such questions have been developed further with the realisation of The Living's latest project, a natural collaboration with artist-engineer Natalie Jeremijenko and her xDesign Environmental Health Clinic at New York University, and with The Living's own research unit, the Living Architecture Lab at Columbia University's Graduate School of Architecture, Planning and Preservation. Amphibious Architecture builds on some of the logics and experimentations found at the heart of River Glow and within Jeremijenko's Glow Fish Interface – a project that she has described as 'a low-resolution screen display on the river'. This new work was commissioned for the exhibition 'Toward the Sentient City', curated by Mark Shepard and organised by the Architectural League of New York (2009).

Amphibious Architecture is a network of interactive tubes of light that float as buoys in several locations of the city's waters (for the Architecture League exhibition they were located in the East River and the Bronx River). Where River Glow could read and minimally convey local live data, Amphibious Architecture holds a memory of change and achieves a much more robust social network: more data types, more locations and even involving more species. The project senses the movement of fish between the buoys and connects the fish to human onlookers via an SMS interface that 'allows homo-citizens to text message the fish and receive real-time information about the river'.[3]

As the designers state on their project website (amphibiousarchitecture.net – another way of accessing the project's sites live), Amphibious Architecture 'submerges ubiquitous computing into the one element that covers 90% of the Earth's inhabitable volume and which envelops New York City but remains under-explored and under-engaged'. Their aim is to firmly depart from what they call a 'do not disturb' position of most urban environmentalism in favour of sparking curiosity and engagement.

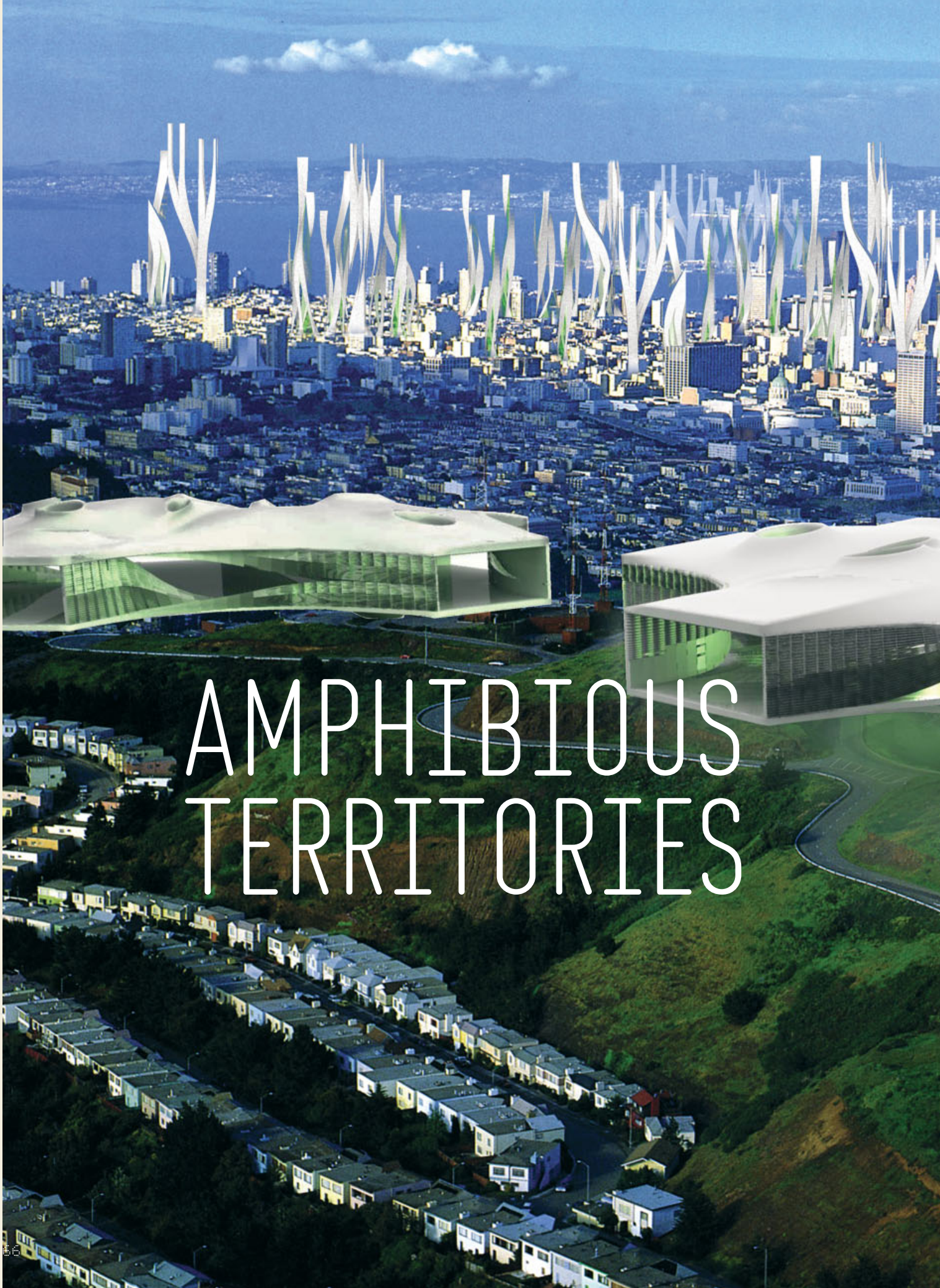
But Amphibious Architecture is also sited at sensitive areas along New York City's waterfront, one of which is slated for a major new work by SHoP Architects and the other a forlorn outer-borough bus stop. Seen in this light, the project also shows the potential of the work to expose the inherent and simultaneous entanglement of urban architecture with such diverse forces as the production of natural conditions within the built environment, civic engagement through new urban interfaces, and the social charges that differ from site to site within one continuous body of the city's waters. Like other works by The Living, the project achieves these numerous goals through an impressive economy of means.

Ultimately, The Living's projects to date expose ambiguities within the surface-sites they choose to work in; and perhaps in the team's own attitudes towards those sites. On the one hand, these extant, postdesigned, postengineered situations emerge as territories of constant and citywide respiratory processes. They are at once collective homes for public health, and new media through which to socialise. They contain strong links and weak ones. Some of these links are being built and rebuilt at this moment, and all appear as hybrid assemblies of new kinds of interaction with ongoing shifts in air and water conditions. And yet the roles of interactive components remain as yet subservient to the conditions on which they report. Air and water – the very stuff of these works – are themselves left unchanged, newly legible perhaps but only implicitly critiqued as needing attention. These jobs, the projects seem to suggest, are left to us to take up.

As Jeremijenko has said: 'The challenge and opportunity of ubiquitous computing is the way in which it can make something, making change possible, through the direct action of people, and in this way give that capacity to act an immediacy not possible in the traditional models of political agency.'[4] To socialise in these environments is not only to send a fish a text message, but to share data with a neighbour, to argue its meaning, to consider action together. It is in these respects that the nature of The Living's critique, its public response and cultural impact, is yet to be determined. AD

Notes

1. David Benjamin and Soo-in Yang, *Life Size*, Graduate School of Architecture, Planning and Preservation, Columbia University (New York), 2006, p 115.
2. Reyner Banham, 'A Home is Not a House', *Art in America*, April 1965, pp 109–18.
3. See www.amphibiousarchitecture.net/.
4. Natalie Jeremijenko and Benjamin H Bratton, 'Suspicious Images, Latent Interfaces', *Situated Technologies Pamphlet 3*, The Architectural League of New York (New York), 2008, pp 40–1.

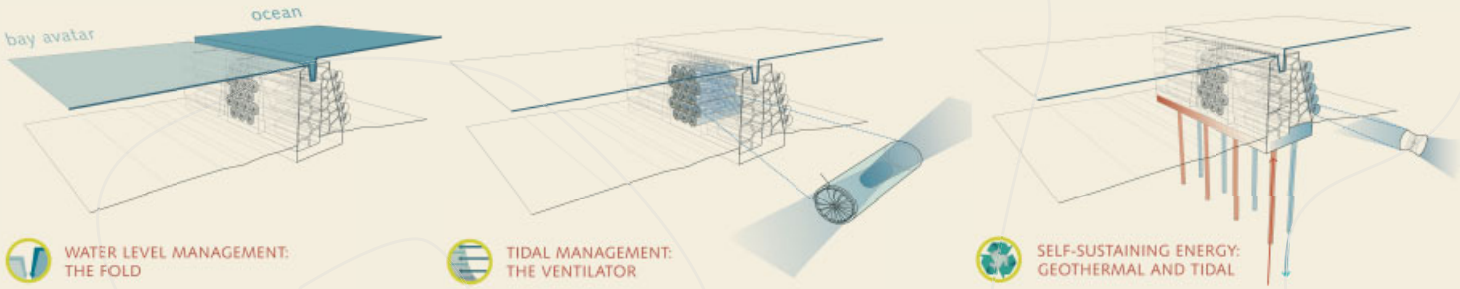

AMPHIBIOUS
TERRITORIES

Since 2005, when Hurricane Katrina wreaked havoc on the Gulf Coast and New Orleans, our polarised perception of land and water has been irrevocably shifted by the failure of static levee flood-control systems. **Ila Berman** explains how a more fluid geographical approach to land and water, which places an emphasis on continuous mutable ecologies, is key to a more sustainable future. She describes four experimental projects that are ground-breaking in their treatment of the relationship between the aquatic and terra firma.

IwamotoScott, Hydro-net, 'City of the Future' competition, San Francisco, 2008
Geothermal mushrooms blooming at Twin Peaks.

Kuth/Ranieri Architects, Folding Water, 'Rising Tides' competition, 2008–09
below: Key location plan and operative diagrams for the fold, ventilators and energy systems.

opposite: Sectional perspective view of the Folding Water sea wall stretched across San Francisco Bay.



The term 'amphibious', etymologically derived from the Greek '*amphi–bios*', referring to the double-sidedness of life, or living that is adaptable to both land and sea, has been extensively applied to recent architectural practices accommodating sedentary or non-migratory living in relation to the flux of fluid environments. 'Amphibious Living', a symposium organised in Kinderdijk, South Holland, almost a decade ago, was presented accordingly; as an appeal to abandon the compulsive control of water, and to generate flexible living environments accepting of climatic influences, tides and seasons, while taking full advantage of the dynamic relationship between land and water.[1] The evolution of amphibious architecture within the Netherlands is certainly not surprising given the country's low-lying terrain and the intensity of its fluid milieu. Flooding caused by storm surges and heavy rainfall, as well as the incremental effects of land subsidence and rises in sea level, are intrinsic to the environmental history of this territory, having dramatically influenced both the sophisticated control mechanisms that have led to the artificiality of the Dutch landscape and, in a form of reverse evolution, the more recent desires of many of its architects to return to the water.[2]

Indeed, although the Dutch have come to signify the idiosyncrasy of, and even an incongruously heroic ambition in relation to, amphibious occupations, they have also become prominent because of their foresight and expertise in dealing with fluid geographies, and the attention they have brought to the pervasiveness of 'watercities' throughout the world. The common historic emergence of urban centres located directly adjacent to water – a result of the life-sustaining potential that such sites have held for food, water, transport, trade and tourism – has rendered even more serious the potentially catastrophic impact of imminent sea-level rise and the inundation by extreme weather systems resulting from global atmospheric changes. As is evident from the many recent architectural exhibitions, symposia and competitions on the subject,[3] our deep-seated anxieties associated with losing the artificial ground that we have so painstakingly built, and being submerged below a liquid landscape, have been heightened by our awareness of the devastation brought about by recent floods in Europe, Asia and America – events that have underscored our current obsessions with water and our ongoing relationship with our unstable, and often turbulent, environs.

In the aftermath of these events, we have also come to realise that our highly orchestrated, static levee flood-control systems, intent on constraining and neutralising the environmental fluctuations impacting our cities, have also been partially responsible for unintentionally amplifying urban and ecological risks. As engineered hydraulic conduits have replaced the complex fluviomorphology of natural river flood plains, for example, the decrease in the lateral spread of much-needed water and alluvial sedimentation has led to the deterioration of fragile ecosystems and accelerated coastal erosion, while diminishing the natural regenerative potential of these marginal territories. Given an architectural tradition that has been historically engendered by the values of firmness, stability and permanence, these modern infrastructural artefacts have promoted static, discrete and formal systems over mobile, continuous and material ones, and only more recently have these earlier models been challenged by proposals that attempt to integrate the concept of fluid geography and the logics of continuous mutable ecologies into their development.

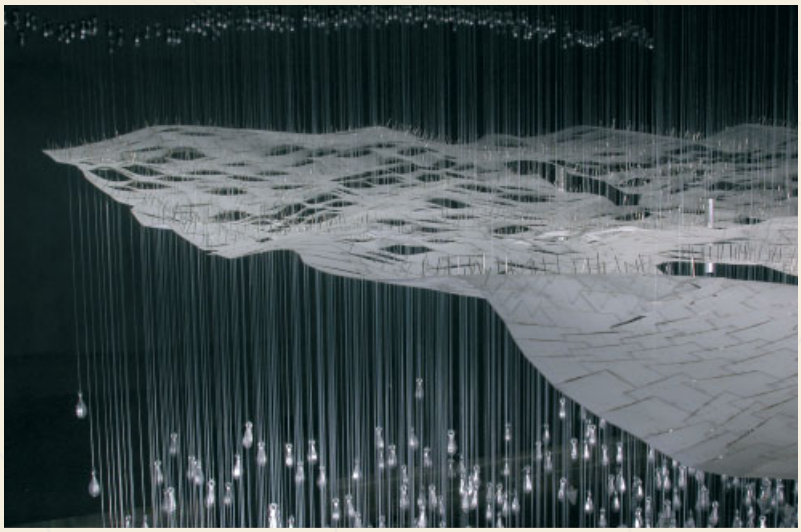
In the wake of these earlier infrastructures, a new breed of experimental 'ground-breaking' projects has since emerged – folded water-walled levees, floating energy-producing occupiable beachscapes, rhizomatic hydrogen-generating aquatic living networks and alluvial sponge combs — each of which occupies that amphibious zone between land and water, while capitalising on the opportunities proffered by the dynamic hydro-geographies in which they are immersed. Rather than simply elevating buildings or dramatically increasing the stability and quantity of urban ground (a tactic already used for the creation of many expanded artificial islands in the Netherlands), these projects do the inverse by incorporating calculated mixtures of flow and stasis into their design parameters to encourage a more synthetic relationship between architecture's artificial containment and the flux of its natural fluid environs.

Folding Water (2008–09), designed by Kuth/Ranieri Architects,[4] is a permeable, ventilated sea wall intended to wrap the coastal regions of San Francisco most vulnerable to flooding. The traditional opposition of levee and water is here dissolved through the creation of a fluid breakwater system – literally a massive 'fold of water' – that artificially protects the city's edge while preserving the estuarine ecologies that are dependent on the flows of tidal movement. The necessity to maintain and regulate coastal water elevations, while accommodating sea-level rise and unpredictable oceanic fluctuations, is managed by a strategic inflection and bifurcation of the water's surface that enables the waters between ocean and bay to be divided, spaced and mediated, yet still remain continuous. This fold produces a dynamic flexible joint in a seamless surface, a critical response to our need for both separation from, and connectivity to, the mutable nature that surrounds us.

The folded wall of water, which is strangely mimetic of the threatening storm surge's wave front that it is meant to withstand, both theatrically repeats, and differentiates itself from, the overlapping wave patterns animating the ocean's surface. It is, paradoxically, a liquid water-wall meant to modulate the less-predictable movements of water. Operating through a form of visual camouflage, the system hides its sophisticated mechanism behind a wall of water, intended, as with the surreptitious surface transformations of both predators and prey, to conceal rather than reveal its artificial implantation.

The fold as a spatial strategy, evident in the tidal patterns of the oceanic surface and the intricate topological undulations of coastal and subsurface topographies, draws its logic from operative traits of the real; continuities intrinsic to natural matter that reveal the forces responsible for its very genesis.[5] It therefore engenders procedures that are both disjunctive and connective, blurring the distinctions between cultural and natural configurations, and facilitating the intertwining of highly artificial organisational strategies such as the planimetric and sectional elaboration of the sea wall – a composite of arrayed discrete aggregated elements – with more continuous ecological processes. This tactical enfolding of nature and artifice is repeated at multiple scales.

As an alternative to the solid levee wall, Folding Water is a fluidal, perforated surface intermittently filled with a cellular stack of pump ventilators that depend upon natural tidal movement to manage alluvial and biotic flows across the wall's variable depth. Solid and liquid, defensive and permeable, the sea wall is therefore both a barrier and instrument for fluvial exchange, a flexible system generated from a blending of mobile and static attributes that coalesce to create a new bio-technological ecological network. Here, the fold is employed



Yusuke Obuchi, Wave Garden, Central Coast, California, 2002
View of model.

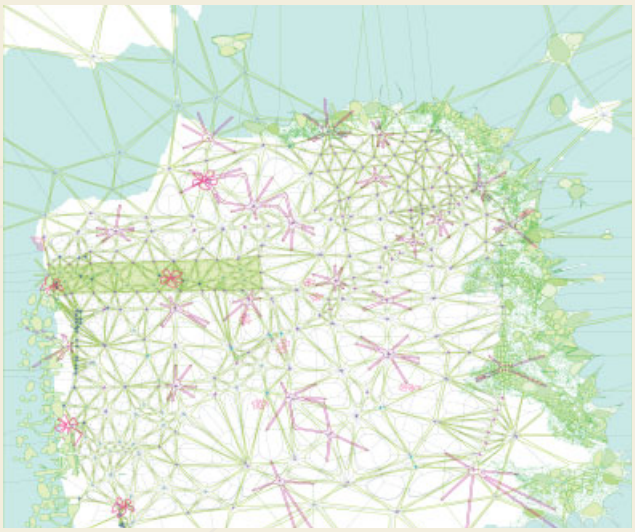
as a strategic device to simultaneously capture, regulate and re-circuit the movements of water and energy, sediment and living organisms, while providing an attenuated boundary that acts as an expanded surface for mediation. In addition, through both its ventilated tidal management system and its proposed use of tidal turbines and geothermal energy, Folding Water amplifies the potential productive 're-sourcing' of untapped dynamic forces while attempting to integrate the movements of larger infrastructural systems.[6]

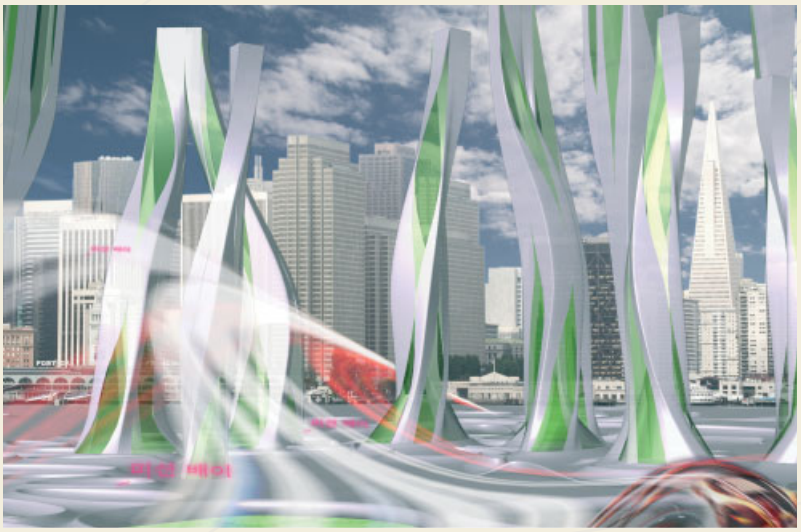
The transformation of unpredictable hydraulic forces into new forms of architecturally embedded energy generation has also become the focus of endeavours such as Yusuke Obuchi's Wave Garden (Central Coast, California, 2002), an enormous floating membrane, equivalent to half the size of Central Park, that conflates the recreational programming of an artificial island and California beachscape with a submerged ocean-energised power plant.[7] This facetted membrane capitalises on the Pacific's tidal currents by strategically transforming them into bending forces that exploit the piezoelectric effect as material surface stresses of the membrane's flexible plate structure are used to generate electricity. In its inverse iteration, the reapplication of such currents to the surface membrane enables it to be animated when programmed for public use. The transference of energy from wind to wave to electricity, and then from the electricity generated to the deformation of an inhabitable artificial geography, challenges architecture to imagine itself as an open territory and dissipative device – a dynamic material mediator that continuously reroutes vital manifestations of renewable energy – rather than as a closed and static object.

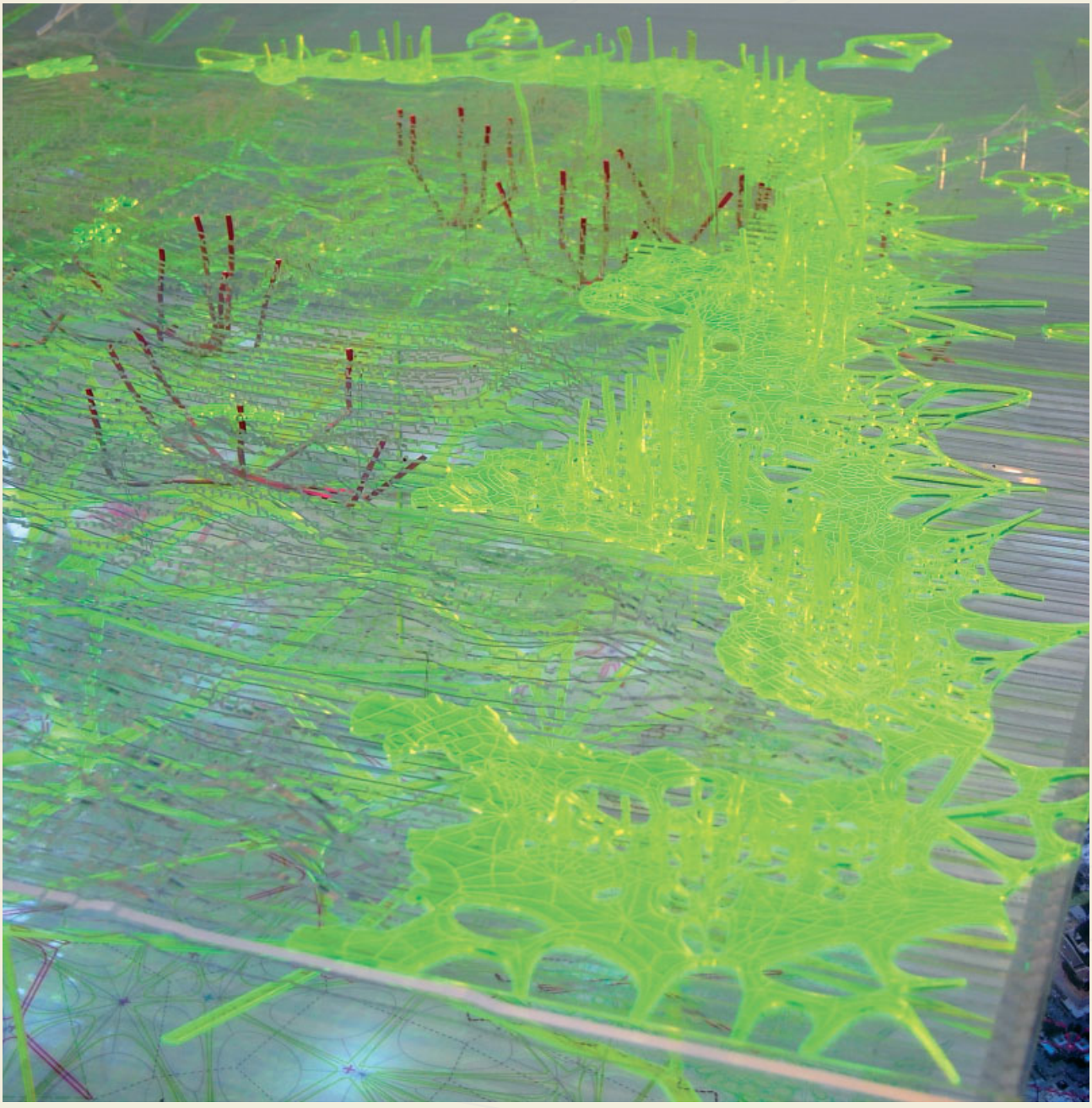
Similar to Folding Water's relationship to the tidal wave, the surface of the Wave Garden provides us with an analogue that collapses the undulating oceanic floor with the buoyancy of the water movement above it. The principle that both the water and oceanic topography are mutually defining is reiterated in the project's changing landscape, which is characterised more by its elasticity as it levitates, sinks and deforms, than by the need to procure a static terrain indicative of gravitationally stabilised land-bound artefacts. Supported by a series of tubes filled with varying combinations of seawater and air, this mobile geography floats both above and below the water's surface, its double life and the metamorphic qualities of its flexible skin referring back to its amphibious nature. Drawing upon a material model that is less concerned with the codified distinctions between nature and culture, work and leisure, this project's criticality resides in its ability to convert these striated oppositions into smooth continuous territories of matter and force. Continuity and flow are therefore not only features of the Wave Garden's surface, but also integral to its mode of operation, enabling its project of fluid continuous conversion to traverse a multitude of scales and material systems.

The strategic conjoining of life-sustaining environmental ecologies with material models of continuous energy conversion is repeated in the Hydro-net project of IwamotoScott (2008) proposed for San Francisco a hundred years into the future.[8] Hydro-net is a visionary macro-scaled infrastructural rhizome that attempts to connect the collection, storage and distribution of water, power, goods and people with a multimodal alternative energy production system drawn from local sources of water, fog, wind and hydrogen. Along with capitalising on the region's geothermal energy potential and creating coastal algae ponds for the production of hydrogen fuel, the project employs well-situated fog catchers to exploit untapped renewable water resources, and maximises the use of aquifers below the city for freshwater reserves (while redirecting currently unabsorbed urban rain runoff to ensure their replenishment).

Hydro-net is a massive supplementary artificial urban ecosystem that is driven by recycled alternative resources and newly acculturated natural forces, drawing its codes, as well as its spatial and material inspiration, from biotic and environmental paradigms. Automated drilling robots, like a colony of self-organising ants, burrow a labyrinth of interconnected tunnels into the earth to form an underground root system intended to nourish the city and accommodate a distribution network of hydrogen-fuelled hover cars. This root system 'blooms' at specific neighbourhood nodes into lofty flowering architectural gardens – inhabitable fog catchers or geothermal mushrooms – exposed to light, air and views in the raised land-filled beds of San Francisco's highland topography. This rhizomatic web is then exposed at the city's periphery as it supports an archipelago of coastal islands along the Pacific Ocean, and sprouts reed-like housing towers in the algae farm's marshland areas intricately stitched into a woven mat along the bay's periphery.





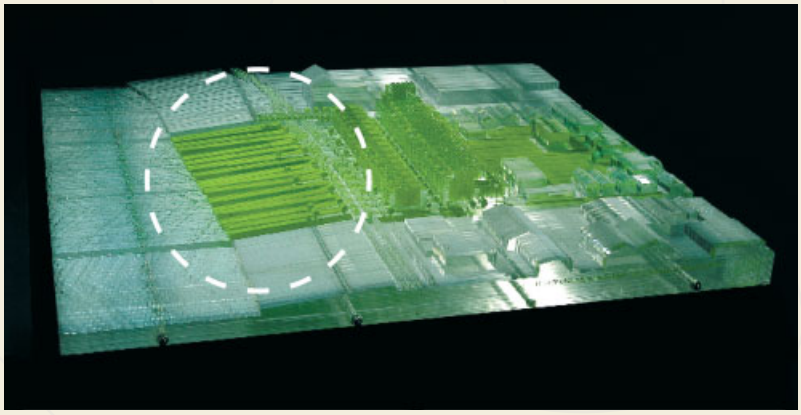


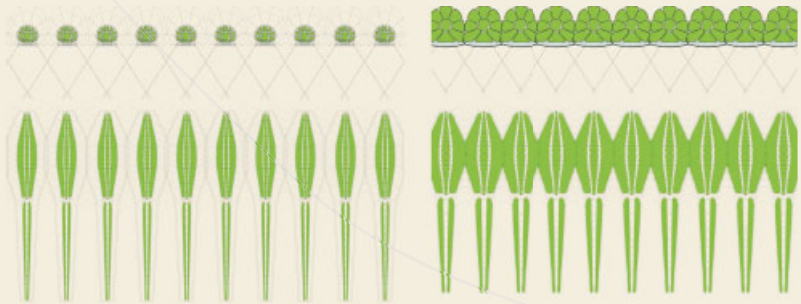
IwamotoScott, Hydro-net, 'City of the Future' competition, San Francisco, 2008
left: Model showing the underground rhizome and aqua-cultural bog along the bay periphery.

above left: Network plan showing the root system below San Francisco.

above right: High-density aquatic living in algae towers.





Anderson Anderson Architecture, Alluvial Sponge Comb, New Orleans and Venice, 2006
top: Full-scale working prototype of sponge comb finger under construction.
centre: The sponge comb as part of a full-scale installation along the Mississippi River.
bottom: Plan of sponge fingers in dry and swollen state.

Although we have yet to understand how these sinuous towers might 'grow', their intention to conflate high-rise, high-density aquatic living with algae-harvesting urban farming to fuel the subterranean hydrogen-powered transportation network below responds to the realities of coastal water inundation from sea-level rise by opportunistically reconfiguring and reprogramming the city's urban edge. Producing a soft porous fringe, rather than a hard perimeter, this biotic sponge-like mass takes its formal and material cues from bog and marsh typologies instead of urban ones, in its attempt to form an architectonic analogue to natural shoreline ecologies that blurs the boundary between the city and its liquid environs. As with the wetlands of low-lying regions, shoreline ecologies are often composed of fragile semistable ecosystems that cohere alluvial deposits within an intricately entangled biomorphic fabric. Like a wet sponge, these landscapes are literally filled with water, accounting for their greater height (and resistance to subsidence) in comparison to neighbouring dry terrains protected behind fixed levee infrastructures.

Nature's mats, rhizomes and sponges are intrinsically open systems of variation and flexibility. They are continuous woven, layered and/or cellular organisations that allow for complex and heterogeneous modes of connectivity, while consisting of differentiated degrees of material density and porosity – important attributes of adaptable living systems in constant fluid exchange with their environments. These are also systems akin to the lungs in our own bodies whose expanded internal surface area (the space-filling surface folds that diminish the difference between boundary and fill) exponentially increases their capacity for locally mediated material transfers, a mechanism exploited for storm mitigation in Anderson Anderson Architecture's Alluvial Sponge Comb (New Orleans and Venice, 2006).[9] This project, to be sited along shorelines in regions susceptible to flooding, is an amphibious infrastructural landscape composed of a multi-pronged inflatable laminar structure. During periods of normal fluvial activity, spaces between the sponge comb's fingers enable the transference of water, silt and organic matter between water and land along coastal territories while simultaneously slowing water flow to replenish the shore's soft alluvial layers as it traps fluid sediment within its folded interstitial structure. This process contributes to erosion control

Prototype at the Venice Biennale, 2006.

while also generating a support mechanism and habitat for wetland ecologies. Under extreme conditions, when inundated by tidal surges or rising water, the sponge comb fills with water and swells to become a shock-absorbing, continuous watertight barrier to guard against lowland flooding which respires and deflates when rising tides subside.

The Alluvial Sponge Comb's tubular fingers are filled with a super-absorbent polymer designed to hold up to a thousand times their weight in water, and are clad in impermeable fabric skins with shingled folded gills on their upper side walls to allow the influx of water only during storm surges. The ductility, cellular internal organisation and pleated skins of these environmental bladders enable their flexible and protean nature, allowing them to continuously move with the flux and unpredictability of real hydraulic events. Rather than a permanent and static monofunctional concrete defensive system that is detrimental to coastal health, the Alluvial Sponge Comb is modelled on the multifunctionality and variable exchange patterns of natural hydraulic systems, provisionally capturing the force and fluidity of water into its cellular system to enact a liquid-filled barrier, while simultaneously deploying a subtle infrastructural net to settle alluvium and regenerate a synthetic coastal topography.

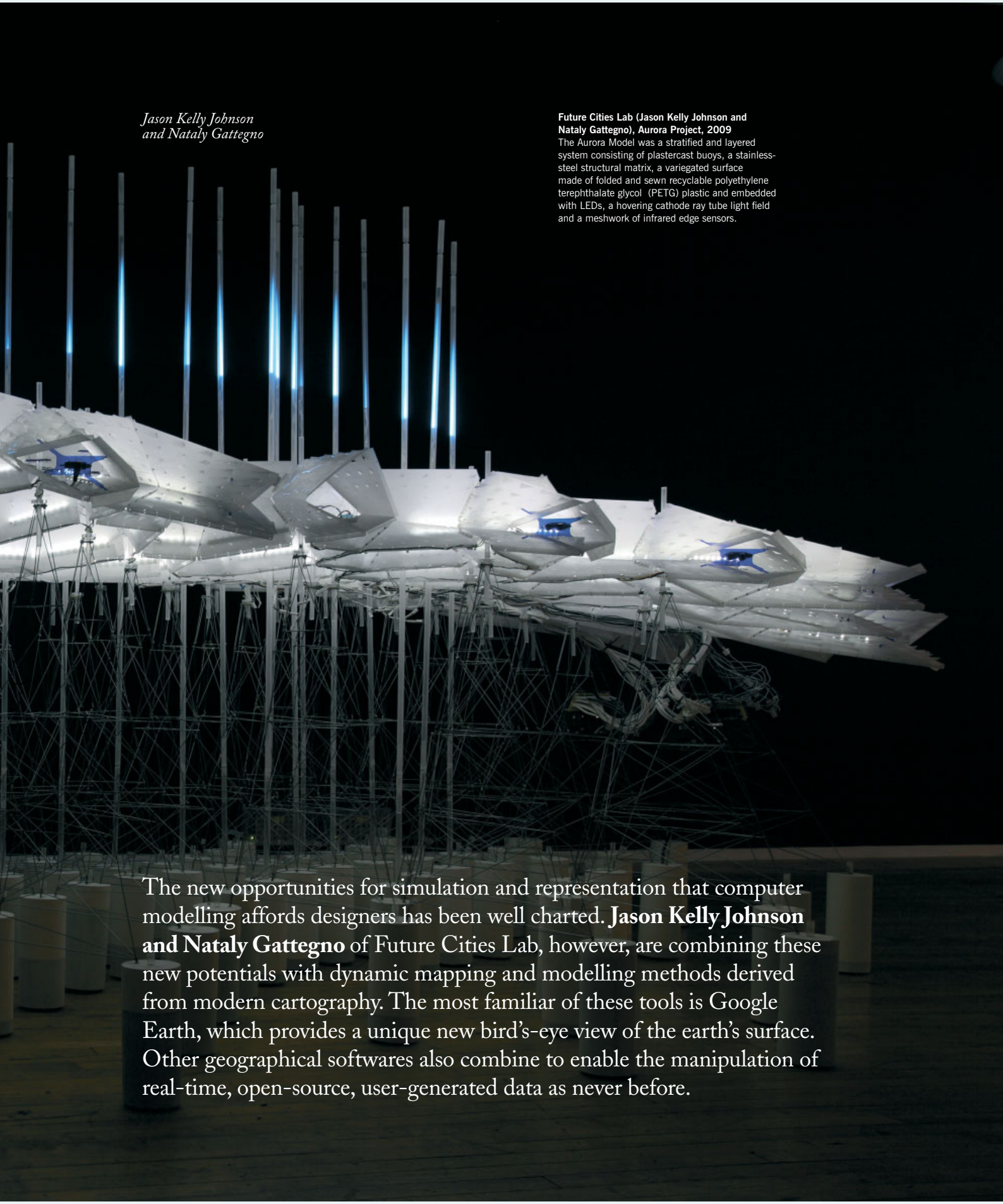
As the discrete architectural object is stretched to the scale of geographical, a new monumental nature is created – one that is highly articulated and deliberately defined, yet also fluid and material in its evolution, operation and effects. Folding Water's water-wall, Hydro-net's urban-aquacultural bog and the Alluvial Sponge Comb's bladder barrier system challenge us to incorporate soggy spaces of porosity, elasticity and growth within our static and solid waterproof environments, just as they also enable us to imagine new opportunities for amphibious infrastructures and architectures that attempt to synthesise technological artifice and its discrete acculturated systems with the fluid geographies and vital ecologies of a continuous material nature. Despite recent fears associated with rising waters and their potential for urban destruction, for many architects the largely uninhabitable oceanic volumes, as well as the bays, rivers and wetlands adjacent to our sedentary urban centres, have remained conceptually and physically underengaged, except by those invested in infrastructures intended to control and restrain them. For others, however, the complexity and boundlessness of this liquid landscape has yet to be fully explored, for the dynamic potential it offers for amphibious urban life as well as its provision of a future territorial frontier for expanded architectural intervention. AD

Notes

1. The 'Amphibious Living' symposium and exhibition was held at the Kunstgebouw, Foundation of Arts and Culture, Kinderdijk, South Holland, 29 September 2000. See Hans Venhuizen (ed), *Amfibisch Wonen = Amphibious Living*, NAi Publishers (Rotterdam), 2000.
2. A significant number of Dutch practices have developed amphibious architectures, including: Koen Olthuis of Waterstudio.NL (Watervilla, Aalsmeet, 2004); Herman Hertzberger (Water Dwelling, Middleburg, 2002; Watervillas, Ypenburg, Den Haag, 2004; Art Zaaijer (Rieteilanden prototypes, IJburg, 2001); Factor Architecten and Dura Vermeer (Floating Houses, Maasbommel, 2007); and AquaDomi (Houseboat and Floating Vill series, Kerteminde, Denmark, 2004–08; Maritime City, Halsskov, 2008–09). See also the 'H2OLLAND: architecture with wet feet' exhibition (Amsterdam, 2006). Royal Institute of Dutch Architects: www.h2olland.nl.
3. Significant exhibitions have included: 'The Flood', International Architecture Biennale Rotterdam, 2005; 'After the Flood: Building on Higher Ground', an exhibition produced for the US Pavilion at the 10th Venice Architectural Biennale in 2006 (and exhibited with the 'Sustainable Dialogues' conferences in Bangkok, Panama City and Los Angeles); 'H2OLLAND: architecture with wet feet', Royal Institute of Dutch Architects (Amsterdam, 2006); 'Newer Orleans', NAi Rotterdam, Winter 2006; and the 'Rising Tides' competition and exhibition at the Ferry Building, San Francisco, April to July 2009.
4. This project was initially designed for the 'City of the Future' competition in San Francisco organised by the History Channel, Infinity and IBM in January 2008. It was later redeveloped and went on to become a winning entry in the San Francisco 'Rising Tides' competition in July 2009.
5. The concept of the trait as an operative function of matter, and the fold as a material inflection that conjoins differing material organisations, is drawn from Gilles Deleuze, *The Fold*, University of Minnesota Press (Minneapolis, MN), 1993.
6. In its earlier incarnation for the 'City of the Future' competition (January 2008), the design of Folding Water also incorporated a regional network of infrastructural transportation systems for air, water and rapid transit, as well as larger water management, treatment and desalination facilities.
7. Wave Garden featured in 'The Flood' exhibition at the Rotterdam Biennale of 2005.
8. Hydro-net was the winning entry in the San Francisco 'City of the Future' competition.
9. The project was a winning entry in the 'High-density on the High Ground' competition organised by Tulane University and *Architectural Record*, and was later shown in the 'After the Flood' exhibition at the 2006 Venice Biennale.

THE AURORA PROJECT

Jason Kelly Johnson and Nataly Gattegno



Future Cities Lab (Jason Kelly Johnson and Nataly Gattegno), Aurora Project, 2009
The Aurora Model was a stratified and layered system consisting of plastercast buoys, a stainless-steel structural matrix, a variegated surface made of folded and sewn recyclable polyethylene terephthalate glycol (PETG) plastic and embedded with LEDs, a hovering cathode ray tube light field and a meshwork of infrared edge sensors.

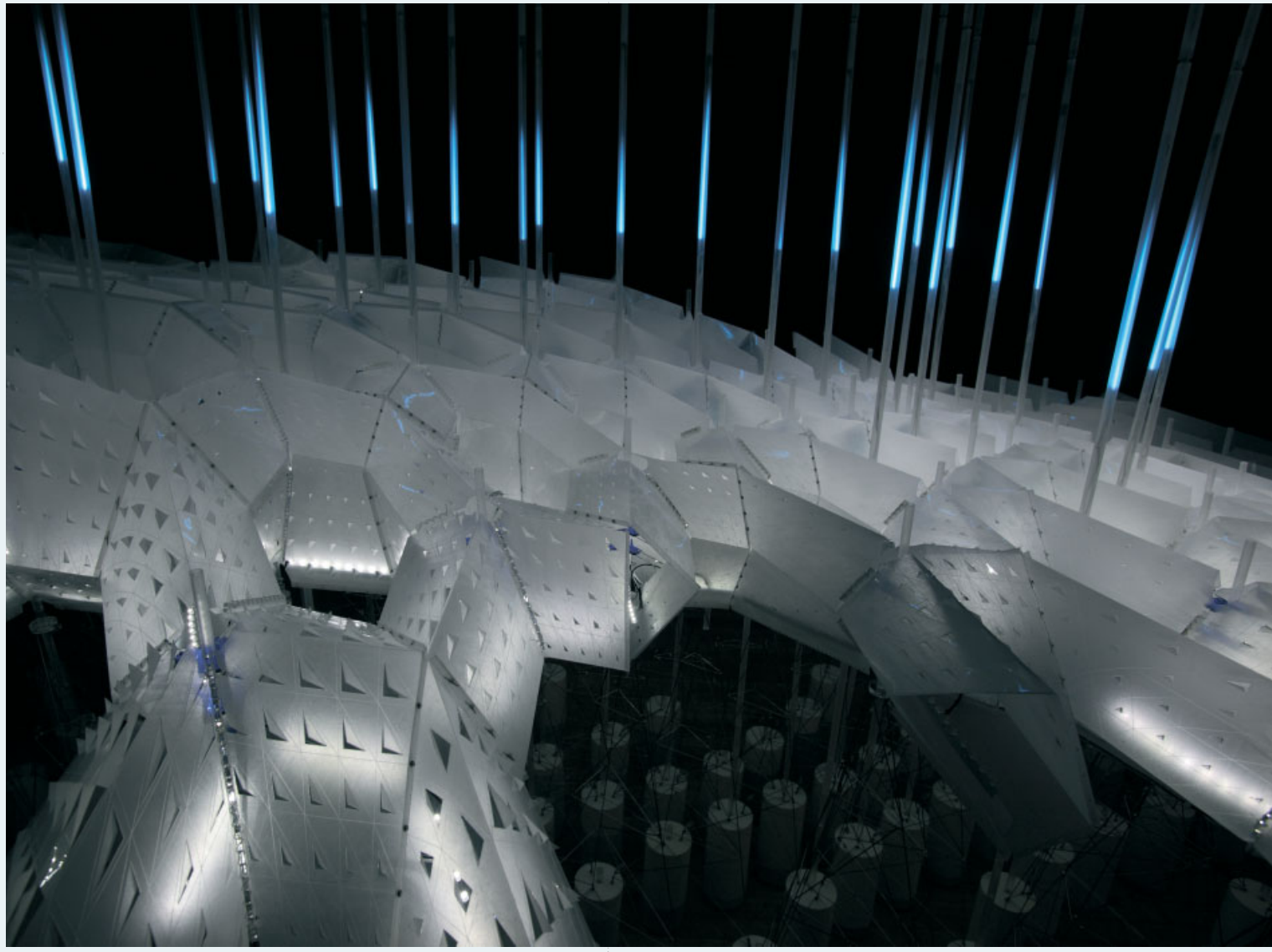
The new opportunities for simulation and representation that computer modelling affords designers has been well charted. **Jason Kelly Johnson and Nataly Gattegno** of Future Cities Lab, however, are combining these new potentials with dynamic mapping and modelling methods derived from modern cartography. The most familiar of these tools is Google Earth, which provides a unique new bird's-eye view of the earth's surface. Other geographical softwares also combine to enable the manipulation of real-time, open-source, user-generated data as never before.

Architects are fascinated with models that visually represent and simulate dynamic relationships in the physical world. These models and the logics they reveal are often used as analytical engines to understand the patterns around us and, in some cases, as conceptual frameworks for design. They range in their modes of scalar transformation, complexity and intent. The most compelling of the models do not merely depict the appearance of things, but seek to reveal the irreducible nature of processes in transition.[1] Not only are they capable of calculating the underlying logic of these processes, they can also reveal emerging patterns in a visually discernible form. Advanced media technologies have made these dynamic visualisations readily accessible, and easy to interpret and creatively modify.

This conflation of dynamic representation, simulation and interpretation has deeply affected how Future Cities Lab approaches design. This essay explores how this conflation and cross-knitting of modes of representation and simulation – including dynamic modelling and cartography – might suggest a productive new framework for design practice. Among the many questions asked are: What is the value of the interplay between science and fiction for contemporary practices such as architecture that routinely appropriate models for analysis and design? What is at stake when a model attempts to exceed the world of pure simulation, and demands some form of analogical reasoning and perceptual analysis? When models routinely employ the tactics of dynamic cartography and interactive media, what are the implications for architecture and beyond?

Dynamic Models

The orrery is an early example of such a model that emerged out of the discipline of precision watch-making in the 18th century. Orreries are small hemispherical theatres consisting of gears and rotating orbs that not only mechanically simulate the interaction of planets in the solar system, but also model spatial relationships including the relative position, volume, scale and trajectory of planets and satellites. They operate as dynamic models and allow users to see, experience and juxtapose information from differing perspectives. The famous Rittenhouse Orreries[2] dating from the 1760s were used as hands-on educational tools. The size of planets is often exaggerated and their materiality is reinterpreted through the use of analogous minerals including polished stones, ivory, metals and glass. Projection orreries extend the concept further by focusing light onto geared mirrors to project points of light and cast shadows on to surrounding surfaces. This technique serves to amplify the



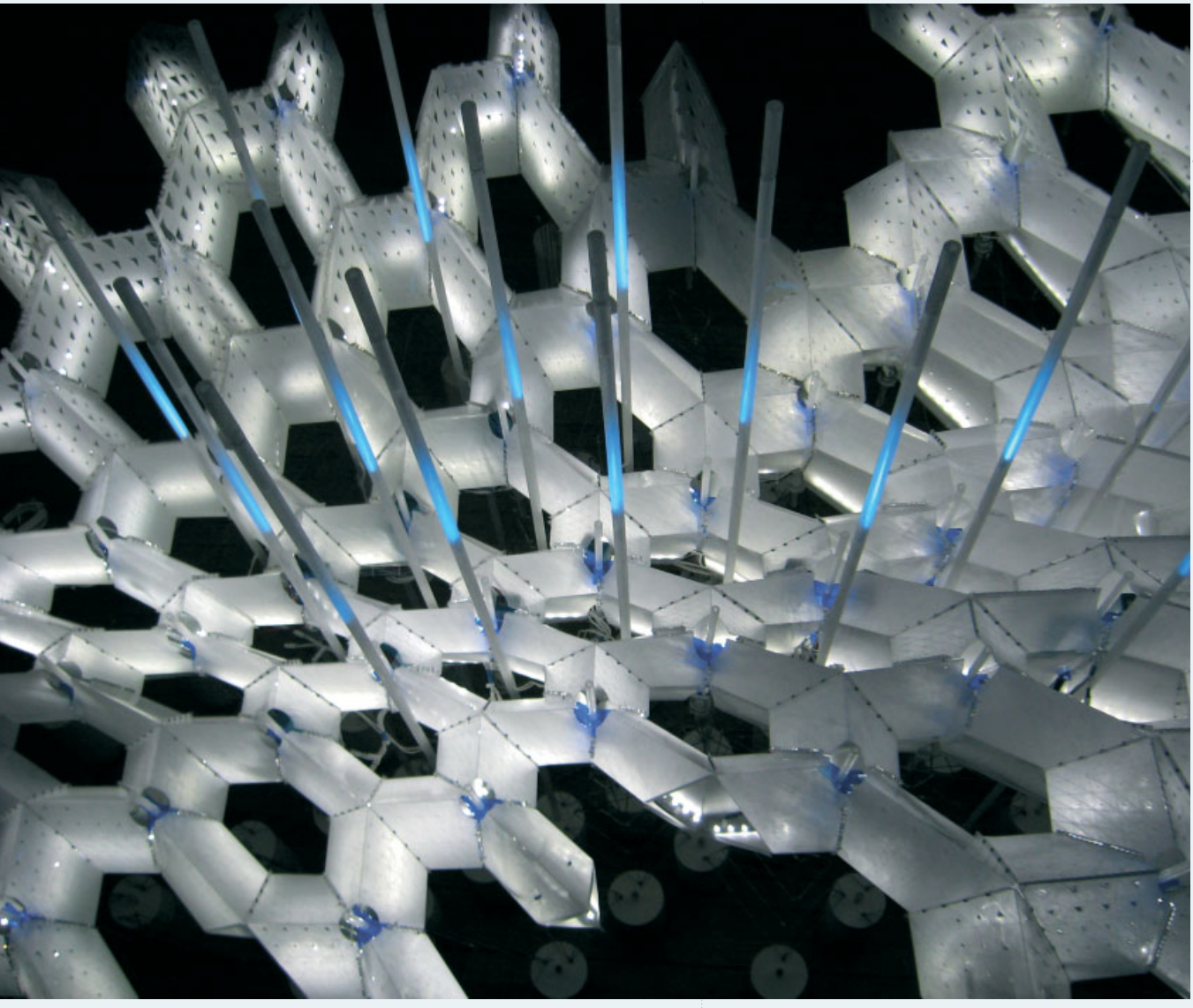
scale, effect and atmosphere of the orrery simulation, and shifts the orrery model from the realm of pure simulation into the domain of sensorial experience, perception and spatial interpretation. Orreries are unique in the way they have been used as both scientific instruments and didactic tools that oscillate back and forth between disciplines of science, experimental technology and art, and, in many cases, creative fiction.

Dynamic Cartographies

In a similar vein, the discipline of modern cartography routinely involves a cross-knitting of disciplines, where formerly static representations are mapped and modelled alongside animate political boundaries, shifting cultural patterns and other data-rich topologies.[3] While cartography has traditionally been concerned with the practice of static geometric modelling and topographic description, the emerging discipline of dynamic cartography[4] is challenging established conventions. New cartographies are now latent with real-time, open-source, user-generated data. The clearest example is Google Earth, which enables users to fluidly navigate a texture-mapped, multi-layered, three-dimensional model of the earth and beyond. Tactically similar to the orrery, these models allow users to control their experience through direct interaction. For instance, a bird's-eye tour of the Arctic ice shelf might cover thousands of miles in a matter of seconds, juxtapose climate data from 1980, 2000 and 2020, or link to an array of live video feeds.

Future Cities Lab (Jason Kelly Johnson and Nataly Gattegno), Aurora Project, 2009
opposite: The upper surface of the Aurora Model consisted of a combination of recyclable PETG plastic, sewn and joined to an acrylic structuring rib system. The perforation gradient was triggered by the age of the ice, rendering the perimeter of the installation filigree and lace-like.

below: Top view of the Aurora Model surface and emerging light field.



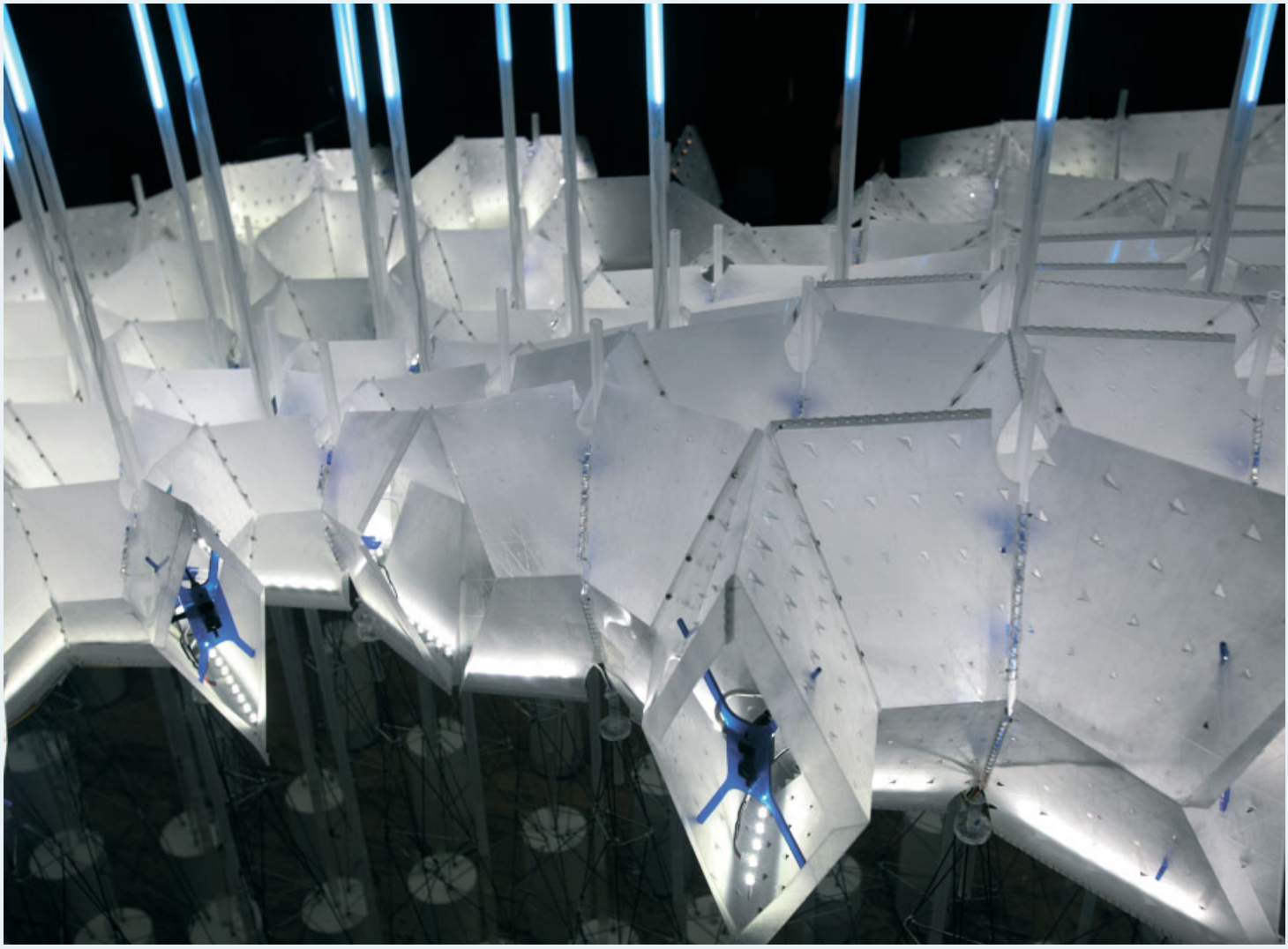
With the advent of immersive technologies, these models are rapidly becoming experiential worlds unto themselves. They are blurring distinctions between models as mere depictions, and models as vital sensorial spaces that are live and impregnated with mutable data. As a design practice, Future Cities Lab is interested in this latency and believes there is a fundamental shift taking place in how we expect models to perform as analytical machines, and how in turn those machines become dynamic, and perhaps intelligent, frameworks for design. What potential does this promiscuous interplay and cross-knitting of cartographic practices hold for how we understand space and approach design?

Three Explorations: Terra Incognita, Aurora Model and Glaciarium

The Aurora Project[5] was initiated as a series of three distinct design explorations that allowed this question to be examined in more depth. It emerged out of an extensive study of how the Arctic region has been represented, and in many cases, misrepresented throughout time. The intention was to use these representations as points of departure for engaging contemporary political, social and ecological issues. Each of the explorations attempted to translate or re-represent these issues through drawings and interactive models that were exhibited together. Terra Incognita consisted of maps and diagrams that provided a view into how the Arctic region has been represented, claimed and mythologised in the past and present. The main interactive piece – the Aurora Model – superimposed the ephemeral qualities of these representations with the dynamic behaviour of multiple users, translating the shifting dimensions of the ice into a responsive light field. A smaller, interactive instrument – the Glaciarium – complemented these larger installation pieces by engaging a smaller group of users' senses through the sight and sound of a melting ice core.

Terra Incognita

This first exploration investigated how early attempts to survey and document the Arctic were complicated by difficulties in representing the ephemeral and the unpredictable qualities of seasonal ice floes. Many of the historical maps that were analysed and presented illustrated the numerous attempts of explorers and cartographers to map the Arctic. While many of them showed static boundaries using solid lines, in actual fact edges would have literally shifted and disappeared along the paths of cartographers who drifted with the ice in search of the Northwest Passage. As a result, early maps of the Arctic region were creative fictions at best: not only were things exaggerated, but entire regions were invented, marked as 'unknown territories' or overlaid with mythical creatures. Pytheas, one of



the first documented explorers of the polar region, described the limitations of static cartography in his account of his explorations there: 'Those places where land properly speaking no longer exists, nor sea nor air, but a mixture of these things … in which it is said that earth and water and all things are in suspension … on which one can neither walk nor sail.'[6]

What emerged from the Terra Incognita study was a database of descriptive tactics for expressing qualities that are ephemeral and perhaps beyond the limits of conventional cartography. In contrast, the Arctic today is one of the most studied and mapped terrains, with networks of sensor buoys arrayed across its surface that capture the changing morphology of ice on an hourly basis.[7] It is now possible to study buoy locations using Google Earth, as well as daily satellite images of sea ice extent. This unprecedented database gives us access to a continuously evolving set of dynamic representations of a territory in a perilous cycle of change. The representations presented in Terra Incognita experimented with ways to synthesise, remap and remodel these representations. The intention was not to abridge or to generalise, but to superimpose and emphasise critical dynamic relationships while restraining others. Layered representations were generated that consciously oscillated between modes of dynamic modelling, cartography and creative fiction.

The Aurora Model

The second exploration, the Aurora Model, attempted to synthesise these modes of representation into a physical form. It was constructed using a series of horizontal layers that indexed both static and dynamic relationships. The lowest layer of the model mapped the underwater bathymetry using an array of plaster cylinders. These provided a stable foundation for a network of stainless-steel tripod structures that suspended a glowing translucent surface assembled from thousands of laser-cut components. The surface's height and thickness mapped the mean water temperature and salinity of Arctic ice, while its specific geometry and variable perforation pattern emerged from a translation of maps related to ice age and overall density. The outer profile of the surface registered the maximum sea-ice extent for 2009.

As gallery visitors interacted with sensors integrated into the edge of the model, arrays of white LEDs embedded in the surface shifted from light to dark. As the surface darkened, the white light was displaced vertically into a hovering blue aurora. Like the Arctic itself, collective actions determined its shifting shape, in this case triggering a constantly mutable field of light. The ephemeral effects of the light field shifted one's position from viewer to participant, revealing the consequences of one's individual and collective actions in real time. The artist

Future Cities Lab (Jason Kelly Johnson and Nataly Gattegno), Aurora Project, 2009
left: Detail of the surface and edge sensors of the Aurora Model.

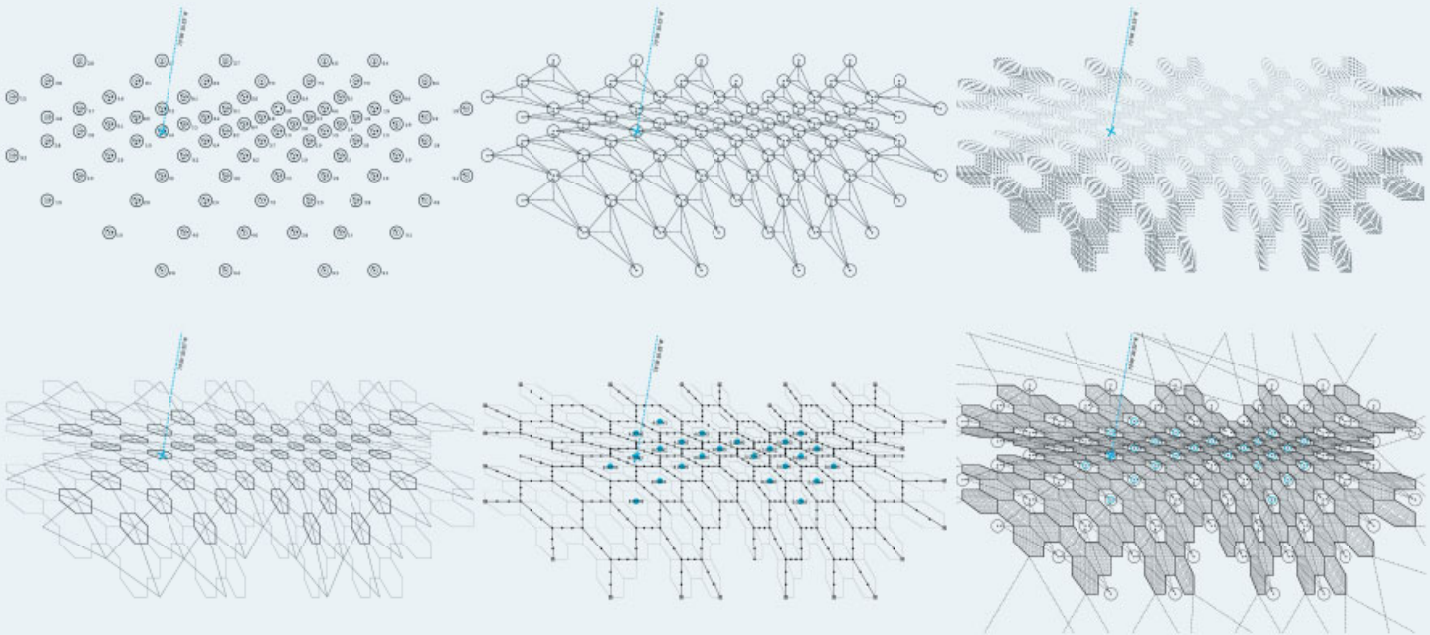
above: In the Terra Incognita investigation, the ephemeral territory of the Arctic was explored through a series of mappings charting the deposits of minerals and the shifting tectonic plates and earthquake epicentres; the oil cache beneath the ice relative to the race to dominate the region; and the shifting dimensions of the ice shelf juxtaposed with the drifting buoy measuring devices.

Olafur Eliasson calls this shift a form of 'double movement' where 'the user's interaction with other people co-produces space which in turn is a co-producer of interaction. By focusing our agency in this critical exchange, it is possible to bring our spatial responsibility to the fore.[8] Similarly, the Aurora Model uses sensors and interactive effects to explore how this co-production allows the model to be understood as both an index of shifting resources in the Arctic and a didactic tool for understanding our individual and collective relationship with space and form.

The Glaciarium

The final exploration sought to distance itself from the vast scale and complexity of the Arctic, and investigated how a dynamic model might use interactivity to turn an abstract global issue into an intimate experience. While the Aurora Model sought to represent billions of cubic feet of Arctic ice, the Glaciarium[9] model encapsulated a mere 2.228 cubic centimetres (136 cubic inches) of frozen water. Its welded stainless-steel lattice and translucent skins were constructed to hold a 46-centimetre (18-inch) tall by 7.6-centimetre (3-inch) diameter cylindrical ice core. At the beginning of the cycle, a core of ice was placed within the Glaciarium. At room temperature, +/– 21˚C (+/– 70˚F) the ice core melted in approximately eight hours. During this process the melting liquid fell almost a metre (3 feet) into an amplified catch basin. The sound of dripping water was transmitted through two speakers suspended within the lattice. Throughout the day, observers of the ice core were tracked by infrared sensors. Increased observation amplified the internal lighting effects and, depending on the duration of interaction, dramatically accelerated the melting of the ice core. The quickening rhythm of dripping water registered the prolonged presence of observers. The more one looked through the viewing aperture, the more one participated in the degradation of the ice core. In a sense, the environmental imperative was no longer argued as a scientific reality and was instead rendered personal; the influence of the individual was linked directly to the materiality and sensation of the project.

The three explorations that make up the Aurora Project suggest that there can be a productive reciprocity between vast scales[10] of both geography and time, and reveal the potential for models (and perhaps by extension, architecture) to simultaneously index, synthesise and engage climactic, cultural, social and politically charged fields. Territorial claims are global and dynamic, yet the physical and spatial implications of the Aurora Project are local, hyper-situated and active. Similar to dynamic cartography these explorations suggest that through the mapping of distant territories new worlds emerge, simultaneously synchronised with



Future Cities Lab (Jason Kelly Johnson and Nataly Gattegno), Aurora Project, 2009
above: The Aurora Model was read as a series of laminates that generated the thickened surface and its structural substrate. The site was inaugurated with a varied field of buoys (*top left*) that tracked an underlying territorial geometry (bottom left). The steel skeleton locked the geometry into place (*top middle*), the surface was deployed, wired and networked (*bottom middle*), perforated and varied according to the density of the ice field (*top right*), and synthesised (*bottom right*).

right: The Glaciarium was an instrument for observing (visually and acoustically) the melting of ice. Human interaction via a series of sensors expedited the melting process rendering the human impact on the degradation of the system visceral and personal. The Glaciarium consisted of a stainless-steel woven and soldered structural cage, inlaid with a faceted interior surface.

opposite: Interacting with the Aurora Model.

their immediate surroundings and tethered to the distant regions they refer to. Nevertheless, some key questions remain: What form of knowledge do these models in fact produce? What is at stake when a map or a model not only demands interaction, but relies on the participation of viewers for the activation of meaning? When a model employs the tactics of interactive media and dynamic cartography, and combines them with the spatial and tectonic agency of architecture, what are the implications for how we understand and construct the world? AD

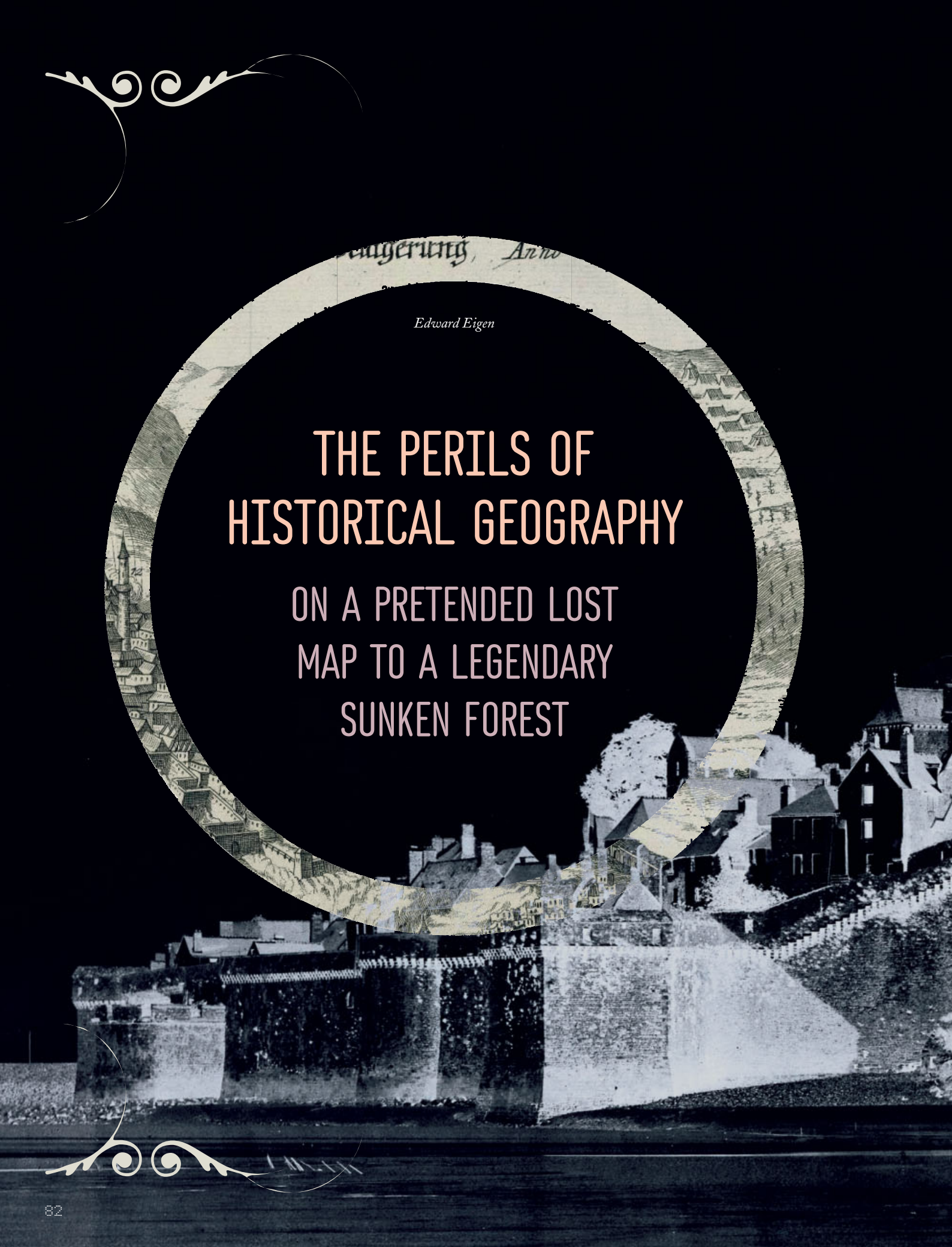
Notes

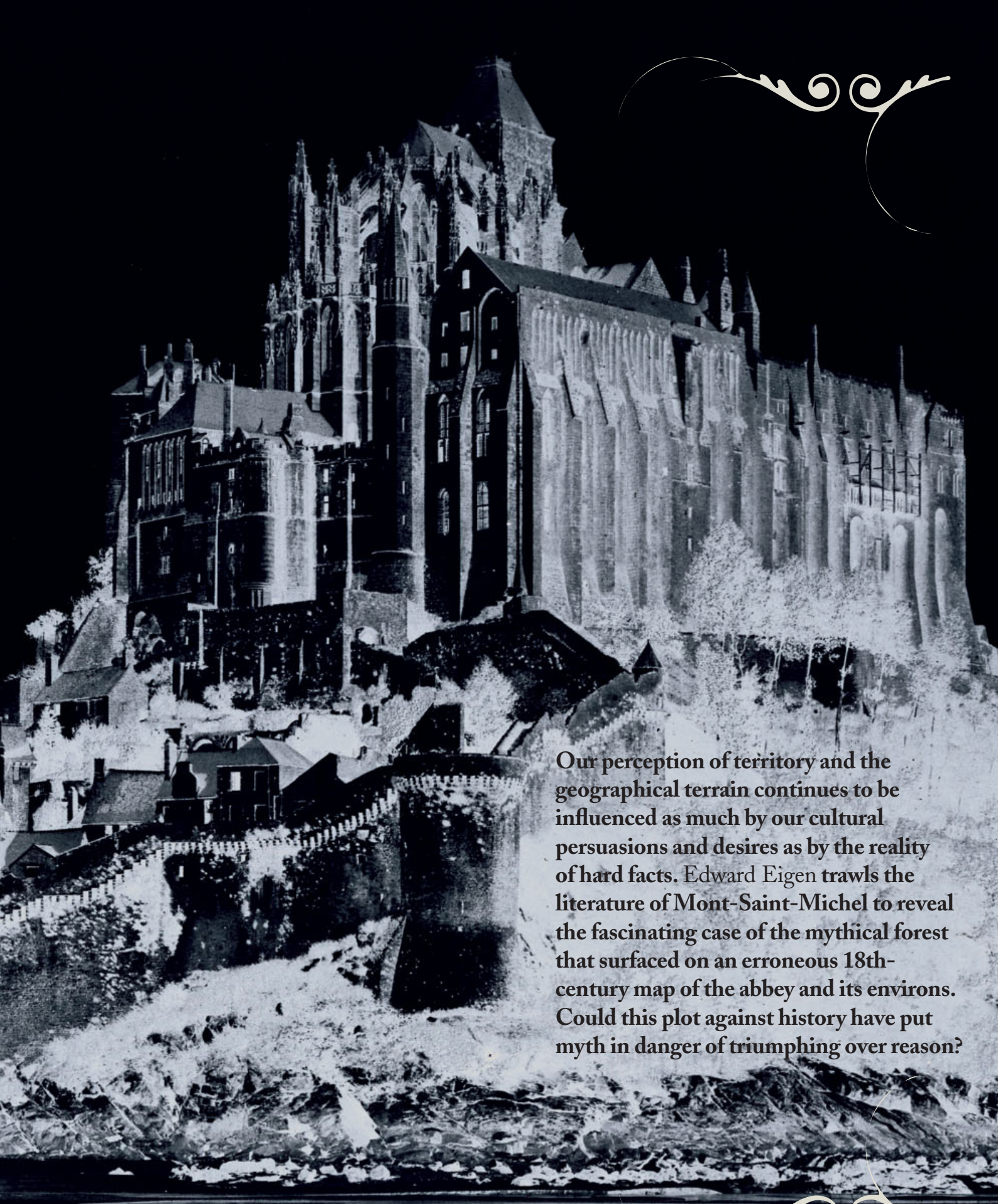
1. For a description of the futility of modelling non-equilibrium systems, see Stuart Kauffman, *Investigations*, Oxford University Press (Oxford), 2000). Chapter 4, 'Propagating organizations', states: 'Maxwell's Demon is the clearest place in physics where matter, energy and information come together. Yet, we will find the demon and his efforts at measurement tantalizingly incomplete' (p 81).
2. The Rittenhouse Orreries were built by David Rittenhouse in the late 1760s. The oldest version is owned by Princeton University and is on permanent display in the lobby of Peyton Hall. Its twin is owned by the University of Pennsylvania and is on permanent display in the Van Pelt Library. See Howard Rice, *The Rittenhouse Orrery: Princeton's Eighteenth-Century Planetarium*, 1767–1954, Princeton University Press (Princeton, NJ), 1954.
3. We define 'information topologies' as representations that seek to diagrammatically establish relationships between things, but might exaggerate scale or other aspects to effectively illustrate an abstract concept or idea.
4. The term 'dynamic cartography' is explored in great detail in the technical essay Lubos Mitas, William Brown and Helena Mitasova, 'Role of Dynamic Cartography in Simulations of Landscape Processes Based on Multivariate Fields', *Computers and Geosciences*, Vol 23, No 4, 1997, pp 437–46.
5. The Aurora Project was completed with the assistance of Carrie Norman and Thomas Kelley and the support of the Van Alen Institute New York Prize Fellowship and a grant from Taubman College at the University of Michigan. For a full list of project credits and collaborators please visit www.future-cities-lab.net.
6. R Chevallier, 'The Greco-Roman Conception of the North from Pytheas to Tacitus', *Arctic*, Vol 37, No 4, December 1984, pp 341–6.
7. Refer to the interactive graphic piece entitled 'Sea Ice in Retreat' by Erin Aigner, Jonathan Corum, Vu Nguyen. The interactive Flash interface accompanied the article 'Arctic Melt Unnerves the Experts', by Andrew C Revkin, published in the *New York Times* on 2 October 2007; see http://www.nytimes.com/2007/10/02/science/earth/02arct.html?_r=1.
8. Olafur Eliasson, 'Models are Real' in Emily Abruzzo, Eric Ellingsen and Jonathan Solomon (eds), *Models: 306090 Books*, Vol 11, 306090, Inc (New York), 2007, p 19.
9. The term 'Glaciarium' was borrowed from a flier dating back to London in 1844 announcing an event in which there would be 'a great thaw of the artificial ice … a model of Lake Lucerne and a glacier of ice were to be thawed'. The flier is currently located in the Alexander Turnbull Library collection of ephemera at the National Library of New Zealand. See (http://mp.natlib.govt.nz/detail/?id=69501&l=en).
10. On the question of scale relative to new cartographic representations, see Antoine Picon, 'Toward a City of Events: Digital Media and Urbanity', in Neyran Turan (ed), *New Geographies 0*, Harvard University Press, 2008, pp 31–43. Picon discusses two emerging categories of contemporary maps: 'global perception' maps are 'dynamic representations that show the city from a control-room perspective'. The second are 'individual experience' maps that 'show us the city as we experience it, with the nearby possibilities offered to us'. The aim of the Aurora Project was to cross-knit these categories into a single assemblage.

Edward Eigen

THE PERILS OF HISTORICAL GEOGRAPHY

ON A PRETENDED LOST MAP TO A LEGENDARY SUNKEN FOREST





Our perception of territory and the geographical terrain continues to be influenced as much by our cultural persuasions and desires as by the reality of hard facts. Edward Eigen **trawls the literature of Mont-Saint-Michel to reveal the fascinating case of the mythical forest that surfaced on an erroneous 18th-century map of the abbey and its environs. Could this plot against history have put myth in danger of triumphing over reason?**

Of popular rumours, probabilities, marvelous traditions, and conjectures, there is no deficiency, but there is not a single fact relating to Mont-Saint-Michel, among the occurrences of those ancient times on which historians agree.

James Hairby, *A Short Historical Account of Mont Saint-Michel and Mont Tombelène*, 1841[1]

Our problem begins with a map, authoritatively said to have been transcribed from a lost original at the abbey of Mont-Saint-Michel. The wonder is not that the authenticity of this unburied treasure at first seemed probable. Rather, what is worth investigating is why, like a lingering presence, it continued to seem so, particularly to those in possession of solid facts who presumably knew how to read the signs. To trace the lines on this map, which limned the time-worn contours of the Bay of Mont-Saint-Michel, is to detect a particular form of errancy and the attempt to straighten it out. This process involved a searching ordeal of criticism that exposed and compensated for the *fact* that the terrain over which it ranged, the forests and welter and waste of the past, was still largely uncharted. To trace these lines is to follow a path of conjecture, to uncover a plot against history that took the discreet form of an 'ancient tattered map, creased and damp', dating to 1406 and copied in 1714, which came to light in 1863 amid questionable circumstances.

The making and unmaking of this (supposedly) irrecusable document provides a map, as it were, to the halting, looping, digressive 19th-century approach to the several pasts of Mont-Saint-Michel. There are few more attractive sites in the terrain of the imagination than this wave-girdled rock crowned by the Norman Gothic abbey fortress La Merveille, and few that are less accessible. For in a setting known especially to wayfaring pilgrims who used their staffs to feel their away across its trackless expanses of miry earth, and to historians and geographers who were uncertain of its once and present extent, each and all were advised to watch their step.

THE ROOTS OF CAUTION

The editors of the *Annuaire du Département* de la Manche (1863) were on to something from the start, even if they followed the wrong lead. 'La Forêt de Scissy,' reads the title of the unremarkable seeming item singled out by them for suspicion. Long submerged beneath the sea, the legendary forest which once sheltered Druids, and after them Christian cenobites, was indeed a dark wood in which even the most circumspect of historians lost their way. It was a darkness within a chaos, a chaos in the archaic sense of an unfinished and unformed earth out of which occasionally reappeared, when violent storms stirred up the loose bottom of the Bay of Saint-Michel, vestiges of villages and houses and roads, and even wagon ruts left by long extinct traffic.

'We dare not place this article in the section devoted to history and antiquities,' the editors explained. They deemed it more 'fitting' to include it in the Miscellany, being a 'document of dubious authority, but one which might one day offer direction and provide information.'[2] Based on this uncertain foundation, presumably the expectation was that future research on the bay would plumb its clayey subsurfaces. The article in question was reprinted from a local newspaper, *Le Mortainais* (9 July 1862), having first appeared several days earlier in the *Journal de Coutances*. This much is beyond question, that it was in the pages of the latter newspaper and not upon withered vellum, and with the excited claims of the capable local historian Léopold Quénault and not some copyist (a Bouvard or Pécuchet) where things begin to go awry. As for Quénault's contributions to the press, he was literally asking for trouble, and he soon found it. But first, a little history about this dubious news item – a fold in time that appeared under the fold.

Prompted by the discovery of an iron-ore deposit reported in the *Journal de Granville*, Quénault made a visit to Bricqueville-sur-Mer. But what caught his attention while walking along the shore at low water were the 'incontestable traces' of the forest of Scissy: tree trunks narrowly rising from a layer of brown peaty sand which, 'in the remote past' must have been humus. At first he mistook the sight for the remains of fencing, but he then carefully (*avec précaution*) 'exhumed' one or two of the stumps revealing their intact roots. Finally, upon discerning the annual rings of trees which had been suspended in time for a millennium or more, there remained no doubt in Quénault's mind. He was standing on the floor of a lost wood. Quénault imagined finding Roman or Celtic love notes carved into the tree trunks – *caudex* (L tree bark) as *codex* (book) – which might allow him to date precisely the 'invasion of the land by the sea'.

Therein lay the problem; namely, establishing the timing and preferably the exact date of the forest's inundation. Twenty years earlier, the Société d'Archéologie d'Avranches announced an essay competition on the very question: What was the geographic situation of Mont-Saint-Michel prior to the reign of Childebert III (695–711)? The author was to investigate (1) whether the mount was once surrounded by a forest, and (2) if so, when the forest disappeared. Was the coast progressively eroded by periodic inundations or, as Arturo du Monstier claimed in his *Neustria Pia* (1663), was it suddenly inundated. If the author accepted du Monstier's 'version', then he was to specify exactly when and how the cataclysm took place, and cite other sources in support of his conclusions.[3] Towards this end, the competition brief 'signalled' a

number of manuscripts from Mont-Saint-Michel in the library of Avranches, where they were taken during the Revolution, which might be 'fruitfully consulted'.[4] As one ambiguous sign of the competition's success, the author of the 'ancient' map in question found useful information in the winning essay. But we are getting ahead of our story.

SAVED FROM THE PAST

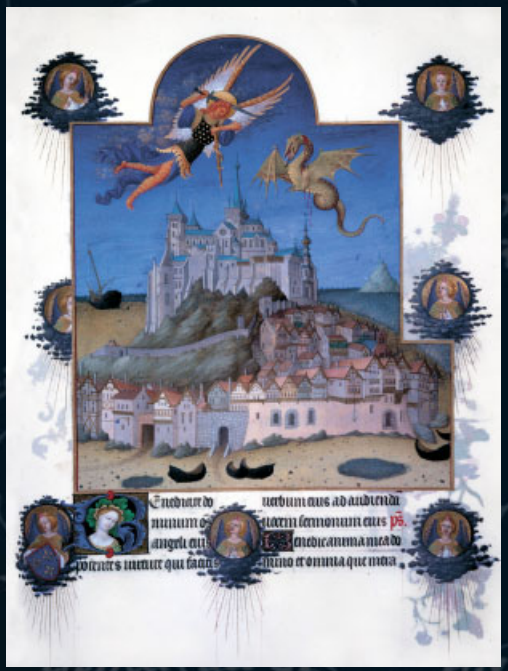
Following his discovery at Bricqueville-sur-Mer, Quénault wished to know more about the forest of Scissy and turned to the *Journal de Coutances* for answers. At the end of his article, the same one that later prompted editorial caution, he asked readers for 'any particular information' they might have about the historical configuration of the coast. To his interpretive peril, his request was fully heeded. Deschamps-Vadeville, a geographical engineer from Cherbourg, came forward with a previously unknown map, which Quénault saw fit to reproduce soon thereafter in the *Journal de Coutances* (28 November 1863). In the accompanying text Quénault explained that this 'extremely curious document' belonged to one of Deschamps-Vadeville's ancestors, a cartographer, to whom it was given by a monk at Mont-Saint-Michel in 1714. The map bore the date 1406, but its calligraphic style made it appear that it was a copy of a still older unknown map.

Quénault was not alone in accepting the map's authenticity. The archaeologist Alexandre Chèvremont was on the same page. In his comprehensive work on the historical and physical geography of the Bay of Mont-Saint-Michel, Chèvremont sought to clear the field of all speculative, legendary and/or fantastical theories about the bay's most recent evolution, though his scorn was directed principally at the abbé François-Gilles Manet, 'prophet of the fatal tide of 709'.[5] Chèvremont alleged that Manet gave credence to and spread a 'historical lie' with his widely read book of 1829 on the former and present state of the bay. Manet's retrospective prophecy of the sudden and catastrophic destruction of coastlands by a hurricane storm surge was the very scenario the archeological society's essay competition was meant to contest on strictly documentary grounds. Yet Manet had another, still more compelling sort of 'proof' at his disposal, well insulated in a crucial essay-length footnote treating the 'ancient forest'.[6]

After citing 18 published sources along with 'all the manuscripts from the abbey of Mont-Saint-Michel', Manet offers that 'even if the historians had taught us nothing, there remains from our own times irrecusable evidence' concerning the forest's former existence. He was referring to the countless tree stumps which, over the course of centuries, had been 'unearthed' from the mud and sand flats surrounding Mont-Saint-Michel. Still more impressively, Manet notes the 'famous storm' of 9 January 1735, which, as if to reverse time, or rather to make its eddying regime visible, swept away the top layer of the bay's bottom revealing thick stands of fallen trees. For Manet, the well-attested observation that all the trees were lying in the same direction proved, 'independently of history', the force and direction of the 'ruinous' wind-driven tide of March 709. In his winning competition essay, the archaeological society's secretary Fulgence Girard similarly mentions the storm of 1735, which briefly uncovered the sea-changed ruins of Saint Etienne-de-Paluel. As late as 1630 this village belonged to one of the parishes mentioned in the synodal books of the bishopric of Dol, which read like a mortuary register of former places which had sunk into the sea and sands.

To Chèvremont the unseasonable reappearance of these ruins was an indication that there was no unified front and no single or sudden invasion of the coast. The sea's conquest was a distributed, discontinuous and still ongoing process of alternating phases of immersion and emergence. Chèvremont deplored the 'prodigious ability' with which a historical or geographical error, once it 'gets its footing in the domain of science', is unquestionably accepted. Whatever non-testimonial evidence Manet presumed to possess, Chèvremont retraced the learned abbé's historical missteps to a 'poisoned well', a single and singularly faulty manuscript from Mont-Saint-Michel. Regrettably, strewn as it was with corruptions, transpositions and interpolations (textually demonstrated by Chèvremont), this manuscript was the one most widely read by historians beginning in the 17th century.

However astute, Chèvremont's criticism of Manet would have been better directed at Deschamps-Vadeville, a version of whose map he approvingly reproduced in his book. After a careful examination, Chèvremont believed himself to be on solid ground in asserting: 'There can be no question here of one of those literary or scientific frauds which attempt to dress up contemporary wishes and beliefs in ancient garb.'[7] Valued by Chèvremont because previous studies of the region's historical geography 'teemed with errors', Deschamps-Vadeville's map succeeded precisely by displacing reliable markers of historical time.



View of Mont-Saint-Michel with the archangel Saint-Michel and winged dragon battling in the air. From Jacques, *Le livre des bonnes moeurs*, dedicated to Jean duc de Berry, 1478.

THE RUINED MAP

The abbé Émile-Auber Pigeon, an accomplished local historian, allowed that Quénault 'probably believed' in the authenticity of Deschamps-Vadeville's map, though it was not Quénault's committed belief that mattered, but rather the prior probability of the supposititious document he unknowingly called for and subsequently published. Pigeon carefully demonstrated that 'to any trained eye the map was a manifest forgery',[8] though his conclusions were not self-evident; as is the case in such ordeals of criticism, documentary proofs needed to be produced, often at the cost of enormous scholarly labour and tedium. The first and perhaps most conspicuous clue to the forger's modus operandi was revealed in a line-up, as it were. Pigeon identified Jacques-François Lefranc's *Tabula topographyca antiqua pagi Abrincatuorum et Unellorum* (Ancient Topographical Map of the Regions of Avranches and Carentan) of 1792 as the direct source for the coastline contours on Deschamps-Vadeville's map. Quénault also noted this similarity, reading it as verification of the map's conformity to a reliable work of reference. To Pigeon it was a clear sign of illegitimate appropriation.

Producing the map's contours, however, was not the most difficult aspect of the forger's craft. 'He needed to fill the map in, to give it life, to make it speak,' Pigeon writes, and make it speak in the dialect of a foreign land – the past. To misspeak was to betray itself as a 'falsification, a historical lie'. The problem for the forger was to name and place localities, many of them lost to the sea and/or to time, such as they were in 1406. This is precisely the point where the progressively more comprehensive inventories of Mont-Saint-Michel's manuscript history (from Eugène Castillon de Saint-Victor to historian and palaeographer Léopold Victor Delisle) reveals its crucial importance.[9]

The return of pilgrims on the mudflats of Mont-Saint-Michel. From *Le Monde Illustre*, No 1057, 14 July 1877.

It was with the sole guidance of numbered catalogue entries that the contest led researchers into the library at Avranches in search of lost place and time. Avoiding the false starts and faulty leads in the history of the history of Mont-Saint-Michel, Pigeon set out to prove that the map never existed at the abbey to begin with, and thus could not have been given to Deschamps-Vadeville's ancestor by a monk there, denying the map and the story of its origin any air of legitimacy.

Had such a map existed, Pigeon reasoned, it was impossible or at least highly improbable that it would not have been mentioned in contemporary inventories nor have figured (prominently so) in the annals produced in and about the abbey. At the time of Pigeon's investigation a number of these manuscripts were being published in critical editions with extensive scholarly apparatuses. This was not the moment to pull off a literary fraud, or at least to have it go unnoticed. Or then again, with an effort under way to gather up the debris of the pre-Revolutionary past, this unlooked-for survival might have been eagerly accepted on its own terms.

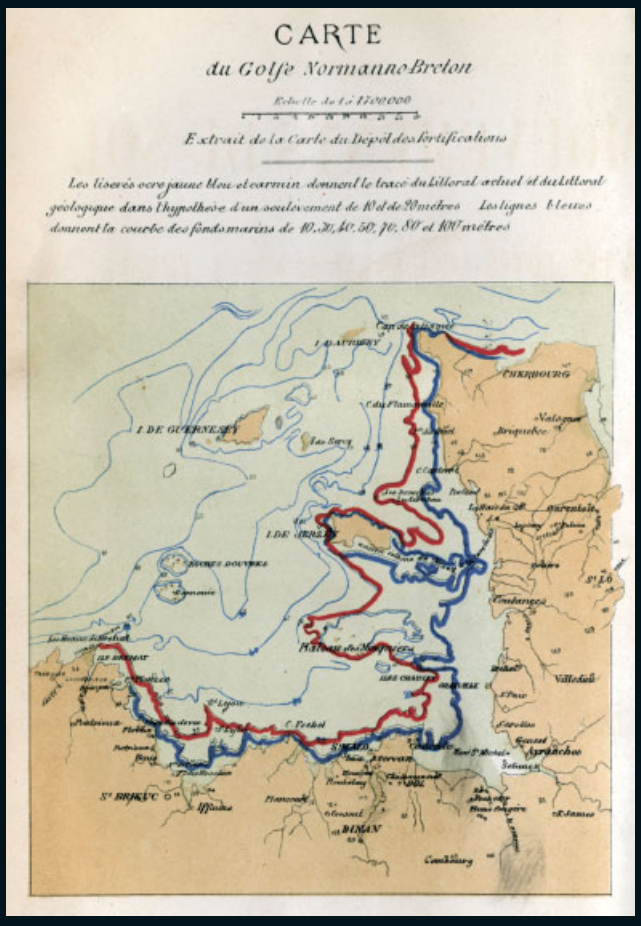
Where Quénault exhumed tree stumps and marvelled at their roots, Pigeon handled the map as if each of its labels had a buried footnote attached to it. He read the document as a dissimulated historiographic bibliography of Mont-Saint-Michel. Some of its place names were anachronisms. Others, like Cathim (Caen), were derived from the work of Daniel Huet, the learned 17th-century bishop of Avranches. The forger's indication of Roman encampments was based on the research of the influential architectural historian Charles-Alexis-Adrien Duhérissier de Gerville, himself a student of Mont-Saint-Michel and its manuscripts. Pigeon finally established a *terminus post quem* by showing that the map incorporated findings presented by Baron de Rostaing in September 1860 at a conference in Deschamps-Vadeville's home city of Cherbourg. Having allowed that Quénault probably believed in good faith that the map was authentic, Pigeon was certain that the forger never believed that his map would ever be closely scrutinised, or severely doubted by the critics.

THEIR PERILOUS CALLING

The matter opened by Quénault in the pages of the *Journal de Coutances* was (temporarily) brought to a close in the *Journal Officiel* (15 June 1889), which published the proceedings of the Société Académique du Cotentin where Pigeon delivered his verdict.[10] His investigation ranged narrowly over the very domain of 'history and antiquities' from which the initial report of Quénault's observations at Bricqueville-sur-Mer had been excluded. It is in the past where things get lost. All the researcher can hope for is that some traces were left behind for him to find, and that the traces have not themselves been lost, erased, or misplaced in the real and proverbial dust and darkness of unvisited libraries and archives. In his analysis of Chèvremont's work, Alfred Maury, of the Académie des Inscriptions, praised the author's 'faultless erudition, extensive knowledge of the sources, and forceful criticism'.

However, by placing his confidence in a mysteriously recovered map, he was led astray.

Pigeon perhaps had the benefit of Dom Jean Huynes's 1638 annals of Mont-Saint-Michel, first published in 1872. Huynes explained that the abbey's surname Au Péril de la Mer (In Peril of the Sea) did not derive from the restless assault of the waves upon the immense rock that served as its unmovable base. Rather, it referred to the treacherous approach to the pilgrimage place across shifting beds of subtle quicksands. Huynes advised all 'prudent' comers to hire a reliable guide before setting out for the abbey.[11] And what of the researcher? As well as any map, the catalogue provides guideposts along a perilous tide-washed causeway; it is an open book of all that has been saved and lost, and what for the present time remains missing. Around Mont-Saint-Michel, search parties were always at the ready. In this region that was not land and not sea, its very bottom unstuck in time, the principal lesson of and from the past was one of caution: watch your step.



Map of the Normanno-Breton Gulf, from Alexandre Chèvremont, *Les Mouvements du Sol sur les Côtes Occidentales de la France*, 1882. The ochre, blue and carmine contours indicate the lie of the coast over the course of its inland retreat.

NOTES

1. James Hairby, *A Short Historical Account of Mont Saint-Michel and Mont Tombelène*, Veuve Tribouillard (Avranches), 1841, p 2.

2. 'La Forêt de Scissy', *Annuaire du Département de la Manche 35e Année–1863*, d'Elie Fils (Saint-Lo), 1863, p 78.

3. Arturo du Monstier, *Neustria Pia, Seu de Omnibus et Singulis Abbatiis et Prioribus Totius Normaniae*, J Berthelin (Rouen), 1663, p 371. 'Hæc rupes antiquitus Mons erat, cinctus sylvis et saltibus' (This rock was of old surrounded by forests and meadows).

4. The prize was awarded on 26 May 1842 to Fulgence Girard, who went on to publish *Histoire Géologique, Archéologique et Pittoresque du Mont Saint-Michel au Péril de la Mer*, E Tostain (Avranches), 1843.

5. Alexandre Chèvremont, *Les Mouvements du Sol sur les Côtes Occidentales de la France et Particulièrement dans le Golfe Normanno-Breton* , Ernest Leroux (Paris), 1882, p 341.

6. F[rançois] G[illes] P[ierre] B[arnabé] Manet, *De l'État Ancien et de l'État Actuel de la Baie du Mont-Saint-Michel*, Chez l'Auteur (Saint-Malo), 1829, pp 52–3.

7. Alexandre Chèvremont, op cit, p 371.

8. Émile-Auber Pigeon, 'Note sur une Carte de Fabrication Moderne Prétendue du XIIIe Siècle', *Bulletin de la Section de Géographie Historique et Descriptive: Année 1889*, 1890, pp 180–90.

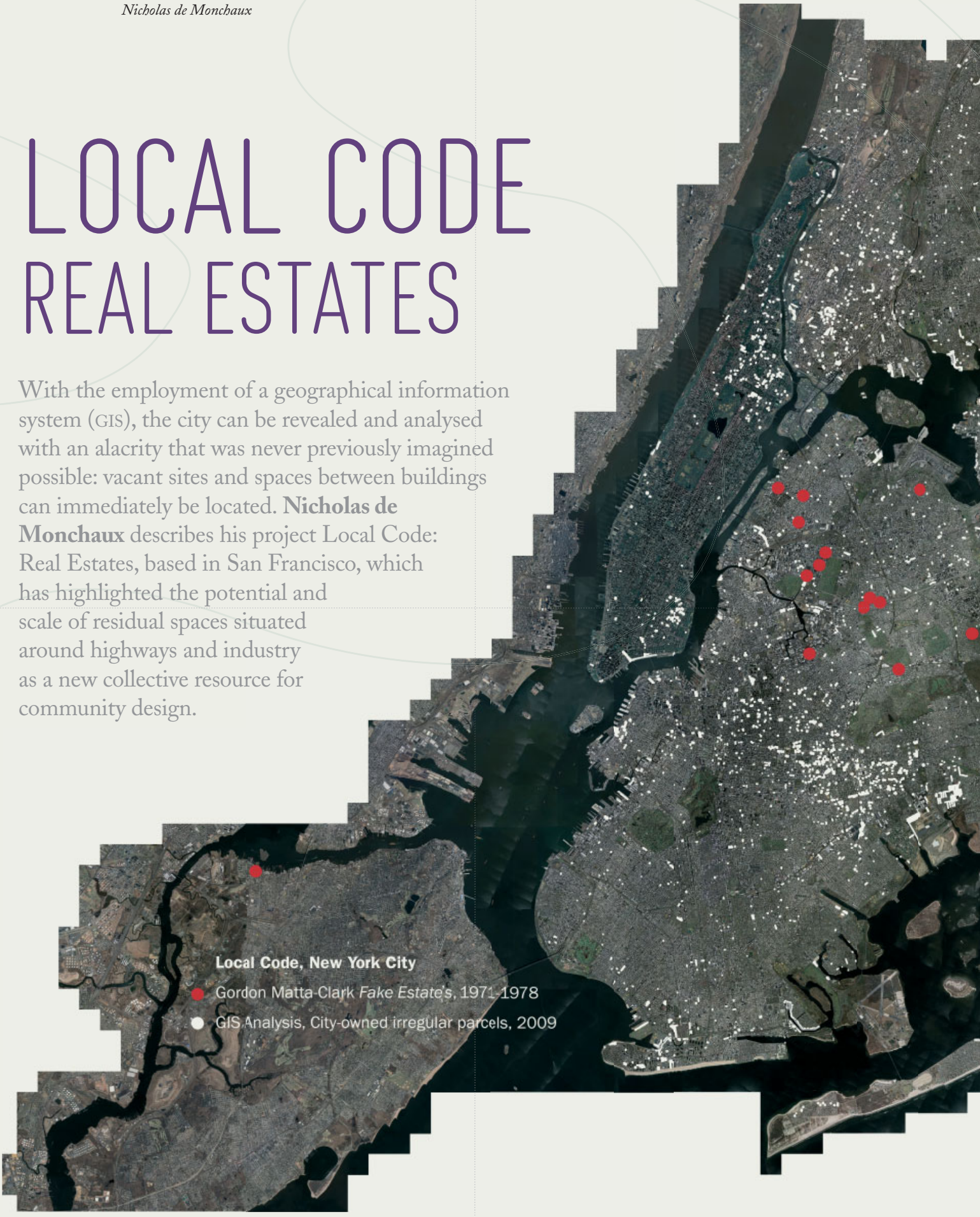
9. On the evolution of the catalogue, see Léopold Delisle, *Catalogue Générale des Manuscrits des Bibliothèque Publiques des Départements. Tome IV: Arras, Avranches, Boulogne* , Imprimerie Nationale (Paris), 1872.

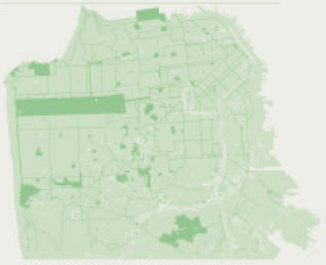
10. By 1891 Charles Noury had declared that while determining how and when the Normanno-Breton coast was vanquished by the sea had long remained a difficult quandary, it was now satisfactorily answered: 'Forêts Sous-Marines et Relations Anciennes de Jersey avec le Cotentin', *Compte Rendu du Congrès Scientifique International des Catholiques. Tenu à Paris du 1er au 6 Avril 1891*, Alphonse Picard (Paris), 1891, p 342.

11. Eugène Robillard de Beaurepaire, *Histoire Générale de l'Abbaye du Mont-St-Michel au Péril de la Mer par Dom Jean Huynes*. Publiée pour la Première Fois avec une Introduction et des Notes, A Le Brument (Rouen), 1872, p 43.

LOCAL CODE
REAL ESTATES

With the employment of a geographical information system (GIS), the city can be revealed and analysed with an alacrity that was never previously imagined possible: vacant sites and spaces between buildings can immediately be located. **Nicholas de Monchaux** describes his project Local Code: Real Estates, based in San Francisco, which has highlighted the potential and scale of residual spaces situated around highways and industry as a new collective resource for community design.

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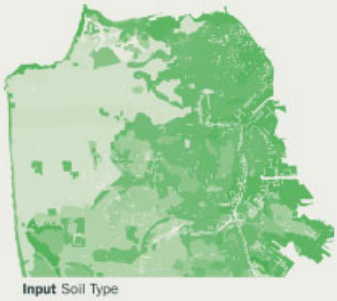
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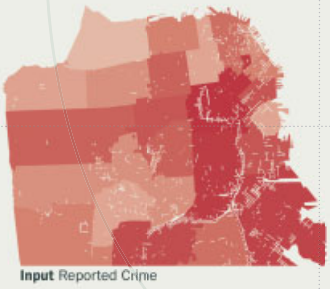
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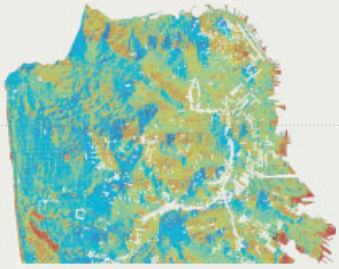
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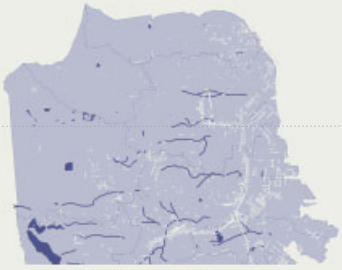
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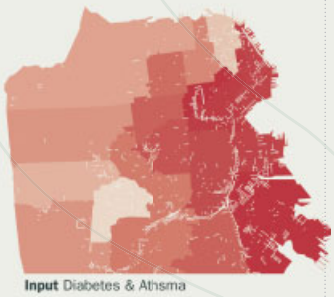
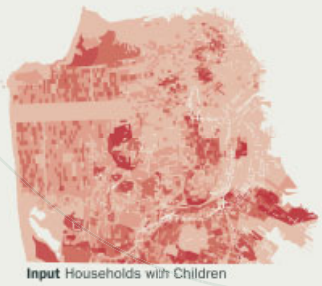
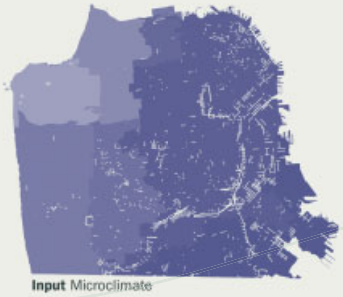

Input Diabetes & Athsma


Input Households with Children


Input Microclimate

Nicholas de Monchaux, Local Code: Real Estates, San Francisco Case Study, 2009
left: Contemporary GIS analysis of New York City showing the location of Gordon Matta-Clark's *Fake Estates*. Matta-Clark spent three years tracking down the 15 sites; a contemporary geospatial analysis of the same property records produces thousands of city-owned irregular lots. These leftover spaces track the history of 20th-century urban development.

above: Multilayered geospatial analysis of 1,625 irregular public lots in San Francisco, termed 'unaccepted streets' by the city's Department of Public Works. Each analysis shown here keys into the parametric design algorithm deployed by the case study.

Nicholas de Monchaux, Local Code: Real Estates, San Francisco Case Study, 2009
below and opposite above: Site survey of irregular public lots in San Francisco – the 'unaccepted streets'. Occurring along highways and throughout so-called 'transitional' neighbourhoods, the sites are an archipelago of neglect and opportunity.

Between 1971 and 1974, it took Gordon Matta-Clark months of methodical sifting through microfiche to locate the 15 'gutterspace' sites – demapped and operationally isolated fragments of New York real estate – that form the work *Reality Properties: Fake Estates*.[1] Using a contemporary geographic information system, or GIS, the same search can now be accomplished in minutes, and locates thousands of marginal, city-owned vacant lots throughout the five boroughs of New York – or any other urban landscape.

When Matta-Clark's *Fake Estates* were first presented together in 1992, the mere fact of their existence, and documentation, was cause for attention. 'Spaces between places' in reality – alleys, gutters, weedy no-man's-lands – they were also spaces between organisational and informational space: virtual fragments as well as real. A *détournement* of property's traditional media, *Fake Estates* is essential in considering how we might respond to the sweeping ubiquity of geospatial technologies. Especially given the current trend towards data-driven architecture, we should demand more of design's encounters with today's cartographic systems.

Formal and Geographic Systems

Crucial to contemporary geography is a revolution in the media of property, and cartography, whose first stirrings predate Matta-Clark's critique of a previous generation of property maps. Facilitated by techniques of electronic map projection invented for America's postwar nuclear defence, and forged in the mid-century optimism of systems-based planning, the first urban geographic information systems (GIS) appeared in the late 1960s and early 1970s.[2] Half a century later, even as the provision of Web-based geospatial data creates fundamental changes in our relationship to place and proximity, a range of forces, including the rift between architecture and planning that is one of the legacies of systems planning's urban failures, continue to militate against the systematic use of geospatial data by architects. Even as some designers employ the power of digital cartography as a creative and political device (for example, Eyal Weizman or Laura Kurgan), our current ability to interrogate places using geospatial data remains substantially absent from the toolbox of architectural design.

Given the foregrounding of parametric computation in today's architectural culture, such an absence seems particularly curious. Perhaps here we should remind ourselves of the debt that today's data-driven practice owes to a quite different child of the 1970s, the 'autonomous' and formal practices which signalled Modernism's retreat from the broad claims of social and systems-based design. Forming part of Matta-Clark's own architectural education at Cornell University from 1962 to 1968, the methodology was ultimately held by him in violent disregard – most famously when he destroyed the windows of Peter Eisenman's Institute for Architecture and Urban Studies (IAUS) with an air rifle.[3]

Parametric Design and Urban Performance

Already, the best of contemporary parametric design moves beyond a simply formal exploration into functional issues of building performance that would not be possible without computational media. Local Code: Real Estates provides an avenue to a wider understanding of data-driven design by extending such a practice to the larger scale of urban performance, and to new models of data-grounded community design as well.

Mined from a database maintained by the San Francisco Department of Public Works, the many sites for the project are 'unaccepted streets', sites in the San Francisco grid which occupy the position of streets but are not maintained by the municipality, or necessarily even passable to traffic. Seen separately and individually, these are litter-filled, residual spaces, condensing around highways and industrial sites. When accumulated and considered together, however, the sites can be more easily seen as a common and collective resource. With a combined surface area of more than half that of San Francisco's Golden Gate Park (and two-thirds the size of New York's Central Park) the sites are an untapped urban resource.

Neglected at the local level, the presence of such sights marks larger patterns of neglect as well. In San Francisco's case, they outline the awkward penumbra of divisive urban highways, as well as the shape of entire neighbourhoods – Hunter's Point, Bayview, the Outer Mission – that are, very precisely, 'off the map'. Abandoned by traditional development, such areas are exactly those in need of ecological and social attention.

Local Code: Real Estates imagines using the same geospatial techniques used to identify the 1,625 sites to construct a broadly optimised network of cultural, agricultural and reparative interventions. Using GIS in conjunction with parametric design tools, it optimises a set of individual landscapes for each site so as to best ameliorate such larger urban performance variables as stormwater retention and heat island effects. (A multi-billion dollar effort at increasing sewer stormwater capacity in San Francisco, which the Local Code: Real Estates proposal would render significantly redundant, is already under way).[4] Together, the sites project an alternative green infrastructure with potentially measurable benefits to safety and public health as well.

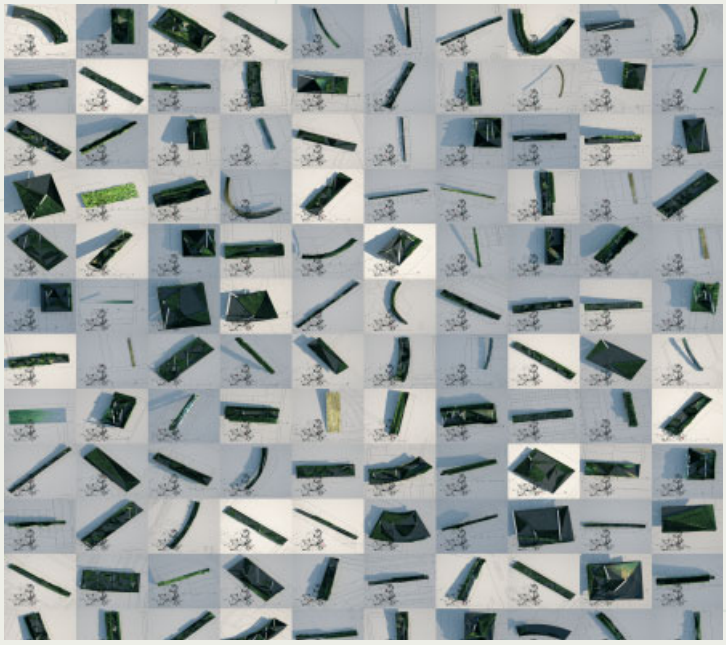
Like Matta-Clark's 15 *Fake Estates*, the 1,625 sites of Local Code: Real Estates are, taken separately, a disjunction or even an irritant in the city's neighbourhood infrastructure. Taken together, however, they represent an archipelago of opportunity, resistant to traditional forms of design, but open to more novel modes of speculation.

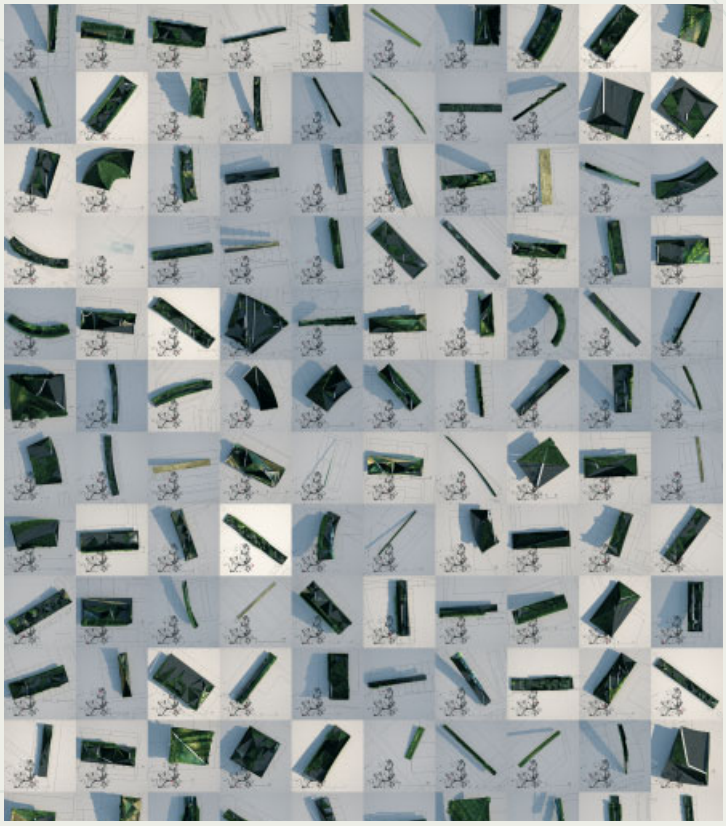
Life and Cities

If Local Code: Real Estates utilises what Matta-Clark termed the city's 'spaces between places', an essential caveat to their instrumentalisation is provided by the artist's own attitudes towards urban planning. Matta-Clark's father, Robert Matta, had worked for two years in the studio of Le Corbusier before rejecting the master's work as suitable

bottom: Four detailed images of Local Code on four 'unaccepted' street sites. Landscape, plantings and public amenities are assembled and deployed according to a local demographic, ecological and spatial analysis.

Nicholas de Monchaux, Local Code: Real Estates, San Francisco Case Study, 2009
A comprehensive analysis of 1,625 vacant, city-owned sites is used to select 525 sites for initial, catalytic action. The designs proposed here form the first step of a new model of urban development and discussion.





Especially relevant to the current proposal is one of the last false distinctions unravelled by post-Darwinian evolutionary theory – the notion of a boundary of influence between organism and environment.

only for a (non-existent) 'creature that lived in perfect harmony with the society and his work'.[5] Matta-Clark traced his own interest in adaptive reuse to the observation that 'the availability of empty and neglected structures [is] a prime textual reminder of the ongoing fallacy of renewal through modernization'.[6]

One of Matta-Clark's last, unfinished works was the physical construction of a community centre on an unused site on Manhattan's Lower East Side, for which he was preparing a proposal at the time of his death in 1978. While we can only speculate on the work, it seems clear that some components of the initial proposal would draw precisely from the geometric and spatial calculations that initiated such parallel works as *Conical Intersect* (1975) and *Office Baroque* (1977). As with Local Code's multiple and mathematical process, such an exercise is best understood as only the first – albeit informative – step in engaging the very real social and political processes of urban transformation. In this vein, Matta-Clark himself described the audience for his own community centre proposal as precisely 'a network of community groups and individuals engaged in open space and rehab projects, sweat equity, community gardens, playlots, cultural events, alternative living structures, etc', adding that the proposal 'has brought these groups together'.[7]

Matta-Clark's use of the word 'network' is notable. Much of contemporary algorithmic design borrows the language of emergence, morphogenesis and phenotype developed to study the non-hierarchical development of natural systems. In the current context, it is useful to recall that the study of the city, and of natural emergence, have had a long history of mutual influence.

One of the earliest critics to connect biological theories of emergence with complex urban systems was also, like Matta-Clark, a student of Manhattan. In the last chapter of *The Death and Life of Great American Cities*, Jane Jacobs in 'The Kind of Problem a City Is' acknowledges her intellectual debt to her officemate at the Rockefeller Foundation, Dr Warren Weaver.[8] A professor of mathematics, Weaver (who was underwriting Jacobs' work) was in reality a polymath, serving as head of Memorial Sloan-Kettering Hospital before arriving at the foundation. Weaver's own efforts supporting the 'science of … organized complexity'[9] played a catalytic role in today's interdisciplinary discussions of emergent form. As one heir to this effort, more recent work in evolutionary theory provides an essential supplement both to Jacobs' preservationist tendencies and to the sometimes overdetermined picture of genotype, phenotype and organism in contemporary architectural conversations. It is a view of nature and complex systems that is disarmingly urbane.

Urban and Niche Construction

Today's discourse surrounding parametric design practices risks not an over-influence of nature, but rather the reverse: assuming that God, or nature, is too much of an architect. The late dean of American evolutionary biologists, Stephen Jay Gould, famously used an architectural metaphor in describing the perils of assuming systematic optimisation in natural form; such a notion would be tantamount, he argued, to assuming that the 'spandrels' (more properly, pendentives) of San Marco were precisely placed to accommodate triangular paintings.[10] Far from an architectural 'blueprint of life', recent science has shown that the 'code' of DNA exists in a web of environmental and informational influences, approximating physical form through a web of constant compromise.

Especially relevant to the current proposal is one of the last false distinctions unravelled by post-Darwinian evolutionary theory – the notion of a boundary of influence between organism and environment. (Typically prescient, Darwin himself questioned such a distinction.) A new field of evolutionary theory precisely studies 'niche construction',[11] and treats the evolved and continuous effects of an organism on its surroundings as an equally important aspect of its inheritance, separate from its originating DNA. Instead of a classical notion of discrete specimens, here organisms are – like the proposed new public spaces of Local Code: Real Estates – a network for recursive, environmental transformation. In the case of the city, fewer subjects and more, we might hope, citizens. AD

Notes

1. A collection of photographs, maps and property deeds for the sites, collected by Matta-Clark, were assembled by his widow, Jane Crawford, into exhibitable artworks after 1980. For an extended discussion of Matta-Clark's process, see Gordon Matta-Clark, Jeffrey Kastner, Sina Najafi, Frances Richard and Jeffrey A Kroessler, *Odd Lots: Revisiting Gordon Matta-Clark's 'Fake Estates'*, Cabinet Books and Queens Museum of Art and White Columns (New York), 2005.
2. The term 'geographic information system' was coined by British geographer Roger Tomlinson in 1966 to describe an attempt to electronically map both agricultural resources and geographic boundaries for the Canadian government. See JT Coppock and DW Rhind, 'The history of GIS', in David J Maguire, Michael F Goodchild and David W Rhind (eds), *Geographical Information Systems*, Longman Scientific & Technical (London), 1991, pp 21–41. The techniques of digital cartographic projection used by Tomlinson, as well as Howard Fisher (another founding figure of GIS based at Harvard's Laboratory of Computer Graphics), had their origins in display techniques developed for the Semi-Autonomous Ground Environment (SAGE), a nuclear defence shield developed by the air force from 1947 to 1958. See Kent C Redmond and Thomas M Smith, *From Whirlwind to MITRE: The R&D Story of the SAGE Air Defense Computer*, MIT Press, Cambridge, MA), 2000.
3. Andrew MacNair's recounting of the incident appears in Mary Jane Jacob (ed), *Gordon Matta-Clark: A Retrospective,* Museum of Contemporary Art (Chicago, IL), 1985, p 96.
4. The San Francisco Sewer Master Plan, currently under environmental review.
5. Nancy Miller, 'Interview with Matta', in *Matta: The First Decade*, exhibition catalogue, Rose Art Museum, Bradeis University (Waltham, MA), 1982, p 19.
6. Gordon Matta-Clark, undated and unaddressed proposal, *c* 1974, Estate of Gordon Matta-Clark. Quoted in Pamela M Lee and Gordon Matta-Clark, *Object to Be Destroyed: The Work of Gordon Matta-Clark*, MIT Press (Cambridge, MA), 2000, p 94.
7. Gordon Matta-Clark, *Draft of A Resource Center and Environmental Youth Program for Louisada: A Proposal*, 18 August 1976, Estate of Gordon Matta-Clark. Quoted in Pamela M Lee and Gordon Matta-Clark, op cit, p 166.
8. See Jane Jacobs, *The Death and Life of Great American Cities*, Random House (New York), 1961, p 558–87.
9. See Warren Weaver, 'A Quarter Century in the Natural Sciences: Science and Complexity', in *The Rockefeller Foundation Annual Report for 1958*, Rockefeller Foundation (New York), 1958.
10. SJ Gould and RC Lewontin, 'The Spandrels of San Marco and the Panglossian Paradigm: a critique of the Adaptationist Programme', in *Proceedings of the Royal Society of London. Series B, Containing Papers of a Biological Character 205*, No 1161, Royal Society (London),1979, pp 581–98.
11. See, most notably, F John Odling-Smee, Kevin N Laland and Marcus W Feldman, *Niche Construction: The Neglected Process in Evolution*, Princeton University Press (Princeton, NJ), 2003.

WHAT HAS HAPPENED TO TERRITORY?

Andries van Eertvelt, *The Return to Amsterdam of the Fleet of the Dutch East India Company in 1599*, c 17th century
Long-range trade routes are an integral part of territorial construction.

In the concluding article of the main section of this issue, **Antoine Picon** evokes the earlier meaning of territory for administrators, architects and engineers, as lands that were integrated into nations or colonies by the early modern European countries. Picon traces how 18th- and 19th-century perceptions of territory with an emphasis on administrative separation fed into an attitude of both distance and sensitivity to landscape, as exemplified by the Romantic movement in painting and literature; a heritage that continued into the 20th century in architecture with its emphasis on rationalisation.

The contributions gathered in this issue of *Architectural Design* epitomise a series of shifts in our understanding of what territory is about, of its relation to human institutions as well as to nature, landscape and environments. To understand the true scope of these evolutions, their consequences for architectural thought and practice in particular, we should begin with a rapid evocation of what territory used to be not so long ago in the eyes of administrators, architects and engineers.

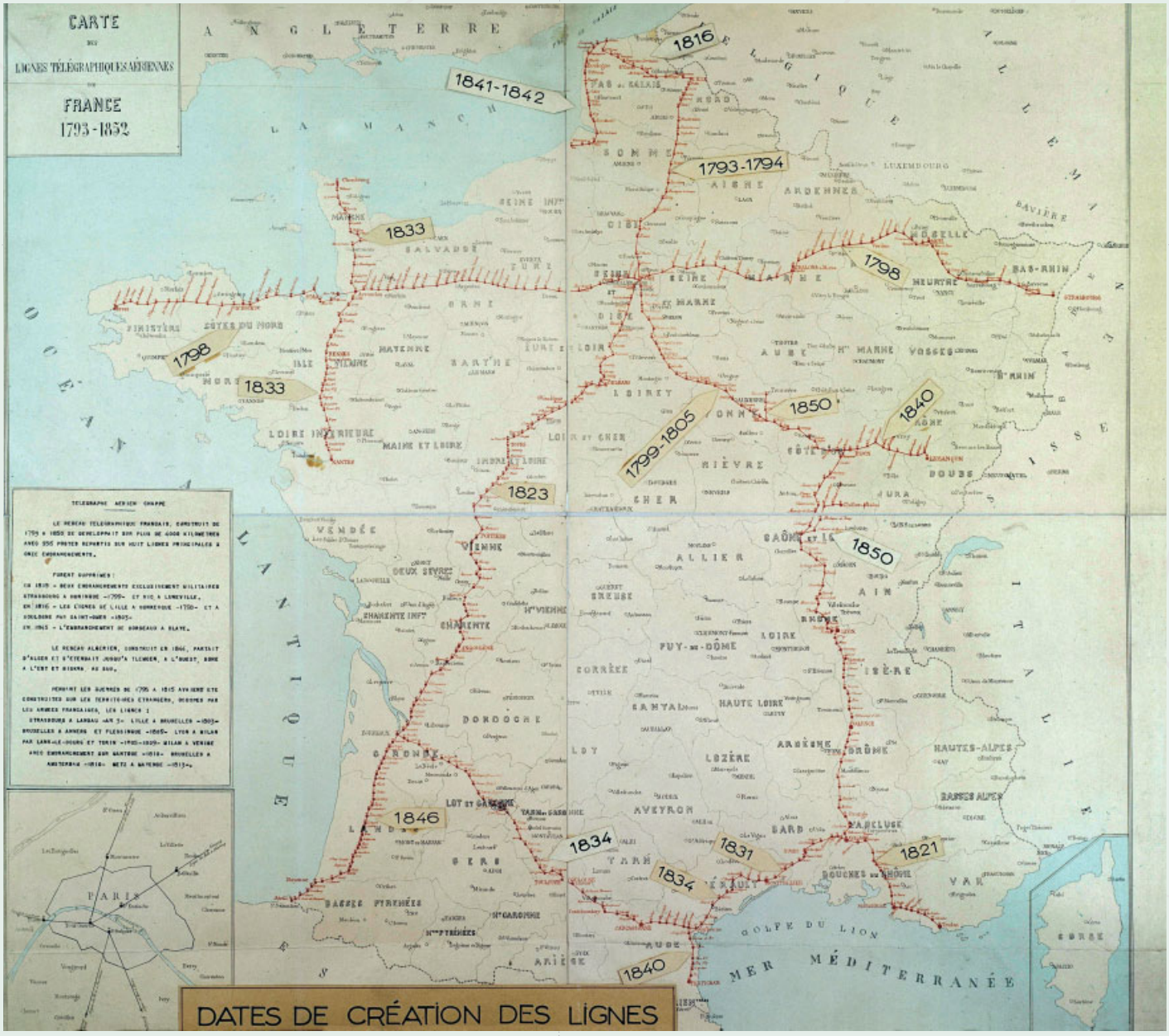
Until recently, territory designated space as a project and as a resource that mainly concerned corporations and institutions. In most early modern European countries, the spaces of everyday life, of artisanal production and local commercial exchanges, were gradually integrated into territories through private commercial and state endeavours ranging from the development of long-range trade routes to the construction of transportation infrastructures. Trade often paved the way for territorial enterprises. The practices of Renaissance Italian and Hanseatic cities, such as the systematic use of bills of exchange, were instrumental in promoting perspectives of economic integration. In the 17th century, a corporation like the Dutch East India Company pushed the logic further by establishing a system of trading posts at a truly global scale; state enterprises were at first more modest in scale. Throughout Europe, the construction of ports, canals and roads developed at a less rapid pace. Early state-funded transportation infrastructure policies indicated nevertheless a direction of development that was to take its full scope from the 18th century onwards. French historian Fernand Braudel has devoted part of his monumental panorama of the early modern world, *Civilization and Capitalism, 15th–18th Century*, to the study of some of the processes leading to the construction of territories in countries like the Netherlands, Spain, England or France.[1]

As a project, territory was synonymous with an ideal of the easy circulation of men and goods, an ideal that the Enlightenment would also translate in intellectual and social terms by relating this easy physical circulation with the abandonment of former prejudices and the promotion of social mobility.[2] Revealingly, the 18th-century figure of the civil engineer in charge of territorial planning and transportation infrastructure construction epitomised the potential for upward social mobility. As a resource, territory opened up the possibility to exploit, in a comprehensive way, mines and fields as well as people and their skills. In many European countries, in England or France for instance, the construction of territory coincided with the emergence of the modern nation-state and the development of a unified market for goods and labour, a process that would come to fruition during the second half of the 19th century.

Another understanding of this is to characterise territory as space mastered and policed by institutions and corporations. Through this process, which was analogous to that which led to the 'death of nature' in the 17th century,[3] territorialised space became synonymous with a set of passive resources. Just like nature, space gradually lost part of its former vital dimension, with its somewhat feminine connotation of primeval fecundity, in order to become fully measurable, quantifiable

Map of French optical telegraph lines, early 19th century
Territory is to a large extent about communication and, from the 19th century onwards, telecommunication.

Territory was from the start inseparable from practices such as survey and cartography that were meant to provide a panoptic-like overview of what was available, in what quantity and where.



Caspar David Friedrich, *Wanderer above a Sea of Fog*, *c* 1817
The Romantic disinterested gaze on nature.

and exploitable. Territory was from the start inseparable from practices such as survey and cartography that were meant to provide a panoptic-like overview of what was available, in what quantity and where.[4] This connection explains the systematic use of cartography in colonial contexts, for example that of British India, to map the potential of conquered countries.[5]

The perception of territory was made possible by the distance that separated the administrator or the professional in charge of its management and transformation and the various geographical places that it comprised. Landscape appeared also as the product of distance, but whereas territorial awareness presupposed a certain degree of interest or even greed, landscape sensitivity, at least according to Kantian aesthetics, was inseparable from disinterestedness.[6] Such disinterestedness was, for instance, at the core of the Romantic attitude towards natural scenery that a painting like Caspar David Friedrich's *Wanderer above a Sea of Fog* (*c* 1817) conveys particularly well. Contrary to what is often assumed by historiography, territory and landscape, in their traditional meanings, represented distinct and complementary perspectives, both based on an estrangement from immediate experience. The mental attitudes that lay at the core of their perception could not be more different one from another. Often using the same remote point of view, the territorial entrepreneur charted resources where the landscape amateur experienced disinterested emotions.

The emergence of an environmental approach at the end of the 19th century

could have led to a radical critique of the type of distance that was thus presupposed. Jacob von Uexküll's notion of '*Umwelt*' was precisely based on the refusal to consider such a distance between living beings and their environment. Uexküll's *Umwelt* was all about how living beings perceive their environment, a perception involving intimate and permanent exchange between them and their surroundings. But this type of alternative perspective remained for a long time confined to small circles of scientists and ideologists pursuing an environmental agenda.

Mainstream architecture and engineering were meanwhile basing their production on the acceptation of the distance presupposed by territorial considerations. Following Manfredo Tafuri's analysis, it is indeed possible to argue that throughout the 19th and 20th centuries, the desire to be an integral component of the construction of territory represented a major concern for architects. As Tafuri has argued, such a desire accounts for the trend towards rationalisation that characterised Modern architecture and its immediate forerunners.[7] As for engineering, its territorial dimension went almost without saying. Even the definite environmental trend present in 1960s and 1970s avant-garde architecture did not challenge as a whole this conception of territory as based on a distance that made efficient planning and design possible.

In the past decade or so, this attitude has been challenged with a vigour that indicates that something fundamental is at stake in the affair. First of all, it is no longer possible to consider space as the field of deployment of a predetermined project and as a passive resource. Space is no longer understandable in neo-Cartesian terms as a *res extensa* synonymous with neutral geometrical extent. It appears to the contrary as full of auto-organising processes, hence the success of Deleuzian-inspired notions such as emergence. With the spread of the computer, emergence has become a tangible reality for designers who can observe the behaviour of complex systems and get inspired by it thanks to digital simulation.[8]

The distance implied by former territorial considerations has also become impossible. Environmental stakes are partly responsible for it. We live in a techno-nature in which everything interacts with everything. Traditional frontiers such as the distinction between human and non-human or the opposition between natural and artificial entities are blurred. As German philosopher Peter Sloterdijk puts it, there is no exterior from which the earth and its various parts can be contemplated.[9] There is also no clear-cut boundary between man and his environment. Cybernetician and anthropologist Gregory Bateson had already envisaged this non-separation in his 1973 *Steps to an Ecology of Mind*.[10] Contemporary discourses on an allegedly 'posthuman' condition appear in many respects as a follow-up from this intellectual posture.[11]

It is worth noting at that stage that the similar distance that used to be at the very principle of landscape sensitivity is also jeopardised. By the same token, it is becoming more and more difficult to distinguish between territory and landscape. Again, if there is no exterior from which things can be contemplated, there is no reason to separate spatial perception and understanding into various genres like the territorial and the landscaped. The evolution of cartography explored in this issue of *AD* by Nicholas de Monchaux reflects this blurring of territory and landscape. Contemporary digital maps are both territorial markers and 'datascapes' inseparable from landscape effects. For designers, the collapse of the distinction between territory and landscape is perhaps among the most intriguing aspects of the present situation. It forces them to associate intimately the rational and the sensitive, the planning and the aesthetic dimensions. Various instances of the collapse of the distinction between territory and landscape are given in this issue, and one of the most evident is the tree canopy theme explored by Mitchell Schwarzer; the tree canopy and the projects it inspires belong at the same time to territory and landscape.

Such a situation may account for the desire for smooth transitions or even continuity that permeates entire domains of the architectural world, even if the production shown in the previous articles is not the most representative of this tendency. It accounts in particular for the various contemporary projects that blur the distinction between architecture and its surroundings, architecture and territory or architecture and landscape. Renzo Piano's Paul Klee Museum in Berne (2005), Odile Decq's Liaunig Collection Museum in Neuhaus, Austria (2008) or Vicente Guallart's Denia Castle Cultural Park in Spain (2003) are good examples of this trend.

Renzo Piano Building Workshop, Paul Klee Museum, Berne, Switzerland, 2005
A realisation emblematic of the tendency to blur the distinction between the architectural object and its surroundings.

The desire for smooth transitions also accounts for the current importance of the notion of 'affect'. Defined by Ali Rahim as 'a crucial link in the capacity of the virtual to instigate new outcomes and behaviors in users',[12] architectural affect is about the new continuity that is supposed to exist between object and subject. Transposing Bateson's theories, another way to put this would be to say that affects are constitutive of the ecology common to architecture and its users. At another level, they express the shift from an aesthetics of contemplation to an aesthetics of active participation that lies at the core of the performalist turn within contemporary architecture.[13] Although the notion of affect is not immediately mobilised in this issue of *AD*, the performalist turn is indeed very present.

As David Gissen notes in his introduction to the pieces gathered here, what is ultimately at stake is the overcoming of the traditional antinomy within the architectural discipline between autonomy and environment. By the same token, even if some of the projects that have been included in the issue are still very present as objects displaying a high degree of formal isolation, they are nevertheless not to be envisaged independently from an environment with which they carry on a rich dialogue.

What happened to territory? It used to be synonymous with a distant, planning, almost scheming gaze. It now appears with an immediacy bordering immanence. In continuity with it, architecture has no longer to defend its status vis-à-vis planning by asserting the shaping power of the built object. Seen as an integral component of territory, architecture is expected to perform with an efficiency and effectiveness that used to be reserved for living beings or machines. From environmental behaviour to the production of affects bridging the former split between object and subject, contemporary architectural performalism is intimately linked to this new territorial dimension.

Such an evolution does not only present advantages; it is also accompanied by new ambiguities. The main ones have probably to do with the political dimension. Territory used to be associated with administrative action. It was in particular often related to the construction of the nation-state. What are the political forces at work in the new fields explored by designers today?

A temptation could be to see no political force at work at all, but processes of emergence that are not related to actors in the traditional sense. The risk would then be to return to a magical world animated by forces that escape human characterisation, a magical but also mythical world in which tales replace arguments. The danger of magic is already there, with presentations of globalisation that put it in the same light as an almost natural phenomenon. Although the present world is all about the blurring of the boundary between the natural and the artificial, despite the success met by Bruno Latour's analysis on the impossibility to totally separate the human and the non-human,[14] the temptation remains to reinvent something like pure nature. One of the major challenges awaiting new territorial design is to avoid such a pitfall by fully accepting its hybrid condition. AD

Notes

1. Fernand Braudel, *Civilization and Capitalism: 15th–18th Century* [Paris, 1979], English trans Harper & Row (New York), 1982.
2. See Antoine Picon, *French Architects and Engineers in the Age of Enlightenment* [Marseilles, 1988], English trans Cambridge University Press (Cambridge), 1992.
3. Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution*, Harper & Row (San Francisco, CA), 1980.
4. See in the case of France, Joseph Konvitz, *Cartography in France 1660–1848: Science, Engineering and Statecraft*, University of Chicago Press (Chicago, IL and London), 1987.
5. See Matthew H Edney, *Mapping an Empire: The Geographical Construction of British India 1765–1843*, University of Chicago Press (Chicago, IL), 1997.
6. See Jacques Roger, *Court Traité du Paysage*, Gallimard (Paris), 1987.
7. Manfredo Tafuri, *Architecture and Utopia: Design and Capitalist Development* [Bari, 1973], English edn MIT Press (Cambridge, MA), 1976.
8. See Michael Hensel, Achim Menges and Michael Weinstock (eds) *AD Emergence: Morphogenetic Design Strategies*, May/June 2004.
9. Peter Sloterdijk, *Blasen: Sphären 1*, Suhrkamp (Frankfurt), 1998, 2003.
10. Gregory Bateson, *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology*, Chandler (San Francisco, CA), 1972. On Bateson's significance, see Katherine N Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*, University of Chicago Press (Chicago, IL), 1999, and Céline Lafontaine, *L'Empire Cybernétique. Des Machines à Penser à la Pensée Machine*, Le Seuil (Paris), 2004.
11. See Katherine N Hayles and Céline Lafontaine, op cit.
12. Ali Rahim, *Catalytic Formations: Architecture and Digital Design*, Taylor & Francis (London and New York), 2006, p 138.
13. On the performalist turn within contemporary architecture, see Branko Kolarevic and Ali M Malkawi (eds), *Performative Architecture: Beyond Instrumentality*, Spon Press (New York and London), 2005, and Eran Neuman and Yasha Grobman (eds), *Performalism. Form and Performance in Digital Architecture*, Tel Aviv Museum of Art (Tel Aviv), 2008.
14. Bruno Latour, *We Have Never Been Modern* [Paris, 1991], English trans Harvard University Press (Cambridge, MA), 1993.

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Matthew Gandy is Professor of Geography at UCL and Director of the UCL Urban Laboratory. His publications include *Concrete and Clay: Reworking Nature in New York City* (MIT Press, 2002) and he is co-editor of *The Return of the White Plague* (Verso, 2003) and *Hydropolis* (Campus, 2006). He is currently writing a book on the cultural histories of urban infrastructure.

Jordan Geiger is an architect and educator. In 2002 he founded Ga-Ga, a design studio devoted to interdisciplinary and collaborative work, primarily in time-based architectures that address the intersections of architecture with both ubiquitous computing and ecological issues. Most of his projects address a dynamic between these three elements, wherein social factors and understanding of contemporary patterns of use figure prominently in research and design response. He is Assistant Professor at the Center for Architecture and Situated Technologies (CAST), School of Architecture, University at Buffalo.

Jason Kelly Johnson and Nataly Gattegno are the founders of Future Cities Lab, an interdisciplinary design and research collaborative bridging architecture and landscape urbanism with material sciences, robotics and engineering. The duo recently served as the 2009 New York Prize Fellows at the Van Alen Institute in New York City and the 2008–9 Oberdick and Muschenheim Architecture Research Fellows at the University of Michigan. Both graduated from Princeton University, hold full-time faculty positions at the California College of the Arts, and have taught at the University of Virginia and the University of Pennsylvania, leading studios and research seminars in design, ecology, landscape urbanism and advanced technologies. Their work was awarded second prize in the 2005 Seoul Performing Arts International Competition and has received an Unbuilt Architecture Award from the Boston AIA. In 2008 they were finalists in the History Channel's 'City of the Future' competition in Washington DC. Their work has been widely published and exhibited, including a recent solo show of their design and interactive work at the Extension Gallery for Architecture in Chicago.

Sean Lally founded the WEATHERS office with the aim of embracing the potential overlap between the disciplines of architecture, landscape architecture and urban design. Recent projects include proposals for the Academy of Arts in Tallinn, Estonia, an extension to the Stockholm City Library, and a proposal for the urban redevelopment of Reykjavik. He is an assistant professor at the School of Architecture at the University of Illinois, Chicago. He is a co-editor and contributor to *SOFTSPACE: From a Representation of Form to a Simulation of Space* (Routledge, 2007) and guest-editor of *AD Energies: New Material Boundaries* (May/June 2009).

Nicholas de Monchaux is an architect and urbanist. His design work and criticism have been published in *Log*, the *New York Times* and *The New York Times Magazine*. He is Assistant Professor of Architecture and Urban Design at UC Berkeley, and the author of the forthcoming *Spacesuit: Fashioning Apollo* (MIT Press, 2011).

Antoine Picon is Professor of the History of Architecture and Technology and Co-Director of Doctoral Programs at Harvard Graduate School of Design, and Researcher at the École nationale des Ponts et Chaussées, Paris. He has published numerous books and articles mostly focusing on the complementary histories of architecture and technology. They include *French Architects and Engineers in the Age of Enlightenment* (Cambridge University Press, 1992), *Claude Perrault 1613–1688 ou la curiosité d'un classique* (Délégation à l'action artistique de la ville de Paris, 1988), *L'Invention de L'ingénieur moderne: L'Ecole des Ponts et Chaussées 1747–1851* (Presses de l'École nationale des ponts et chaussées, 1992), *La ville territoire des cyborgs* (Editions de l'Imprimeur, 1998) and *Les Saint-Simoniens: Raison, Imaginaire, et Utopie* (Belin, 2002). He is currently completing a new book on digital architecture that will be published this year by Birkhäuser.

Mitchell Schwarzer is Professor of Visual Studies at California College of the Arts where he teaches courses in the history of art, architecture and urbanism. Publications include the books *Architecture of the San Francisco Bay Area* (William Stout, 2006) and *Zoomscape: Architecture in Motion and Media* (Princeton Architectural Press, 2004). He is currently working on a book about Jewish space and landscape.

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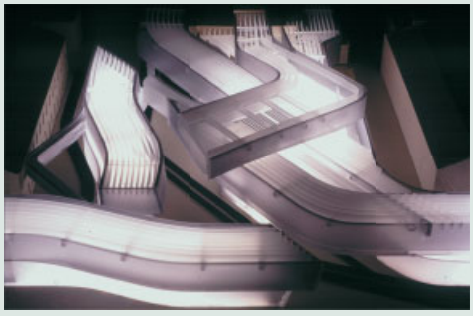
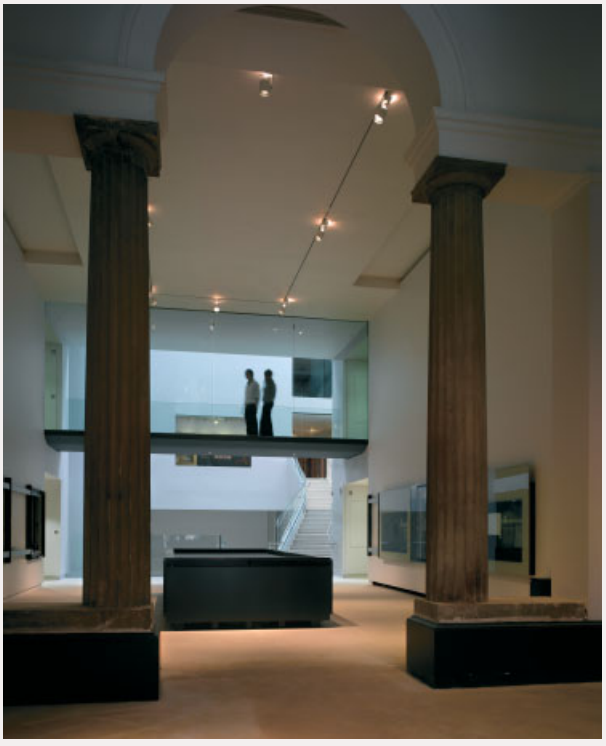


ASHMOLEAN MUSEUM, OXFORD

In November 2009, the Ashmolean Museum opened a new extension that doubled its gallery space on its existing city centre site. **Howard Watson** looks at how the redevelopment of the museum has been to its benefit curatorially, optimising the display space available for its extensive collections, but also enabling new connections to be made between artefacts in a way that fully tells the stories of civilisations across the globe.

For just a brief while the Ashmolean Museum of Art and Archaeology in Oxford is simultaneously the world's oldest and newest public museum. It opened in Oxford in 1683, but is now graced with 39 additional galleries in an extension designed by Rick Mather Architects at a cost of £61 million, aided by £15 million from the Heritage Lottery Fund. The collection, which started as a hoard of natural history specimens gathered by father and son gardeners both called John Tradescant, developed into a unique cross-cultural repository telling the story of civilisation. It finally has a home which allows that story to be explored more fully.

The museum was born out of a grand educational and popular purpose when the antiquarian Elias Ashmole donated the Tradescant collection to Oxford University as a teaching and research facility that would also be accessible to the public. It eventually found a permanent home in Charles Cockerell's 1845 creation: a stately, broad, Neoclassical, three-storey building which was extended by a hotchpotch of additions to compensate for the original building's lack of depth. The later buildings have been cleared away for Mather's six-storey extension, which is closely bordered by existing buildings so its exterior is barely visible. Its challenge, and its success, lies in its interior architecture, which allows for 100 per cent more display space on the same footprint, as well as providing four temporary exhibition galleries and an education centre. Christopher Brown, the Director of the Ashmolean, believes that it 'will be recognised as one of the finest buildings of the 21st century'. Subjective hyperbole to one side, it is a very successful exposition of the ubiquitous contemporary museum model that draws upon the virtues of clarity, light and accessibility.



Rick Mather Architects, Ashmolean Museum of Art and Archaeology, Oxford, 2009
View from the tribune of the old Cockerell building into the new extension, where walkways adjoining the single-height spaces traverse the double-height rooms.

Rick Mather Architects, a London-based practice, has a great deal of experience in the arts sector, bringing a trademark mix of white linearity and glass to augment existing buildings in projects such as the award-winning Dulwich Picture Gallery extension and the Wallace Collection in London. At the Ashmolean, the Cockerell building has been effectively reawakened. The main museum entrance, once through an inconsequential door down the side of the site, has been returned to centre of the august, pillared portico. There is a direct, level line of vision, through the focus of a decorative tribune, to the atrium of the new extension, which draws on the original building's double heights. The atrium, which is full of natural light, provides the path of orientation, pivoting the museum-goer from the main entrance towards the breadth of the new display space or upwards via a magnificent staircase. Here the connection with the Cockerell building is emphasised through the use of Portland stone – from the same source as the original – on the floor and staircase. The slightly curving staircase steps back as it rises, so the volume of the atrium broadens as it ascends. The understair space and thick walls are used for services, allowing fuller floor-to-ceiling heights throughout the extension. A second, equally grand staircase aids orientation at the west side of the building and hides the loading bay.

Brown says that the particular task at the Ashmolean was to 'get the collections to speak to each other, to establish narratives', which is a difficult challenge when artefacts range so broadly from the stuffed last-known dodo to ancient Chinese artworks to Guy Fawkes's lamp. Under the heading 'Crossing Borders, Crossing Time', the works from all around the world are reoriented in chronological proximity; the redesigned museum is now an exploration of what connects civilisations rather than the aesthetics that divide them.

Internal windows permit a continual connection to other parts of the museum and augment the play between volumes of different heights. Double-sided glass displays set between rooms also emphasise the theme of cultural connectivity.

Gone is the blinkered, closed-in experience of the old Ashmolean labyrinth, where one peered through the murk at objects while feeling that one had been denied the privileged code of broader context. The mix of double-height and single-height spaces, as well as the staircases and the series of bridges that traverse the double-height volumes, provides a great array of vistas into other worlds and back towards the original building: the interior architecture offers a constant connection between cultures. As Rick Mather explains: 'One of the major ideas is "no dead ends".' Sometimes architecture and display are married perfectly in a *coup de théâtre* that emphasises the remit of connectivity: double-sided glass displays sit in holes that have been punched through the interior walls between galleries. Consequently, a room focusing on Islamic artefacts can feature a window through to Chinese works from the same century. (Curiously, these holes are reminiscent of the actions of Ashmole himself who, while in dispute with Tradescant the Younger's widow, bought the house next door to the collection and is said to have knocked a hole through the wall so that he could see what was going on.)

Exhibition designers/architects Metaphor have taken a key role in expounding the possibilities of both the collection and the new building through the new display strategy. They have designed 400 showcases that draw on interconnectivity, using dark-grey case frames, coloured backgrounds and focused lighting to establish a warm contrast to Mather's white surrounds.

In the UK the 'light and white' pro-accessibility, anti-elite model of contemporary museum architecture has been fuelled by huge amounts of public money since the creation of the National Lottery in 1994. However, years of recession, the financial burden of the 2012 Olympics and a political shift to the right indicate that this era of grand public building, and perhaps this style of white museum interior architecture, is more or less exhausted, at least for the time being. Interestingly, in conversation Stephen Greenberg, the architect who founded Metaphor, talks of wishing to return to the greater sense of personal discovery one used to find in older-style museums – 'before all this emphasis on the virtue of light' – where the small scale, the warren of rooms and the lesser luminance added to the theatricality of the experience. Furthermore, directed rather than washed light is likely to become more of a priority with the onset of fuel shortages as the century progresses. Mather's Ashmolean may be the apogee of the contemporary approach, but the future may be much darker. AD+

Howard Watson is an author, journalist and editor based in London. He is co-author, with Eleanor Curtis, of the new 2nd edition of *Fashion Retail* (Wiley-Academy, 2007), £34.99. See www.wiley.com. Previous books include *The Design Mix: Bars, Cocktails and Style* (2006) and *Hotel Revolution: 21st-Century Hotel Design* (2005), both also published by Wiley-Academy.

The staircase of the atrium. The curved staircase steps back as it rises from the lower ground floor, allowing more natural light into the galleries.

ANTWERP CENTRAL AND LIÈGE-GUILLEMINS, BELGIUM

David Littlefield describes how Belgian railway company NMBS/SNCB is realising a new holistic vision for high-speed rail in the country with railway stations that are being envisaged as destinations in themselves that connect their urban contexts. This is epitomised by Jacques Voncke's recently completed renovation and expansion of the *fin-de-siècle* Antwerp Central and Santiago Calatrava's dramatic white canopy for the new station at Liège-Guillemins.

David Littlefield

Continental Europe already has a reputation for slick, reliable and fast rail services, but Belgium has recently upped the ante with the opening of border-to-border (north–south and east–west) high-speed rail links served by entirely new or thoroughly modernised stations. The €5 billion project includes a €1.2 billion spend on trebling the size of Antwerp's century-old classical (floridly palatial) station, and constructing an entirely new engineering marvel at Liège, designed by Santiago Calatrava. With Brussels Midi already expanded into something the size of a large airport, the three stations function as key nodes within a high-speed rail network that reaches into France, Germany and the Netherlands. And high speed is exactly that – 300 kilometres (186 miles) per hour.

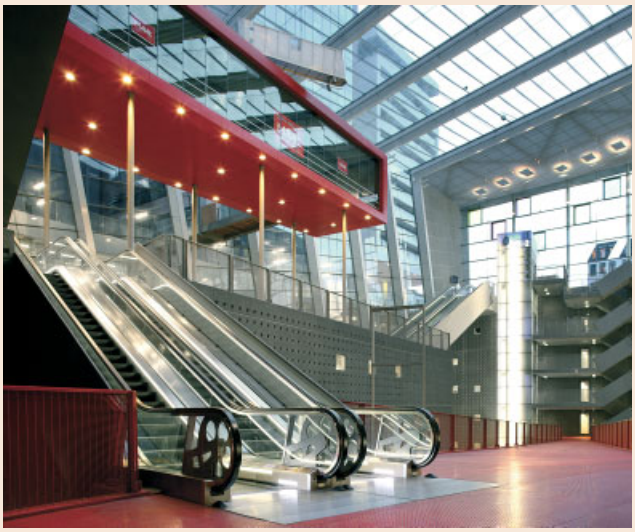
'We're pretty proud of this,' said Jannie Kaek, Chief Executive of Belgian railway company NMBS/SNCB, who has made sure that the new and reinvented stations become an integral part of the urban fabric. 'Our philosophy is for the stations to become places where you can have a social life, where people can come together … places where the customer, the traveller, feels good. Each station should act as the heart and the blood of the city. Very often railway stations are like walls, cutting the city in two. We did not want to create a front yard and a backyard; we wanted to create a connection.'

Antwerp Central and Liège-Guillemins, both of which became fully functional in September 2009, are the jewels in the Belgian railway's crown. But they are entirely different jewels. Calatrava's extravagant arch at Liège provides the postindustrial city with an icon that might well redefine both its image and appeal. Set against a hillside, this vast white canopy is a direct descendant of heroic 19th-century railway sheds; its scale and engineering élan is simultaneously breathtaking and alien. The intervention at Antwerp, however, represents something quite different. A monument to Belgian wealth and imperial confidence, commissioned by King Leopold II, the station has been called 'the fourth most beautiful in the world' by *Newsweek* magazine, but it was almost useless as a high-speed transport node. Located at the end of a spur line, trains pulled into Antwerp and then had to reverse out and loop around the city to continue northwards; also, its historic nature made extending the station difficult. So engineers, led by Belgian Jacques Voncke, dug beneath the building, excavating to a depth of 20 metres (65.6 feet) and placing two levels of tracks deep underground, allowing the station to function as a stop on a north–south line rather than as a terminus. Outwardly, therefore, this station remains little changed; its architectural glories, at street level anyway, are still those of 1905.

The remodelled Antwerp and the entirely replaced Liège stations cannot, and should not, be compared architecturally. The performance standards are much the same, and both make significant efforts to open up lateral routes through their estates to encourage movement across the city rather than, as Jannie Kaek says, operate as almost insurmountable barriers. Retail units are plentiful in both, creating a mixed-use function that makes travel just part of their

Jacques Voncke, Antwerp Central, Antwerp, Belgium, 2009
opposite: View showing the raised platforms and central void giving access to the new subground platforms which carry TGV trains. The station canopy was completed in 1898 by engineer Clement Van Bogaert.

Santiago Calatrava, Liège-Guillemins, Liège, Belgium, 2009
above: The high-speed station was conceived as a 'building without a facade'; it is essentially a giant arch under which trains pass.



role; and each embodies a sense of occasion, adding a thrill to the experience of arrival or departure. Yet Calatrava's programme is one of soaring upwards, contriving to sculpture light (and the sense of the lightweight) out of steel and concrete; Voncke's, on the other hand, is a more tectonic language, one of creating muscular below-ground structures which force the earth apart and admit light to the station's lowest levels.

Antwerp station has become stratified. The lower, newer levels are composed of concrete, red brick and steel, while the large central slot which runs the length of the station draws travellers upwards towards daylight and the finer, arching structures of architect Louis Delacenserie. What travellers get is a perspective view of the grand hall that would once have been impossible – from beneath. It is a view that recasts the *belle époque* building; it becomes emblematic of refinement, grace and airiness when approached from Voncke's subterranea of giant orders. This is not a criticism of Voncke. He has played his role well. The southern end of the station, however, is very different. Here, an entirely new entrance and concourse (asymmetrical, of steel and glass) has been added to serve an emerging commercial district that is slowly replacing an apparently insalubrious zone that was once the station's 'backyard'. Antwerp station is a structure with two distinct personalities, with little overlap.

Calatrava's escapade at Liège, however, won in competition in 1997, embodies no such ambiguity. He describes it as 'a building with no facade', which is true insofar as the station has no external wall to speak of; rather, it is more of an enormous canopy, lifted up at the sides, under which trains and retail outlets shelter. Calatrava took the unusual decision to create an arch which runs lengthways down the tracks, rather than laterally. The sheer span of this structure, around 200 metres (656 feet), forces the arch upwards to increase its strength and integrity. Meanwhile, the station abuts a hillside, in which is located an 800-space car park, creating a further set of forces to be factored into the engineer's calculations. Typically, Calatrava has responded as an artist, with half an eye on his calculator: 'I work as a sculptor. For me sculpture is research,' he says. 'When you're working with very traditional materials, when you're spanning enormous spaces and dealing with the forces of a hill, the expression of the forces is very important.'

Again, light is important. The platforms under which nestle retail and units of organic concrete (as well as paintings on loan from the city art gallery) are paved in glass blocks to better illuminate the space from above. 'I very much believe that in modern transportation real comfort is given by easy orientation, the generosity of space and the quality of light,' says Calatrava. In many ways, the structure, self-contained and distinctive enough to resist extensions, performs the same function as Antwerp's original railway station. One cannot help but wonder whether engineers of the future will be burrowing beneath it, humbly deferring to the skill and poise of their forebears. AD+

David Littlefield is an architectural writer. He has written and edited a number of books, including *Architectural Voices: Listening to Old Buildings* (2007) and *Liverpool One: Remaking a City Centre* (2009), both published by John Wiley & Sons Ltd. He was also the curator of the exhibition 'Unseen Hands: 100 Years of Structural Engineering', which ran at the Victoria & Albert Museum in 2008. He is a senior lecturer at the University of the West of England.

Jacques Voncke, Antwerp Central, Antwerp, Belgium, 2009
opposite top: View upwards, showing the transition from 21st-century sub-ground structure to the neo-Baroque magnificence of the late 19th century. *above left*: A new station entrance has been added at the southern end of the rail complex. This capacious building forms part of a wider programme of surface-level regeneration.

Santiago Calatrava, Liège-Guillemins, Liège, Belgium, 2009
opposite bottom: Liège-Guillemins frames the city of Liège. A wider master plan by Calatrava envisages some of the postwar buildings in the background being demolished to make way for a grand vista between the railway station and the Meuse River. *above right*: Individual canopies stretch along the platforms, extending the reach of the central arch and enabling the station to accommodate double-length TGV trains.

ECOLOGICSTUDIO

From their office in Hackney, in London's East End, Italian duo Claudia Pasquero and Marco Poletto, have established an international reputation as ecoLogicStudio, an innovative practice that fuses digital technologies with environmental design. As **Terri Peters** explains, the ethos and approach of the studio extends beyond that of finding technological solutions to ecological design projects.

Marco Poletto and Claudia Pasquero

Experimental, multidisciplinary and, at times, almost utopian, ecoLogicStudio have a unique approach to design, using it to rethink relationships between humans and their environment. It is an architecture of tuning architectural spaces and materials to serve human needs while respecting a larger ecological whole. Inspired by cybernetics and redefining the relationships between man and machine, they have developed a systems-based approach to design, using the underlying logic in natural processes to establish a new form of dynamic equilibrium between users and local context.

London-based architects Claudia Pasquero and Marco Poletto founded ecoLogicStudio in 2004 after completing their masters in Environment and Energy at the Architectural Association (AA) in London. The studio began with the idea of fusing a design method capable of exploiting the latest innovations in computational design with an ecological agenda that explores material processes unfolding in space and time.

Pursuing these ideas both in small-scale prototypes, such as their experimental 'ecomachines', as well as large-scale theoretical designs, such as their Milan 2015: Metropolitan protoGARDEN (2009), their work is notable for its use of technology and sustainability. However, the focus is not on incrementally reducing carbon footprints, conservation or reducing waste or material. They are not inspired by mainstream, reductive notions of 'sustainability' in architecture. Poletto argues that architecture and sustainability should focus more on relationships and parameters: 'To approach sustainability we need to train our imaginations to think beyond objects.' Their AA colleagues Michael Hensel and Achim Menges have coined the term 'morpho-ecology' as a way of describing architectural design that is rooted in the biological paradigm and concerned with issues of functionality and performance capacity.[1] The work of ecoLogicStudio builds on these ideas, focusing on specificity of place and context.

Pasquero and Poletto's professional work benefits from direct feedback and exchange with their academic positions as AA Intermediate 10 unit masters. In both arenas, the duo aim to redescribe current paradigms of inhabitation and manipulation of the environment. An example of the interchange between practice and teaching was their study trip in winter 2009 to Dubai to see The World. This quirky version of a modern-day Grand Tour is a visit to the partially completed 4-kilometre by 3-kilometre (2.4-mile by 1.86-mile) artificial lagoon including a series of islands, which sits in limbo off the coast of Dubai City – a stalled architectural super-project and a monument to capitalist excess and Arab oil dollars. ecoLogicStudio see these artificial islands, which if and when they are completed will form the shapes of all of the earth's landmasses, as a fascinating site for investigation. The World serves as a metaphor for what happens when the equilibrium in the natural world and the artificial goes haywire.

AquaGarden, Milan Furniture Fair, Milan, 2007
AquaGarden is one of a series of responsive ecomachines designed by ecoLogicStudio as an interactive artificial garden which collects and stores rainwater, stimulating processes such as algae growth. Exhibited at the Milan Furniture Fair in 2007, the prototype is also part of a later, larger proposal, the Milan 2015: Metropolitan protoGARDEN (2009), which uses alternative urban mapping techniques to understand a system of specific and dynamic real-time behaviours in the city. Pop-up gardens, flexible infrastructure and dynamic decision-making are all possible in this proposal for a new relationship with the city. As Pasquero and Poletto explain: 'This form of machinic architecture is a synthetic hybrid embedded with biological life [physical proto-gardens], remote sensing and actuating capabilities [control and interaction systems embedded in the proto-gardens], performance [urban oxygenation, algae farming and microclimatic regulation], computational power [built-in mapping and simulation engines] and communication capabilities [online visual interface and the interactive physical systems].'

Perhaps predictably, the project has resulted in an ecological wasteland rather than an oasis. Here, in a place where all that seems to grow is buildings and oil, Pasquero and Poletto's brief to their students involved design at an unfamiliar architectural scale. The challenge was to reintegrate nature into the damaged landscape, imagining coral gardens between the man-made islands, and stimulating discussion about the iconic and literally global context versus the local, material processes. Using digital design tools they see this project as an opportunity to teach a systems-based, parametric approach to urban ecology that responds to its micro-environment, drawing on ideas relating to their recently developed ecomachines, a series of site-specific, architectural prototypes which challenge the typical purely representational role of architectural models.

Developing models to understand processes rather than material or formal relationships, the ecomachines are derived from user engagement and local context. As an architectural response to the natural world becoming embedded with artificiality, ecoLogicStudio's approach is not a strategy of conservation and reducing human efforts, but rather an approach of harnessing the power and logic of nature through responsive design. In the last three years they have developed and tested a series of ecomachines – AquaGarden (Milan, 2007), Fibrous Room (Istanbul,2008), STEM (London, 2006) and STEMcloudv2.0 (Seville, 2009) – which function as individual experiments as well as larger-scale urban strategies in the theoretical project Milan 2015: Metropolitan protoGARDEN. In the small interventions, ecoLogicStudio try to bring prototyping and materials systems together to allow a relational approach, rather than fixed absolutes, to evolve and allow a material logic to emerge.

STEMcloudv2.0 is both an architectural model and an eco-laboratory. The installation, a stacked arrangement of clear plastic trays filled with local river water set on a laser-cut cardboard artificial landscape, transforms the gallery into an oxygen-making machine and a breeding ground for ecological diversity and algae growth. Visitors to the STEMcloud2.0 installation in Seville 'fed' the local river water in the installation with their breath, blowing through latex tubes to trigger the natural processes. Through the use of distributed rather than centrally organised technologies and systems, STEMcloudv2.0 proposes a web of relationships between systems. This localised, bottom-up approach creates adaptive mechanisms of management and direct evaluation through feedback of the effects of human transformation of natural ecosystems.

While formally very different from the handful of other international practitioners experimenting with adapting technology to generate spatial and climatic effects, such as Philippe Rahm´s multisensory Digestible Gulfstream (Venice, 2008) and architect Philip Beesley´s Hylozoic Soil (Montreal, 2007), ecoLogicStudio is part of an emerging breed of parametric designers increasingly concerned with local context, specificity of place and natural processes. Beesley´s kinetic installations have experimented with artificial life technologies and natural energy generation to achieve spatial complexity and responsive environments using distributed systems and technologies.[2] Both Beesley and ecoLogicStudio are known as ecological designers interested in rethinking the flows of energy, information and material between user and environment. Neither are concerned with 'efficiency' in this exchange, preferring to focus instead on weak, subtle movements to great architectural and conceptual effect.

ecoLogicStudio uses the lightweight living screen of the STEMcloudv2.0 as an architectural element to conceal and reveal the life forming in the plastic 'skin'. This transparent network of pseudo-scientific tubes and valves suggests the creative possibilities of a systems approach to architecture through an alternative approach to sustainability.

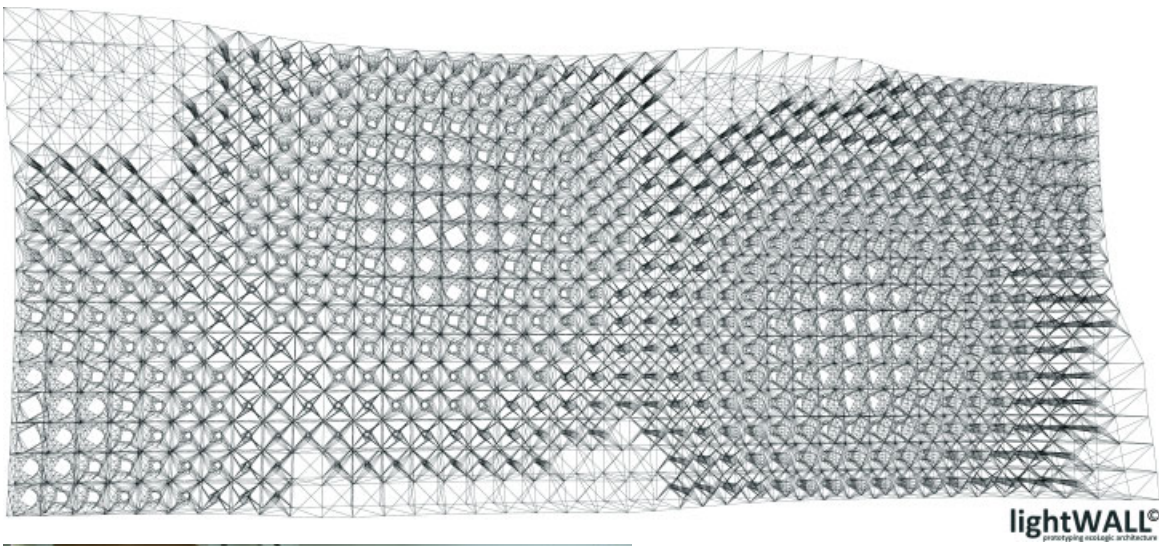
STEMcloudv4.0, an ecomachine which also produces oxygen through user interaction, encourages the birth of tiny tadpoles which both entertain and challenge visitors' expectations. It puts the spectacle of life on show in an architectural mix of science fiction and idealism.

At a larger scale, ecoLogicStudio's alternative approach to sustainability is demonstrated in the radical renovation of a large house in Turin, Italy, through the transformation of the building into a five-unit modern condominium. In the Lightwall House (2008), the studio respond to the local vernacular by adapting the thick exterior envelope of a 1970s traditional Italian house to preference local context and specific user needs. Through the mapping of sun, light and privacy conditions on the site using digital tools, and combining the performance requirements of absorbing and filtering heat, light and views, the designers developed a site-specific solution. The transformation is a 'light wall' which features custom spiralling apertures connecting inside and outside in varying geometries.

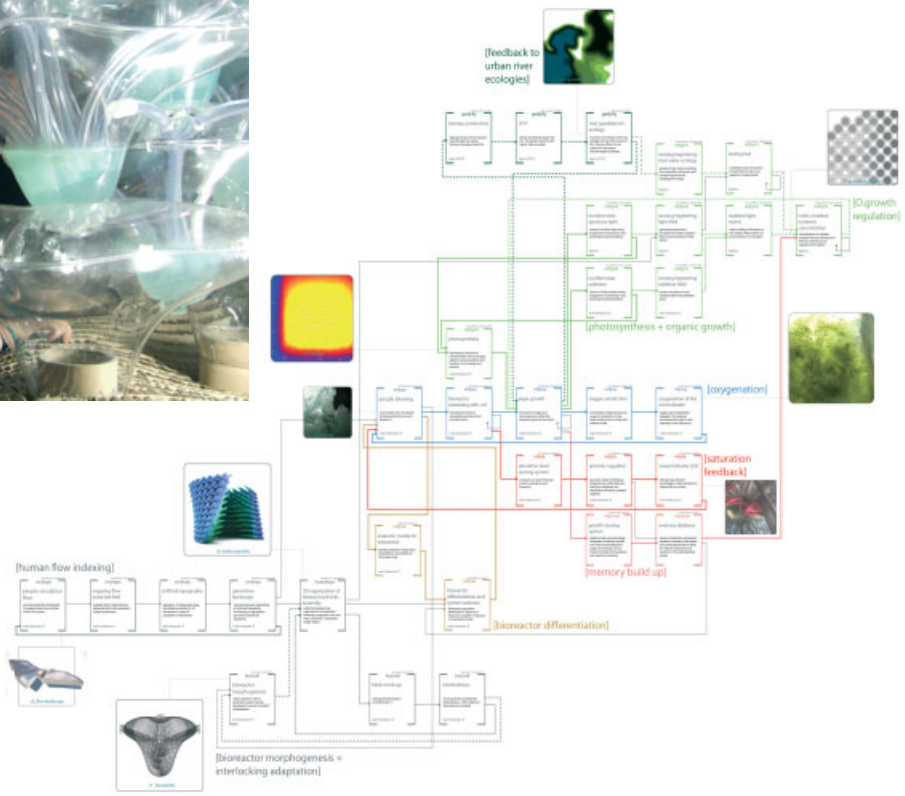
Using this idea of sustainable building transformation, ecoLogicStudio recently completed an intervention as part of the extension works to the Carosello Shopping Centre in Carugate, Milan (2009). The project, developed with retail specialist architect Dunnet Craven and managing architects Systemica, exploits the potential of the building envelope as a filter between the qualities of indoor and outdoor space, using parametrically designed light cannons in the ceiling as a way of responding to exterior climatic conditions and creating a visual link to the environment. The shopping centre is usually thought of as an unsustainable building type, a black box with artificial light and air, and little outside interaction. At Carosello, the corridors now have a series of 'pores' in the ceiling, which bring nature inside, so that the building starts to become a part of its context. Fresh air and indirect light reduce the need for artificial ventilation and lighting, and create a more environmentally responsive space for users.

User interaction and environmental adaptation to local context are the main themes in ecoLogicoStudio´s work, across all scales. The office has proposed designs for high-rise buildings, community renovations and urban master plans, and they are currently working on their first newbuild house project in the UK.

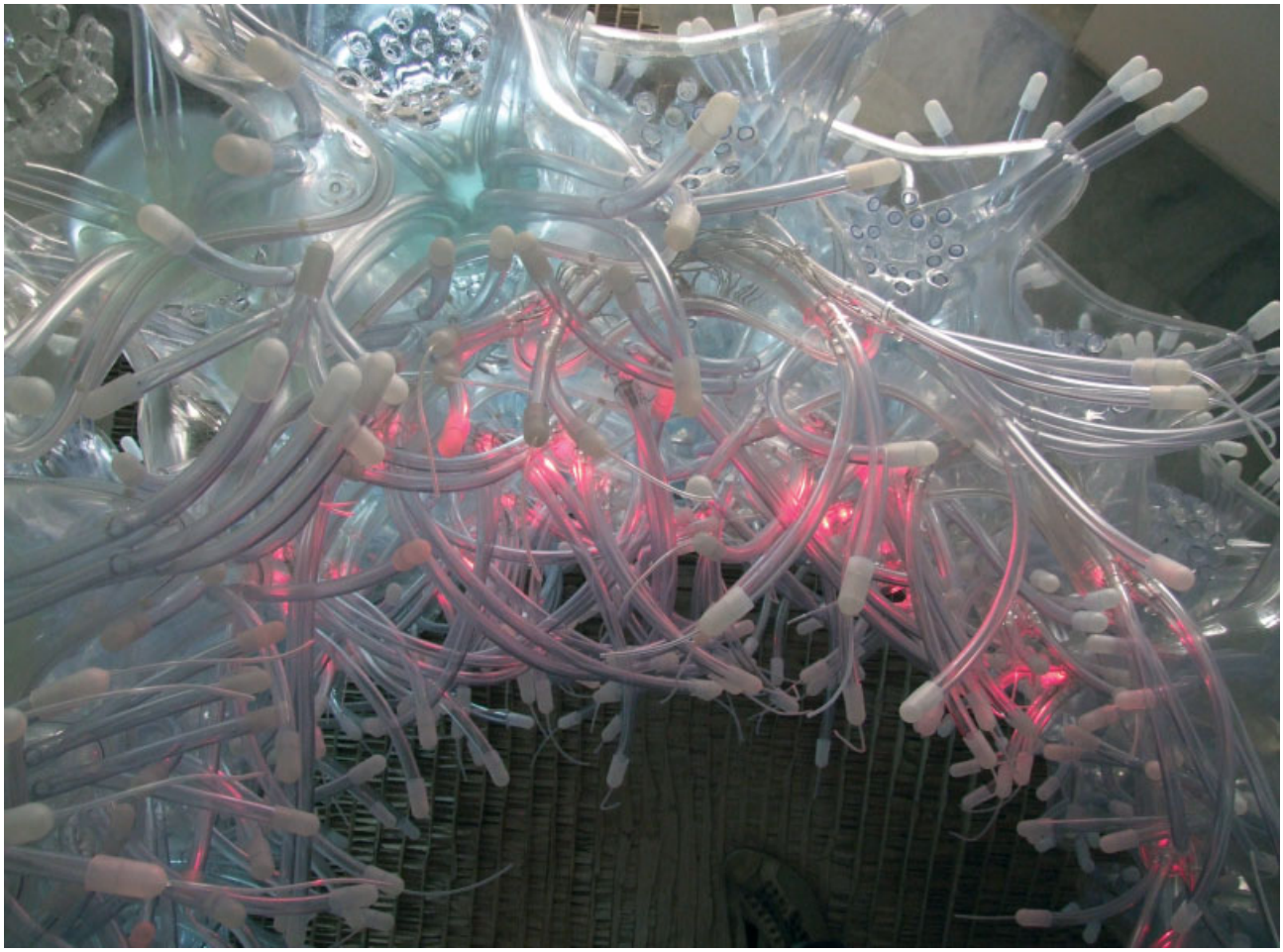
Milan 2015: Metropolitan protoGARDEN is an example of a city-scale intervention, an intense, site-specific platform for self-regulating urban scenarios in the city. Developed for the 12x Milano architectural exhibition, the proposal uses the city as an example of an environmental and social ecology. It challenges the necessity of permanent buildings or interventions, and temporary scenarios create a provocative alternative to top-down urban planning. Pasquero explains that the project is about abstracting the behaviour of the city, using mapping as a way of understanding the city through the specific, dynamic, real-time behaviours within it. It suggests a new kind of cybernetic urban ecology where every thing and every event is part of an interconnected system with dynamic relationships. She likens it to 'Facebook for architecture'

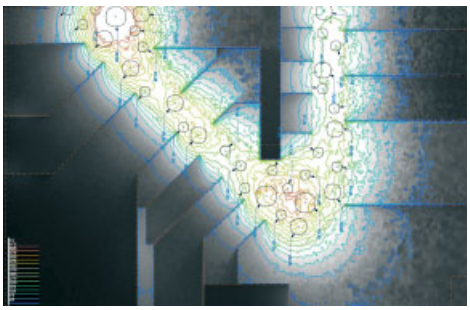


Lightwall House, Turin, 2008
The Lightwall House is a renovation of a traditional Italian house which involved the adaptation of the exterior envelope and the transformation of the interior from a single house into five condominium units. ecoLogicStudio adapted the white 'sponge' wall, a vernacular building element in this region which absorbs light and heat using thermal mass. By mapping personalised user needs and climatic data on to the facade, their transformation of the wall retains about 70 per cent of its original mass, but now has a pattern of twisted square holes arranged on the facade. This mass-customised wall system was made from precast concrete blocks and designed using parametric software to balance thermal performance criteria while experimenting with the manipulation of the filtering potentials of the envelope in an iterative process.



STEMcloudv2.0: the Guadalquivir Experiment, Seville Art and Architecture Biennale, Seville, 2009
The STEMcloudv2.0 ecomachine builds on the ideas of the studio's STEM project (2006), an interactive prototype concerned with algae farming and oxygen generation. In the absence of natural light, artificial light was used to nourish the gallery space in Seville. Patterns of interaction with the public in turn affect the natural growth, using visual cues and sensors so that visitors can see feedback. Dialogue between the space and the users is key, but is purposely uncontrolled. There is interplay between the accidental and the designed, as the results of the experimental environment cannot be accurately predicted at the beginning. There is no way of knowing what kind of algae will grow or how visitors will interact with the space.





Carosello Shopping Centre, Milan, 2009
The extension for the Carosello shopping mall features a distinctive landscaped roof system shaped like an artificial hill and conceived of as a 'living skin' for the building, gently rising from ground level, covered with a thick grass carpet. The green roof and geometric double-skinned rooflights create microclimatic effects including air cooling and rainwater retention using the green roof and the creation of thermal mass for stabilising the interior conditions. The architectural response is integrated with the environmental performance of the building with particular attention to responding to specificity of place, using mapped data relating to local climate and views.

because it uses selectively edited, subjective data such as Google Maps, Google Earth, flickr and other digital data sets as layers of information to understand the city. The mapping of this data will allow users to communicate and eventually adapt the real material processes (such as rates of air pollution, places for rainwater collection, public transportation) unfolding in Milan.

Relying on user data such as flickr and other social networking sites creates an unusual relationship between users and the city. Brett Steele, head of the AA, advocates a network-based design studio. He argues that despite new 'disruptive' technologies, social networking and digital interactions cannot replace real-world interactions.[3] Taking the example of architectural education at the AA, he suggests that the school is more than just a building or an organisation; it is a network, in the manner of a living system, where students and tutors interact and relate to each other. ecoLogicStudio propose using the city as a dynamic, adaptable ecology, in a similar way that Steele proposes using the school as a way to develop knowledge, to communicate and adapt behaviours in real time.

In all of their work, from their ecomachines to urban networks to house renovations, ecoLogicStudio aim to define scale through hierarchy between components rather than physical dimensions. Their relationship to technology sets them apart from their peers because while they use digital tools to describe formal relationships, objects and performance, they go beyond these ways of working. They use parametric modelling to create a platform for user interaction, and to describe systems and networks. Rather than focusing on the optimisation of form or digital fabrication, they focus on using distributed technology to create adaptive and systems-based architecture. Performance is a criterion, as demonstrated in the Turin house where they used software to map light and views on to the facades to use personal data and client wishes to adapt the building. But where are they going next?

Future projects will build on their interests in designing intelligence in materials, using distributed material logic to create localised performance as part of an architectural ecology. ecoLogicStudio's approach to networking relates to an architecture of the near future, to a time when all things will be connected and adaptation can happen in real time based on information and interaction. Through experimentation and feedback in their teaching and professional work, Pasquero and Poletto are mapping territories between theory and practice, and proposing a new approach to sustainability. AD+

Terri Peters is an architect and writer from Canada. Her research focuses on sustainable building transformation through her PhD fellowship at the Aarhus School of Architecture in Denmark. She has spent the last eight years living in London where she has worked as an architect and writer, contributing to numerous specialist publications. She is guest-editor of a forthcoming (2011) issue of *AD* on the theme of ecological research as a design tool.

Notes

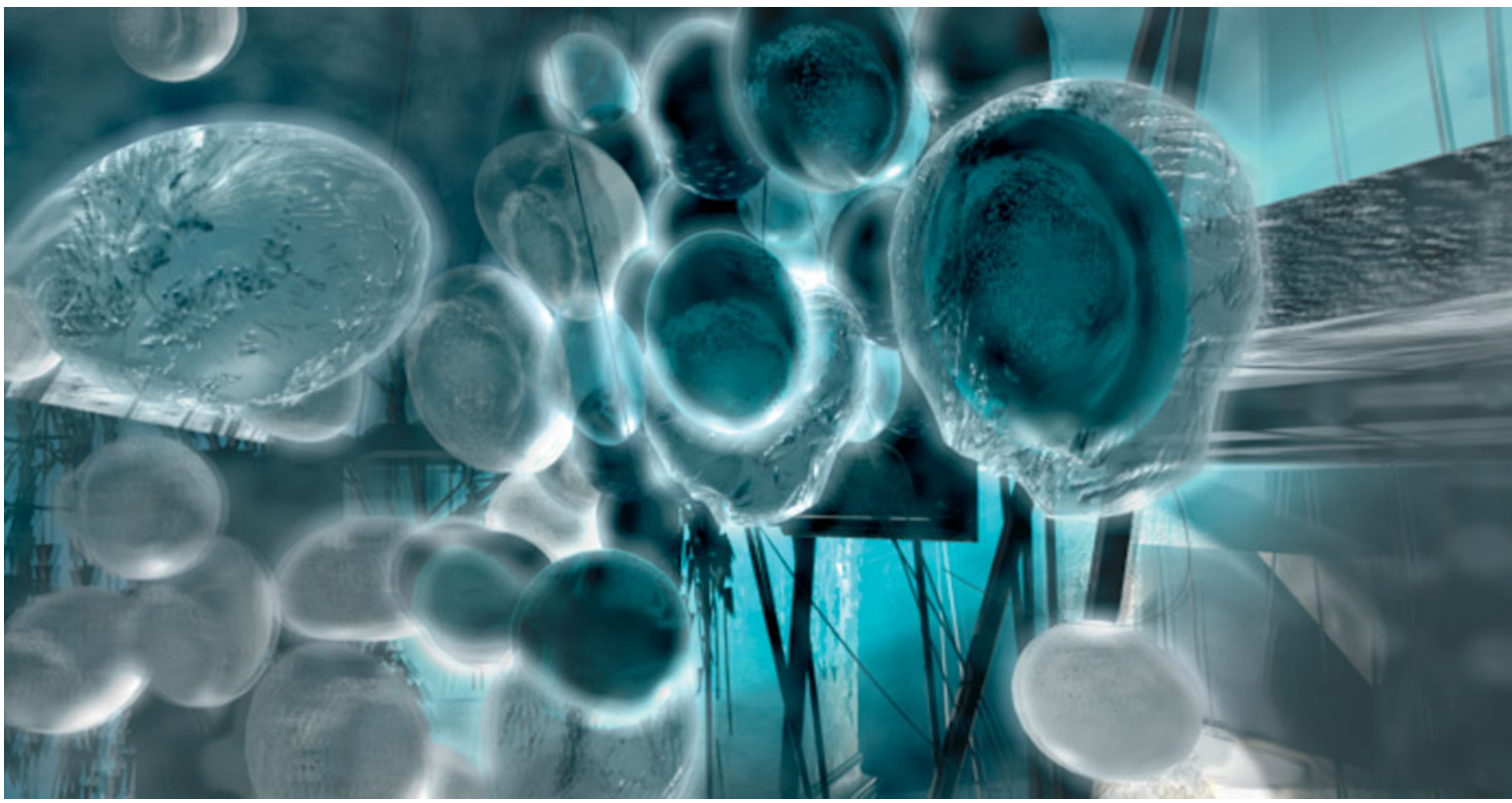
1. Michael Hensel and Achim Menges (eds), *Morpho-Ecologies: Towards Heterogeneous Space in Architectural Design*, Architectural Association Publications (London), 2006, p 16. See also the *AD* titles guest-edited by Michael Hensel, Achim Menges and Michael Weinstock: *Emergence: Morphogenetic Design Strategies* (May/June 2004) and *Techniques and Technologies in Morphogenetic Design* (March/April 2006).
2. Philip Beesley, *Hylozoic Soil*, Riverside Architectural Press (Toronto), 2007.
3. Brett Steele at the 'Smart Geometry Conference', San Francisco, 2009.

Neil Spiller

FIDDLING WHILE THE WORLD BURNS

Neil Spiller sharpens his claws and puts some bite into his final 'Bits' in this closing edition of AD+. He addresses the pressing question of climate change and politicians', architects' and the construction industry's general proclivity to bury their heads in the sand or to 'fiddle' tangentially in another direction.

AVATAR research group, Future Venice, 2009
Neil Spiller's AVATAR research group, including Dr Rachel Armstrong, at the Bartlett School of Architecture, UCL, in collaboration with physicist and chemist Professor Martin Hanczyc at the University of Southern Denmark, are developing a 'living technology' that transforms a combination of readily available cellular materials – including CO_2 – into something akin to limestone. This technology, they hope, may be used for creative interventions within the built environment, including that of Venice. In this case it is hoped that the technology can be used to petrify the wooden piles under Venice and to create artificial reefs around the city to rescue it from its impending watery doom. The images show the artificial reefs and protocell action below water level.



I write this last Spiller's Bits on the eve of the Copenhagen Climate Change Conference. Political brinkmanship, charge and counter-charge are well advanced. Who pays for what? Why it's the West's fault and that of the 'evil USA', and other specious political wranglings and dung-throwing, are all preventing the basic problem being heard. This basic problem is simple, but politically difficult for politicians to enunciate. The fact is that there are too many of us in the world, capitalism has created an essentially north/south global divide, and our selfishness and short-termism as we serve Mammon, together with our own vanity, is nothing short of suicidal. Religion is also to blame. So I predict the climate change conference will have little impact; but an optimistic-sounding, expedient form of words will be agreed by all parties.

Meanwhile, in a parallel world, the little 'sniffle' of parametricism has turned into a full-blown epidemic affecting nearly every student in the world, and architects fiddle while the world burns, drowns, desertifies and freezes. They ignore the elephant in the room: that parametricism manipulates merely the formal qualities of an architectural object and therefore architecture as a force for meaningful cultural and political change is ignored. Indeed, if we consider what is called 'parametric urbanism' or other sophist conceits concerning benevolent patterned facades, these approaches never engage with the politics, sociology, demographics, ecologies, procurement and dynamics of capital – the real parameters that influence the built form of the city. Let's face it, it is not just our funky formal friends who are busy selling the architectural profession down the river, but all those involved in the provision of the built environment.

We have collectively disengaged ourselves from real decision-making concerning the true 'parametrics' of urbanism, preferring to celebrate each other for acts of miasma in some bizarre cult of iconographic mediocrity. This mediocrity is predicated on basic Victorian construction technologies that propagate the soon to be outmoded notion of binary opposites. This logic says that the building industry is mostly dry, not wet, inorganic not organic, hard not soft, preformed not grown on site, and smooth not knobbly. So I have three simple suggestions to help us see our world for what it is and what it might be. Firstly, to understand the world not as comprised of opposites but as a series of spatial and material continua. Secondly, to stop thinking of buildings as fighting nature's environmental entropy but to see them as part of the natural ecology not just at the macro scale but also at the micro and nano scales. Finally, to put considerable thought into retrofitting old buildings, and start seeing the existing built environment as not a blight but an opportunity to use cities as massive factories for environmental good.

To achieve these points we have to give up on the idea of constructing carbon-neutral buildings which merely propagate the apocalyptic status quo. We need to develop carbon-negative (by this I mean utilise carbon capture and storage technologies) buildings. But, more importantly, we need to develop carbon-negative refurbishment technologies that are cheap and easily deployable and actively extract carbon from the environment, ameliorating existing damage. I'm starting to call these technologies (and I think they reside within the province of synthetic biology) ReCanT Systems (Retrofitted Carbon Ameliorising Technologic Systems). In this respect Dr Rachel Armstrong and I will be editing an edition of *AD* (out March 2011) on these technologies and their attendant architectures. But I would like to leave you to consider how much work we have yet to do and the speed with which we are required to do it.

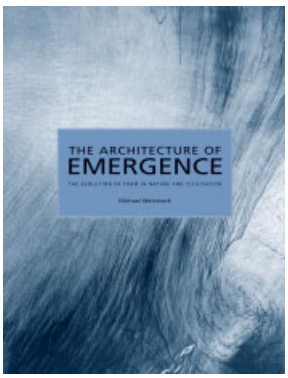
In short we need to retool architects and architectural education, within the next 10 years, to deal with the fact that the building industry is the largest energy-consuming and greenhouse-gas emitting sector; close to double that of any other sector. This is therefore an opportunity for the building industry to develop a solution. We have not started well and we are behind schedule already. AD+

Neil Spiller is Professor of Architecture and Theory, Graduate Design Director and Vice Dean at the Bartlett, University College London.

EMERGENCE AND THE FORMS OF CITIES

Michael Weinstock's significant new book *The Architecture of Emergence: The Evolution of Form in Nature and Civilisation* calls into question the received notion of culture. Rather than perceiving civilisation as intrinsically human or humanist, standing outside and beyond nature, Weinstock positions human development alongside ecological development: the history of cultural evolution and the production of cities are set in the context of processes and forms of the natural world. In this extract from Chapter 7, Weinstock charts how the proliferation of cities and systems of cities and their extended metabolic systems across the world were characterised by episodic and irregular expansions, consolidation, collapse and subsequent reorganisation.

Michael Weinstock



Human forms and culture evolved over a period of extreme fluctuations in the climate and consequential rapid variations in ecologies; a regime of natural selection that conserved and enhanced the ability to adapt their culture to a variety of climates and ecological conditions. Culture acts to transmit complex social and ecologically contextualised information down through the generations, and has tended to increase in complexity over time, a process that began over 130,000 years ago in East Africa with the emergence of anatomically modern humans, the diaspora 'out of Africa' and the spread of humans across the world.[1]

By 35,000 years ago, long-term settlements, complex spoken language, calendars and the material archiving of ecological information had emerged.[2] Humans began to modify their local ecological systems about the same time, as the extinction of the mega-fauna and the use of fire to drive game and clear land produced changes in patterns of vegetation in steppe grasslands, in cool forests and in warmer grasslands. As the energetic returns from hunting were reduced, the increase in the gathering of grains initiated the genetic changes that over many thousands of years led to the domestication of wild cereals.

Excavated dwellings, or 'pit houses', provided a fixed residential location for the winter months and enabled humans to regulate their collective metabolism in a great range of climates, and to expand into the very cold territories of the high northern latitudes. In the other seasons, tents and temporary structures were occupied in ecologically determined patterns of movements around the home range. Pit dwellings were arranged in clusters, and included 'long houses' for the communal occupation by several families at the same time. Adaptations to differing regional climates, topographies and ecologies emerged from variations in the patterns of movements around the territory, and in the depth and size of the excavation and construction.

The founding system of civilisation continued to develop local and regional variations over tens of thousands of years, with long periods of population growth and local episodes of rapid decline. In many locations it had developed to its maximum metabolic capacity, and had become highly vulnerable to climatic and ecological changes.

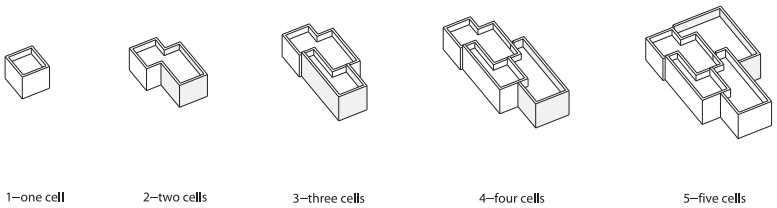
Cities emerged from a process of nucleation in five topographically and ecologically defined regions within a latitudinal band characterised by either hot or cold arid climates. In each region recurrent episodes of climatic change induced further ecological stresses on the widely distributed pattern of settlements that had already made pronounced changes to local and regional ecological systems. River valleys were the most favourable areas, and the flow of migrants from the ecologically stressed territories into the valleys increased the population in topographically and ecologically delimited territories. The concentration of people, and the consequential increase

in the volume of exchanges between settlements of food, fuel and materials, established the integration of the individual metabolic system of groups of settlements into larger systems. Severe climatic and ecological changes induced the process of nucleation and the subsequent emergence of cities.[3]

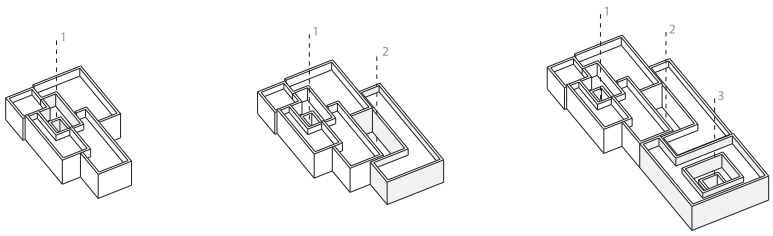
City forms are material constructs that are composed of a spatial array of dwellings, a pattern of streets and public spaces together with differentiated buildings of varying sizes associated with the regulation of energy and material flow, and the extension of a metabolic network across the surrounding territory. When further sequential episodes of prolonged drought occurred throughout the latitudinal band, the flow of energy through the system of cities was substantially reduced as crops failed, animal pastures withered away, and rivers dried up. Systems poised close to the critical threshold of stability are sensitive, and a small change may precipitate collapse. In Egypt, the Levant and southwest Asia, the Indus Valley, Crete and Greece, the systems of cities had all expanded their populations to the maximum capacity of their system, each close to the critical threshold of stability, and the links between them had intensified.

There were several century-long episodes of drought and high temperatures in the millennia between 6,000 and 2,500 years ago, and several sequences lasting three or more decades. In each case the consequence was drastically reduced flow in the river systems, and in the territories that were not directly fed by rivers that were wholly reliant on seasonal rains, the failure of agriculture and widespread famine, and subsequent collapse. Some systems of cities persisted longer than others in the severe droughts, reverting to a simpler and more localised array supporting a lower population, but eventually many cities were simply abandoned, and their peoples migrated to more ecologically favourable locations. In the Levant and southwest Asia, there were many iterations of gradual expansion and intensification of links over increasing large areas, growing complexity and subsequent collapse and reorganisation. In Middle Asia and the Indus Valley, the collapse was followed by abandonment and migration of the population towards the east. Those people that did remain reverted to a simpler system of settlements with fewer links, smaller populations and reduced complexity. No further rise in complexity occurred in these areas for thousands of years.

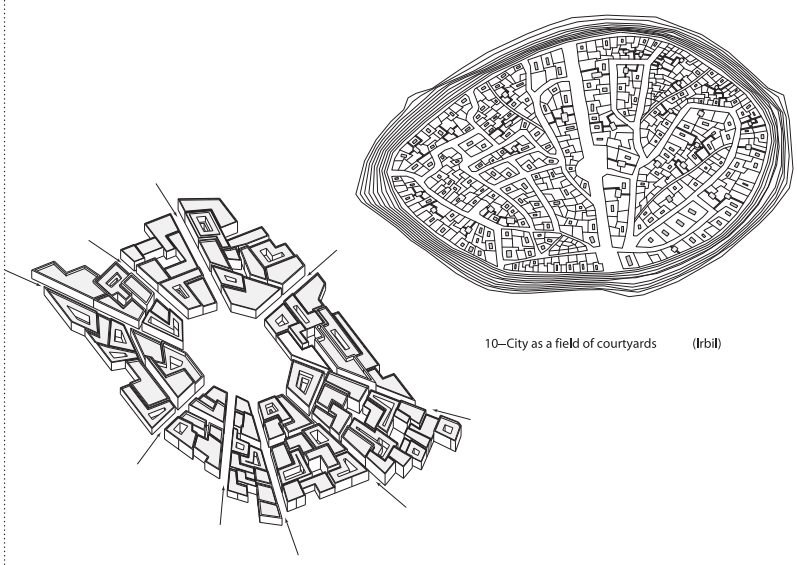
In northern China climatic and ecological changes induced contraction and a subsequent reorganisation. Cities and settlements in the colder arid territories were abandoned to the emerging nomadic system of the Mongol tribes about 3,500 years ago. In both Peru and Greece the expansion of cities was severely constrained by the topography and ecology, with quite different outcomes. It is thought that cities and settlements in Peru were abandoned, with the peoples migrating to the north where the Inca later emerged. In Greece, the reorganisation of the systems of the metropolises, or 'mother cities', was achieved by the proliferation of 'colony' cities along the coastlines of the Mediterranean and the Black Sea, and as far north inland as the Ukraine, and as far south as Alexandria in Egypt. Energy, in the form of food and materials, flowed



1–one cell 2–two cells 3–three cells 4–four cells 5–five cells



6–one courtyard house 7--two courtyard house 8–three courtyard house



10–City as a field of courtyards (Irbil)

9–urban courtyards

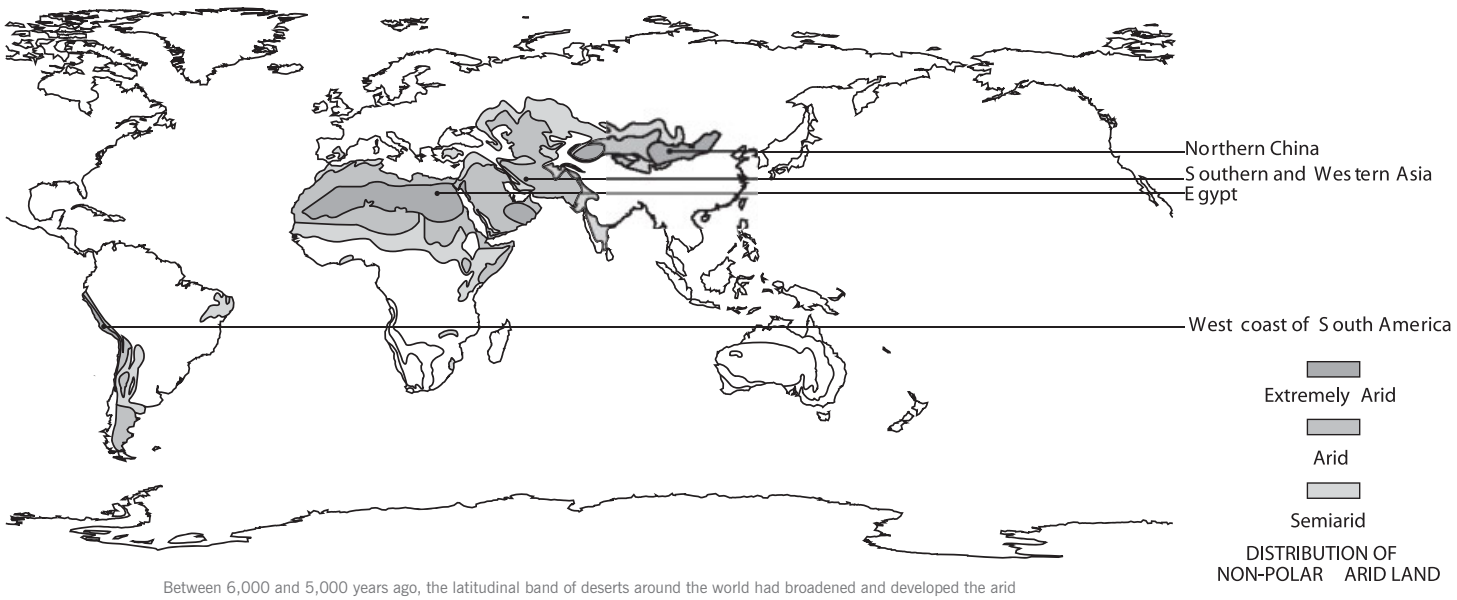
The evolutionary development and elaboration of the courtyard, from the simple space between dwellings in the first settlements to its incorporation within spatially complex buildings of varying sizes and functions, occurred throughout the region. Courtyards also emerged within the dense pattern of dwellings, co-evolving with social orders and values as urban spaces for collective functions. Walled cities emerged with populations of up to 10,000 people, within large arrays of extensively linked settlements of different sizes. Open space within the inner walled enclosure was organised as a series of courtyards, surrounded by a tightly packed configuration of dwellings and narrow streets, often just wide enough for a pack animal, limiting the exposure of pedestrians to the sun and restricting views.

from the overseas cities back to the metropolises. Information flowed in the reverse direction, as knowledge and expertise in the organisation and construction of buildings and cities, in the manipulation of timber, bricks and ceramics, stone and metals.

As cities emerged within a latitudinal band characterised by arid climates, and arose from variations of the common founding system, their evolutionary development tended to be convergent, exhibiting many similar patterns, arrays and forms. Convergent evolution has occurred widely in living forms, and many animals and plants that emerge from quite different evolutionary trajectories exhibit strong similarities in their body plans and the processes of their organs. Likewise, there are common material, spatial and metabolic organisations in the forms of cities, most notably in the hot arid climatic regions of the Levant and southwest Asia, Egypt and the Indus Valley, and in their descendants in the Arabian peninsula and around the Mediterranean. The evolutionary development and elaboration of the courtyard, from the simple space between dwellings in the first settlements to its incorporation within spatially complex buildings of varying sizes and functions, occurred throughout the region. Courtyards also emerged within the dense pattern of dwellings, co-evolving with social orders and values as urban spaces for collective functions. Within the cooler regions of Eurasia and the cold arid climate of northern China the longhouse evolved and was developed, and in combination with the courtyard was elaborated to complex spatial organisations and material forms at a variety of scales. Variation of the form of individual and groups of dwellings occurred locally, through the idiosyncrasies and necessities of the local topography and local knowledge of construction, or in response to irregularities in the flow of materials and available energy in 'manpower'. The emergence of larger building forms and the evolutionary development and elaboration of variant forms was strongly coupled with the rise in the flow of energy from intense cultivation, increased social complexity and the evolution of information systems.

As the populations in extended city systems continued to expand, plant cultivation and animal husbandry were intensified and the flow of materials and energy increased. In turn, the built area of cities expanded over the established patterns of cultivated fields, pastures and irrigation canals. Along the Nile Valley, new cities and associated agricultural field systems were laid out and rapidly constructed as variations in the river flow changed the river geometry and modified existing floodplains. The shallow gradient of the river enabled the evolutionary development of river craft and enabled the flow of materials, energy and people between cities and settlements. There were similar developments in the Euphrates/Tigris, the Indus and the Yiluo and Huanghe rivers of China.

The subsequent development of maritime nomadic systems initiated the processes from which extended sets of colony cities arose. As the collective metabolic systems extended over increasingly larger geographical areas, the integration of colony cities into larger and more complex hierarchical systems acted as a positive feedback to the development of information systems including notation, calculation and writing. Information systems related to the differentiated and fluctuating flows of energy and as materials evolved, the complexity of the system increased commensurately. The growth and development of cities and systems of cities across the world was characterised by episodic and irregular expansions and incorporations, and by local- and regional-scale patches of collapse, the abandonment of cities and dispersal of the people, and subsequent reorganisation. Systems of cities all tended to develop and expand so that they were operating close to the limit of their capacity to extract energy and materials from their environment, and to manage the complexity of flows through their system. Systems of cities developed multiple processes, each with flows of energy and materials through them, and with critical thresholds at differing scales of distance and time. They developed and grew



Between 6,000 and 5,000 years ago, the latitudinal band of deserts around the world had broadened and developed the arid ecologies and spatial extent that they have today. Within the hot arid regions of the Levant and southwest Asia, Egypt and the Indus Valley of southern Asia, and in the cold arid regions of northern China, and the northwest coast of South America, river valleys provided the only ecologically favourable locations for all living species, including humans. Cities emerged in these locations.

The total population of Greece and its colonies is estimated to have grown by an order of magnitude over a period of 500 years, from one million to 10 million people. Many of the independent cities became the 'mother' city of an overseas colony; for example, Corinth was the 'mother city', or metropolis, of Syracuse.

until they were delicately poised close to their critical threshold of stability, and were thus extremely sensitive to changes within their environment.

The outcomes of system collapse can be the abandonment and migration of the people and a complete loss of order; a regrouping of the components of the system into smaller dispersed assemblies with fewer links and reduced flows of energy, materials and information or reorganisation to a lower level of complexity; and the reordering of the components into a more integrated assembly with increased flows or reorganisation to a higher level of complexity.

In each of the five regions within which cities emerged, the ecological system was modified by humans at a variety of spatial and temporal scales. The intensive cultivation of land supported large populations, but also resulted in the depletion of nutrients in the soil, and in some areas caused a marked salinisation of the soil. The use of timber for construction and for fuel, coupled with the clearance of land for agricultural use, resulted in deforestation at a regional scale, the spread of grassland savannahs and the extinction of animal and plant species. Successive cycles of drought, and the elimination of tree root systems that bound the soil together, exposed the soil to further drying and erosion. The changes were cumulative and long lasting, and in many regions the modification of ecological systems by humans are still evident in the arid and denuded landscapes that persist until today. AD+

Michael Weinstock, *The Architecture of Emergence: The Evolution of Form in Nature and Civilisation* (John Wiley & Sons, 2010), is available in paperback at £29.99 (PB ISBN: 978-0-470-06633-1) from www.wiley.com and www.Amazon.co.uk.

'Unit Factor' is edited by Michael Weinstock, who is Director of Research and Development and of Emergent Technologies and Design at the Architectural Association School of Architecture in London. He is co-guest-editor with Michael Hensel and Achim Menges of the *Emergence: Morphogenetic Design Strategies* (May 2004) and *Techniques and Technologies in Morphogenetic Design* (March 2006) issues of *Architectural Design*.

Notes

1. See M Lahr and R Foley, 'Towards a Theory of Modern Human Origins: Geography, Demography, and Diversity in Recent Human Evolution', *Yearbook of Physical Anthropology* 41, 1998, pp 137–76, and S McBrearty and A Brooks, 'The Revolution that Wasn't: A New Interpretation of the Origin of Modern Human Behavior', *Journal of Human Evolution* 39, 2000, pp 453–563
2. See W Noble and I Davidson, 'The Evolutionary Emergence of Modern Human Behaviour: Language and its Archaeology', *Journal of the Royal Anthropological Institute*, 1991, pp 223–53.
3. See EJ Steig, 'Mid-Holocene Climate Change', *Science* 286, 1999, pp 1485–87, and N Brooks, 'Cultural Responses to Aridity in the Middle Holocene and Increased Social Complexity', *Quaternary International* 151, 2006, pp 29–49.

RELATIONAL INTERACTIVE ARCHITECTURE

In her concluding 'Userscape', **Valentina Croci** assesses the state of interactive design as it becomes an increasingly mature practice, with over 10 years of activity behind it. Looking at works by some of the most significant designers internationally, she emphasises how this new field of spatial design has enabled new sensory investigation and innovative explorations into the relations between people.

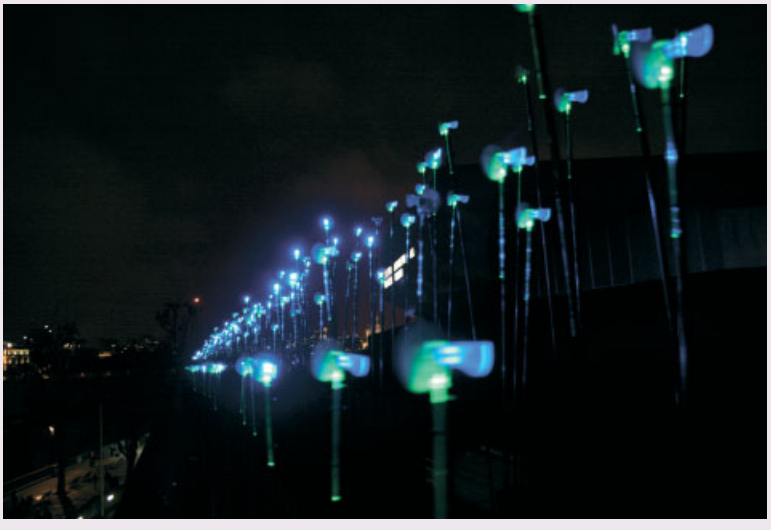
Valentina Croci

Interactive design, which has given rise to so-called responsive environments, first appeared within the field of architecture little more than a decade ago. This design practice demonstrates how a system, controlled by sensors and a computer software interface, can respond to user input and behaviour. The nature of such interaction is not linear and univocal, but rather biunivocal, between the environment and users. In terms of design, 'relational' and interactive works of architecture become a complex technological, conceptual and semiotic problem. In terms of encounter, this type of architecture allows people to experience the built environment in a more playful and participative manner, perhaps transforming their perception of public spaces.

It is probable that most works in urban contexts, such as those by Jason Bruges or Rafael Lozano-Hemmer, contribute less to the understanding of the compositional qualities of space and more to the emotional involvement of the user within it. In the works of Lozano-Hemmer, the human body is used to activate hyperlinks and audiovisual content that overlap another meaning on to the experience of the context. The 15 works of Relational Architecture designed by this Mexican artist between 1997 and 2008 focused on realising vulnerable traditional concepts of space, the body and architecture, as well as demonumentalising urban spaces. In general, his work is an attempt to overcome the dualism between public and private space in favour of a shared territory in which the installation offers the user a personal vision of a site.

Rafael Lozano-Hemmer, Pulse Park, Relational Architecture 15, Madison Square Park, New York, 2008
left: This interactive installation features 200 spotlights controlled by a heart-rate sensor and consists of a matrix of light beams that glare over the oval lawn of Madison Square Park. The intensity of the light depends on the sum of the cardiac pulsations, as well as the visualisation of systolic and diastolic impulses. It is as if the installation represents the heart of the city's inhabitants at the urban scale. The Pulse Park project was inspired by the film *Macario* (Mexico, 1960) by the Mexican director Roberto Gavaldón, and represents the conclusive phase of the research begun by Lozano-Hemmer at the 2007 Venice Biennale.

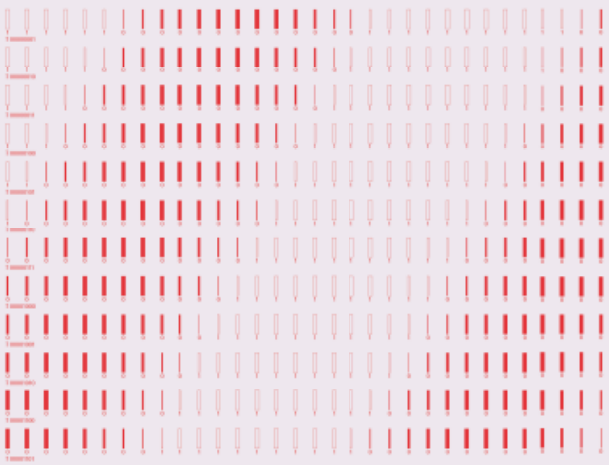
Jason Bruges Studio, Wind to Light, Southbank Centre, London, 2007
below: In response to the theme 'How green is our space?', Jason Bruges Studio devised an installation that focuses attention on the availability of alternative energy, even in the urban environment. Wind to Light visualised wind movement across the roof terraces of the Queen Elizabeth Hall using pole-mounted mini turbines that power blue and green LEDs. The installation was sensitive enough to the wind to allow viewers to see gusts and breezes passing through the turbines. The project was produced in collaboration with OneDotZero and Light Lab for London Architecture Week 2007.



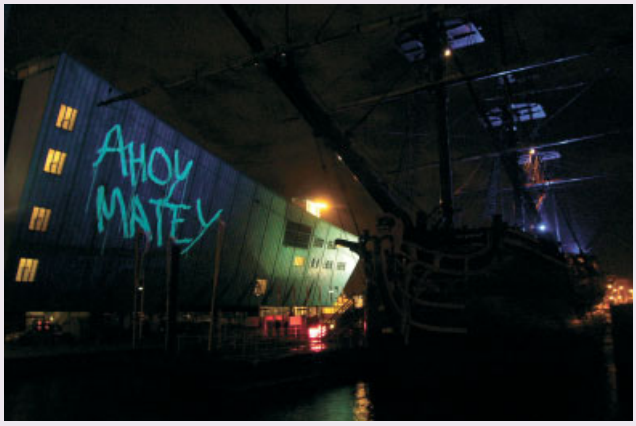
Projects such as Toyo Ito's Tower of Winds (Yokohama, 1986) or Diller + Scofidio's Blur (Swiss Expo, 2002) transformed the static nature of construction using specific atmospheric elements of a site's atmosphere – humidity, air, and the sounds and noises of the city. Buildings are thus transformed into a living creature with a strong characteristic of unpredictability. Or better yet, the architectural project becomes the display of what exists and is invisible, making us aware of the flows and physical forces that surround us and how they are interrelated. An example of this is the FLUX, binary waves (2008) project by the Belgian group LAB[au], in which the rotation of panels, patterns and the colour of integrated LEDS represent the confluence of traffic flows and electromagnetic fields in a given urban space.

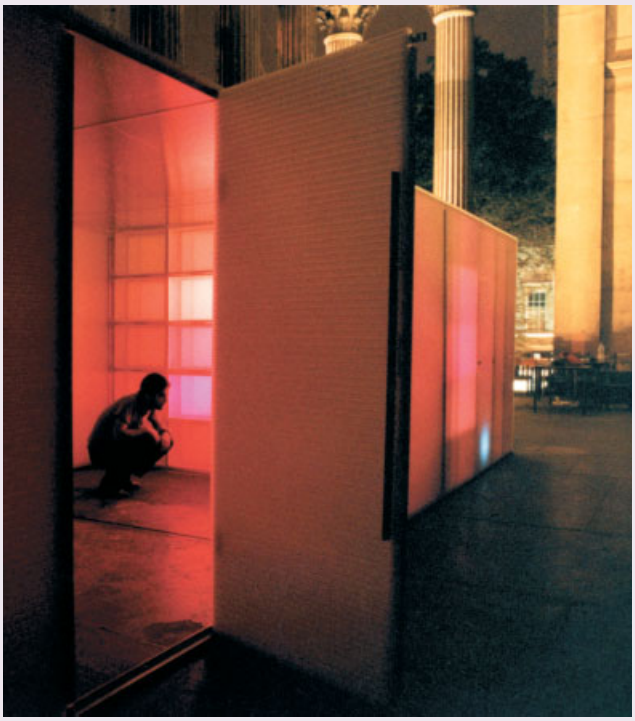
In interactive projects, even the parameter of scale becomes non-conventional: the factor of performance makes the dimensions of urban spaces relative. For example, in the Laser Tag project by Graffiti Research Lab, in which bands of lasers are projected on to the facades of buildings, the leap in scale permitted by technology generates an impressive event. The building becomes a gigantic canvas for messages, as well as a political symbol desecrated by graffiti. The project recalls the subversive culture of 1980s Street Art, transforming the practices of graffiti writers from secret and illegal into theatrical and accepted. The Laser Tag performances are promoted by the Graffiti Research Lab, a Dutch collective dedicated to writing using new technologies.

LAb[au] (Manuel Abendroth, Jérôme Decock, Alexandre Plennevaux and Els Vermang), fLUX, binary waves, Saint-Denis RER D station, Paris, 2008
The installation is composed of 32 rotating panels with integrated LED illumination driven by internal microprocessors that calculate signals captured by infrared sensors from infrastructural flows (the passage of vehicles, pedestrians and trains) and communication flows (electromagnetic fields produced by radios and cellular phones). The impulses are transmitted from one panel to another to produce luminous waves and rotation. The lights are in two colours: white or red depending upon whether they represent the frequencies of flows or the intensity of electromagnetic fields. The installation is thus a sort of kinetic wall that reveals human activity in a particular urban space, giving form to invisible matter.

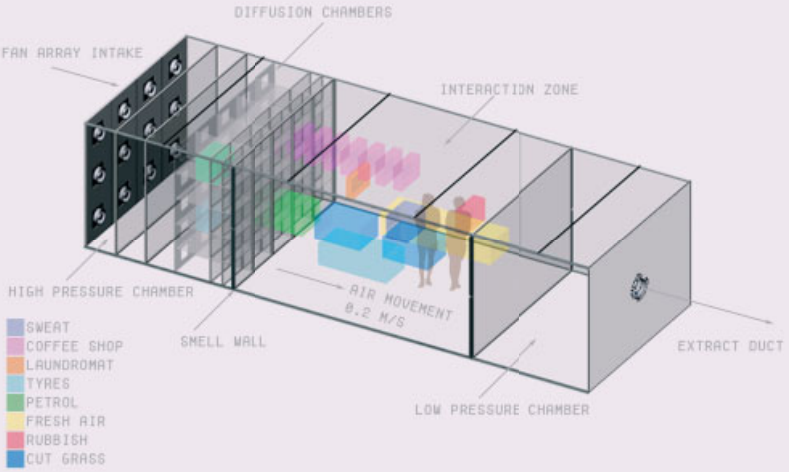


Graffiti Research Lab, Laser Tag, Amsterdam, 2007
The first Laser Tag performance was held in Rotterdam and since then there have been more than 15 performances in Australia, Austria, Canada, Germany, Japan, Hong Kong, the US, Switzerland, Spain and Sweden. Laser Tag is a mobile broadcast unit capable of projecting a 60-megawatt laser beam up to 100 metres (328 feet) in distance and on to large surfaces. The mobile unit can be moved on wheels and features a 1,000-watt audio system. The character of the event is significant: it directly involves and brings together citizens, encouraging them to express and exchange their opinions. Similar to the practice of writers in the 1980s, this type of performance has a subversive objective, with the difference that the urban scale of the graffiti makes the performance impressive and collective, and temporary though no longer clandestine.





Usman Haque, Josephine Pletts and Dr Luca Turin, Scents of Space, Bartlett School of Architecture, UCL, 2002
This interactive room allows for the transmission of olfactory stimuli across a three-dimensional grid. The objective is that of guiding the user through a narrative using the experience of smell. There are no physical confines in the environment, but rather olfactory zones. The installation is very simple: an empty 9-square-metre (97-square-foot) room that shines inside by day and outside by night. The production of aromas is orchestrated by software, diffused by a system of fans and realised by visual stimuli on the walls that indicate the point at which the odour is perceivable. The stimuli are transmitted at 20 centimetres (7.8 inches) per second so that users perceive only a change in smell, and not the movement of air.



Somewhere between art, anthropology, computer science and physiology, interactive design involves research into tactile interfaces and, more generally, the dialogue between a project and the user through multisensorial feedback. The installations by Usman Haque are 'spatial operating systems' or 'open-source' environments that create consequentiality between the shifting characteristics of a space and the behaviour of its users. With the Scents of Space project (2002), an interactive system that transmits olfactory stimuli across a three-dimensional grid based on human movement, Haque wanted to overcome the definition of architecture as something solid, static and permanent. He thus introduces the choreography of sensations as an ulterior element of architectural composition, generating spatial organisms that mutate through interaction and stimulate narrations – we need only recall the evocative power exercised by the olfactory senses over human perception.

This type of project highlights the non-existence of univocal parameters in the experience of the built environment, together with the importance of the subjective component. Interaction between humans and the environment depends less on the accuracy of the architectural envelope or its functions, and to a greater degree on the element of surprise and suggestion. Furthermore, because the user assumes a primary role in the functioning of space, the ideas of enjoyment and involvement exercised by an architectural context become crucial. This condition, well known to museum curators, has led in recent years to the design of interactive tours and methods of accessing collections in a playful and personalisable manner.

The field of responsive environments is not yet a mass phenomenon; however, interactive installations are progressively more common at trade fairs and cultural events. Their presence can be attributed to the growing access to technologies and the more relevant familiarity of users with interactive interfaces; here we can mention the touch screens used on a daily basis, various digital devices and the reduced use of screens in favour of objects to be manipulated. What is more, the responsive environments sector manifests the changing social value attributed to connectivity between people: the quality of the artefacts is tied less to functionality and more to the aspect of relation and participation. One example can be found in Tobi Schneidler's project for the Remote Home at the London Science Museum and the Raumlabor in Berlin in 2002. This system of communication between two environments is composed of objects of furniture that move based on input from a remote location. Or, as a mutated value attributed to connectivity, we can mention the transformation of the Web through social networks, the open-source system and the role of 'prosumer' users, or producers of content. These common phenomena stimulate research into responsive environments.

Furthermore, wireless technology sensing, portable computing and locational media are all aspects of daily practice that have allowed us to overcome the conceptual gap between the real and the virtual: what takes place on the screen of the digital device is real, even if it is composed of bits. This leap has allowed designers to investigate new technologies in order to seek out more important content and new social meanings. Humans and their sensory experiences are thus at the centre of an architectural project that is part of a new phenomenology where built space is based on investigating sensations and relations between people. Δ+

Valentina Croci is a freelance journalist of industrial design and architecture. She is also coordinating the Design for Living commission at the Association of Italian Design (ADI). She graduated from Venice University of Architecture (IUAV), and attained an MSC in Architectural History from the Bartlett School of Architecture, University College London. She achieved a PHD in Industrial Design Science at the IUAV with a theoretical thesis on wearable digital technologies.

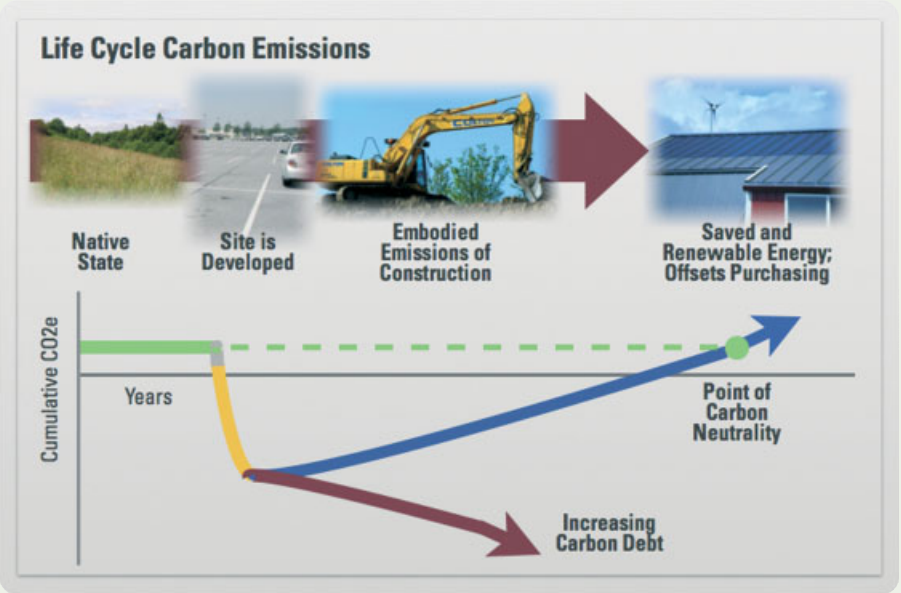
GREEN FOOTSTEP
A TOOL FOR EVALUATING A BUILDING'S LIFE-CYCLE CARBON FOOTPRINT AND INFORMING CARBON DECISIONS DURING THE BUILDING DESIGN PROCESS

The Green Footstep model provides a valuable set of metrics for ecodesign and masterplanning. Here **Michael Bendewald and Victor Olgyay** of the Rocky Mountain Institute (RMI), with **Ken Yeang**, describe the significance of this new online tool. In addition to supplying the basis for balancing the built environment's engineering systems, the Green Footstep enables efficiency with the use of renewable energy systems, such as photovoltaics (illustrated here). By presenting the critical case for increasing the percentage of new vegetation and trees in new developments, it enhances local biodiversity. Carbon emissions are offset from: on-site clearance of vegetation, the disturbance of the many constituents of the local ecosystem and the removal of organic rich soil by new construction.

Ken Yeang

A worldview is emerging that shows nature as a limiting factor to economic growth. This worldview is thoroughly and quantitatively represented by the ecological footprint metric for sustainability developed by Wackernagel and Rees.[1] Designers of the built environment need tools that help them design within this ecological constraint, which, in the case of carbon emissions is necessarily moving design towards carbon neutrality. Designers must integrally consider operational emissions, embodied emissions of construction (that is, the raw material extraction, processing, transportation, on-site assembly and demolition of building materials), and emissions from the permanent change in amount of on-site vegetation and other sources (such as workers commuting to and from the building). These emissions sources can be presented over several years of the building's lifetime to provide a whole-systems perspective of the carbon footprint in an understandable way.

Green Footstep, a free online tool (www.greenfootstep.org) developed at Rocky Mountain Institute (RMI), is now available for this purpose. In addition to describing a project's life-cycle carbon footprint, the tool also informs decisions regarding carbon during the design process by showing in real time the sensitivity of life-cycle carbon emissions to variable design targets such



Life-cycle carbon emissions. Green Footstep accounts for a larger carbon footprint than is typically considered.

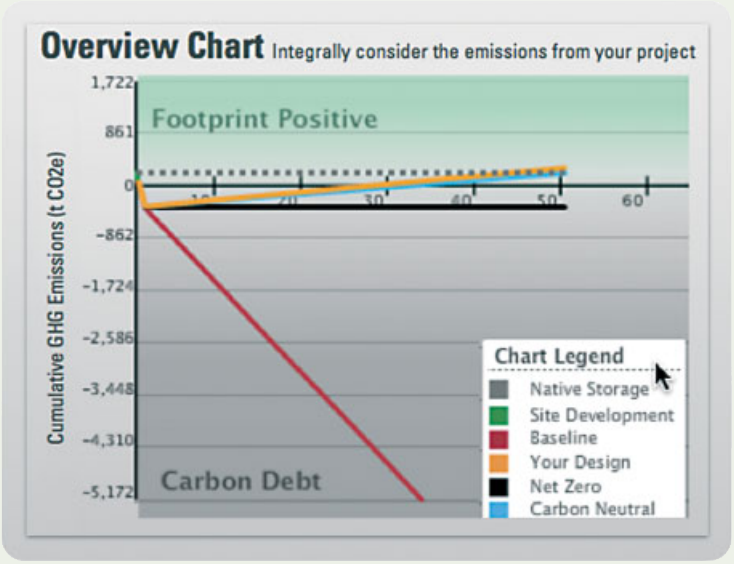
as building energy use intensity, building size, on-site renewable energy, on-site native vegetation and per cent reduction in embodied emissions of construction. Carbon offsets and clean power purchasing can also be taken into account, and both existing buildings and new construction evaluated. Green Footstep is an interactive tool that informs design decisions in the context of an ecologically constrained world.

The Green Footstep Method

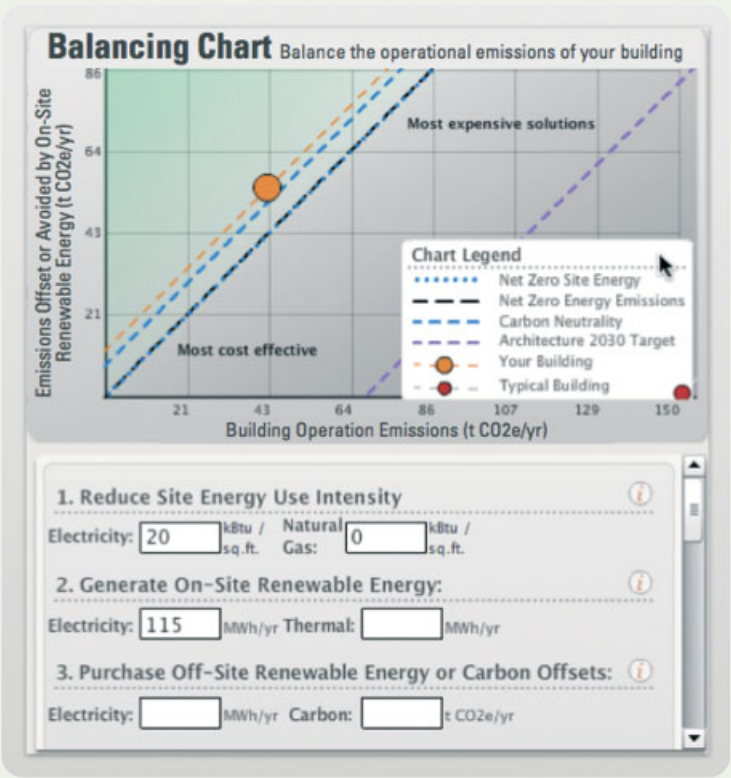
The Green Footstep method is best explained using an accounting metaphor to describe the carbon emissions of a project. The native state carbon storage is considered the amount of carbon the owner of the facility 'owns'. Any carbon emissions send the owner into 'carbon debt'. In order for a project to be 'carbon neutral', this debt must be paid off and the original amount of carbon (equal in magnitude to the native state carbon storage) must be restored.

Green Footstep guides the user through a series of questions to establish a baseline from which to compare the designer's building and to determine the point of carbon neutrality (the carbon stored on the site in its native state). It allows users to be as general or as accurate as they can be. For instance, users can estimate the energy use intensity of their building prior to design using US survey data,[2] or can enter the results from their baseline energy model.

Use of the Green Footstep tool generates three main outputs: native site carbon storage, embodied emissions of construction and operational emissions. Native site carbon storage is determined using carbon storage data by ecosystem type from the Intergovernmental Panel on Climate Change.[3] When the vegetation is cleared (as is common to make room for a building), it is assumed that the cleared vegetation will biodegrade, combine with oxygen (O_2), and enter the atmosphere as carbon dioxide (CO_2). In the Green Footstep model, these emissions can be decreased in the design case by increasing the percentage of on-site vegetation and trees.[4] The default values for embodied emissions of construction were obtained using an economic input-output life-cycle assessment (LCA) of the US economy.[5] While the estimate is generic (based on carbon emissions per US$ of building construction), it is much faster than a process-based LCA of individual building materials. The emissions coefficients for the operational emissions were taken from the US EPA eGRID and Energy Information Administration.[6] The default values in each category can be adjusted as the designer obtains more detailed data in any class.



Life-cycle carbon emissions of a building project. Users adjust design targets and watch the Green Footstep chart adjust in real time.



Balancing chart for viewing operational emissions relative to goals. Users can adjust design targets such as building size and site energy-use intensity, and see the 'Your Building' (orange) dot moving accordingly.

Balancing Efficiency and Photovoltaics (PV): A Sample Project

The power of the Green Footstep tool is evident in application. The example here is a small 1,393 square-metre (15,000 square-foot) office building located in Maine on a 2-hectare (5-acre) site. After answering the preliminary set of questions, users are directed to a 'Design Decisions' page where they can adjust design targets to be distinct from the baseline and reach goals such as carbon neutrality. In this section users are presented with a baseline and two scenarios that a designer might consider: Mild Efficiency + PV to Reach Carbon Neutrality, and Aggressive Efficiency + PV to Reach Carbon Neutrality.

The overview chart in Green Footstep plots the baseline and Mild Efficiency + PV buildings. Notice that after the estimated building lifetime of 50 years, the design case building reaches back up to the native site carbon storage (dotted grey line) and thus carbon neutrality. However, a significant amount of PV is required to reach this goal. A 200-kilowatt system to produce 240 megawatt hours a year (MWh/yr) would require more than 4,500 horizontal square metres (48,000 horizontal square feet).[7]

This scenario is also shown in the Balancing Chart where loads are plotted against resources, with the midline representing net zero energy. Users can increase the energy efficiency to reach the same goal of carbon neutrality with less PV. Through aggressive energy reduction targets, Green Footstep shows that the PV can be reduced by more than half to 115 MWh/yr. Other building performance targets such as the Architecture 2030 challenge[8] can be plotted and assessed.

Sample project scenarios. Alternate scenarios show the trade-off between energy efficiency and PV.

Baseline	Mild Efficiency + PV to Reach Carbon Neutrality	Aggressive Efficiency + PV to Reach Carbon Neutrality
Electricity: 53 kBtu/sq ft (170 kWh/sq m)	Electricity: 30% reduction to 37 kBtu/sq ft (80 kWh/sq m)	Electricity: 62% reduction to 20 kBtu/sq ft (64 kWh/sq m)
Natural gas: 42 kBtu/sq ft (130 kWh/sq m)	Natural gas: 30% reduction to 29 kBtu/sq ft (80 kWh/sq m)	Natural gas 100% reduction
PV: 0 MWh/yr	PV: 240 MWh/yr	PV: 115 MWh/yr

Conclusion

Addressing the atmospheric carbon associated with buildings is critical to reduce global climate change. The calculations associated with this issue are not complicated, but are typically not carried out. Green Footstep provides an accurate, comprehensive and easy to use tool that allows decisions to be made during the design process to encourage the development of high-performance, very low carbon designs. Broad use of tools such as Green Footstep may assist in the development of high-performance buildings appropriate for an ecologically constrained world. Δ+

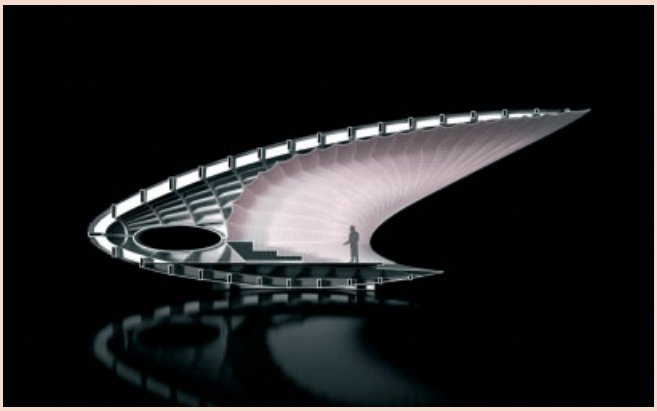
Michael Bendewald is an analyst at Rocky Mountain Institute where he provides research, writing and consulting on RMI projects. His main experience is in assessing life-cycle carbon emissions of buildings and analysing building design process. Other experience includes tool development, case study development, life-cycle cost analysis and technical consulting.

Victor Olgyay, AIA, is a principal at the Rocky Mountain Institute where he leads the Buildings practice, and is currently directing an initiative to stimulate comprehensive building energy retrofits. He was an associate professor and Director of Research at the University of Hawaii School of Architecture from 1993 to 2000. His recent research has focused on ecosystem services as criteria for green building assessment, including building tool applications.

Ken Yeang is a director of Llewelyn Davies Yeang in London and TR Hamzah & Yeang, its sister company, in Kuala Lumpur, Malaysia. He is the author of many articles and books on sustainable design, including *Ecodesign: A Manual for Ecological Design* (Wiley-Academy, 2006).

Notes

1. See Mathis Wackernagel and William Rees, *Our Ecological Footprint*, New Society (Gabriola Island, BC), 1996.
2. National averages by space type from the US Energy Information Administration's Residential Energy Consumption Surveys or its Commercial Buildings Energy Consumption Surveys.
3. Intergovernmental Panel on Climate Change, '2006 IPPC Guidelines for National Greenhouse Gas Inventories', Vol 4, Chapter 4: 'Forest Land', Figure 4.1. Available from www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html; accessed 1 October 2009.
4. Carbon storage by tree is calculated using the following source: '2006 IPPC Guidelines for National Greenhouse Gas Inventories', Vol 4, Chapter 8: 'Agriculture, Forestry and Other Land Use', Table 8.2. The total carbon storage of a tree was determined based on annual accumulation and a 20-year growing period. For instance, a mixed hardwood accumulates 0.01 tonnes of carbon (t C) per year for 20 years then its growth drops off considerably. Thus, 0.2 t C (which becomes 0.73 t CO_2 when the tree decomposes) was estimated. Carbon storage of all listed trees in Table 8.2 were averaged to produce the single storage figure used in Green Footstep of 0.77 t CO_2.
5. Carnegie Mellon University Green Design Institute 'Economic Input-Output Life Cycle Assessment (EIO-LCA)', US 1997 Industry Benchmark model [Internet]. See www.eiolca.net; accessed 1 October 2009. The figure was converted for US$ (2009) using a factor of 1.34 to account for market differential.
6. Electricity carbon emissions coefficient: US Environmental Protection Agency's eGRID. Data available from www.epa.gov/cleanenergy/energy-resources/egrid/index.html; accessed 1 October 2009. Natural gas carbon emissions coefficient: US Energy Information Administration. Data available from www.eia.doe.gov/oiaf/1605/coefficients.html; accessed 1 October 2009.
7. Green Footstep does not calculate the required amount of PV to produce the PV-generated energy. The authors made the conversion from PV-generated energy to PV size assuming a 13.6 capacity factor (PV Watts V.1, available from http://rredc.nrel.gov/solar/codes_algs/PVWATTS/ version1/), a tilt angle of 47 degrees (PV is aligned in rows with zero self-shading when the altitude angle of the sun is above 15 degrees), and a 15 per cent efficiency panel.
8. Architect Edward Mazria established Architecture 2030, a non-profit, non-partisan and independent organisation in 2002 in response to the global warming crisis. Architecture 2030 has issued the 2030 Challenge which asks the global architecture and building community to adopt design targets that from now until 2030 will come closer to achieving net zero operational carbon emissions. For more information see www.architecture2030.org/.



Section through the Sound Forms acoustic shell structure.

Noise Annoys

The dark art of acoustics continues to polarise objective opinion, particularly when you cannot always see the expensive tweaks and enhancements of major concert venues. A new venture for temporary and relocatable outdoor acoustic performance may offer a more positively designed sonic experience. Designed as a replacement for ubiquitous music festival staging, the form and material construction of Sound Forms[1] help to naturally amplify, focus and broadcast acoustic and electro-acoustic performances. Designed by architect and sound artist Paul Bavister[2] in partnership with Arup Acoustics, the Sound Forms team envisage that this new demountable monocoque shell, or mobile acoustic performance shell (MAPS), revolutionises the acoustic quality of outdoor classical concerts.

Less topical, but no less relevant are the remarkable acoustic experiments and hypotheses of Athanius Kircher, which have been brilliantly captured in Joscelyn Godwin's new book on the 17th-century polymath.[3] Kircher's work in the field of sound, music and acoustics ranges from eavesdropping devices of giant spiral trumpets buried in walls, toan early prototype for a public address system, flying Aeolian harps and his more straightforward, but no less engaging empirical work on echoes and theatre acoustics. Still within the analogue age of music, but around 300 years later, a report in the *Los Angeles Times* from 1987 profiled Dr Arthur Lintgen,[4] a medical diagnostician from Pennsylvania who claimed that he could identify the music on a phonograph record by simply looking at the grooves. In a test detailed in the article, Lintgen successfully differentiated between two separate recordings of Stravinsky's *The Rite of Spring,* and added that one of the recordings was made by a German orchestra. It is not known whether Lintgen's visual acumen extended to the compact disc, or how a digital-only music recording might be visually deciphered. In a more recent development in the art of sonic remediation, staff at the Swedish School of Textiles in Borås have announced the development of Cullus,[5] a three-dimensional knitted sound absorber, which can change shape to create a variable acoustic condition.

Local Economies

Think globally and act locally is a much-used *cri de coeur* with a disputed provenance (I for one will put my money on Buckminster Fuller), and, talking of putting your money where your mouth is (colloquialism), isn't it about time we take seriously the idea of local economies. In particular, the ownership of the establishments we shop and spend our free time in is sometimes more opaque than you may think. Do not be fooled by badly maintained lavatorial facilities, vague, disinterested staff and ersatz blackboard menued boho chic; the 'trendy' gastro makeover pub you frequent might just be another corporately rolled-out 'leisure offering', a hedge fund-backed financial instrument thinly disguised with studiously mismatched furniture.

In an initiative designed to keep more of one's liquid assets local, 17 September 2009 saw the launch of the Brixton pound (B£),[6] the UK's first urban complementary currency. The project, conceived by local community organisation Transition Town Brixton (TTB),[7] involves the participation of local shops and services who accept the new Brixton currency of 1, 5, 10 and 20 Brixton pound notes. The notes are pegged at a 1:1 currency exchange rate with pounds sterling, but use of the B£ offers special discounts and ensures that a greater percentage of the money you spend locally stays local, supporting independent businesses and local jobs and thus counteracting the hegemony of big national and international chain stores. Tim Nichols, project manager of the B£ project,[8] says that of any money spent in a well-known UK supermarket chain only 10 per cent will remain in the local economy. The B£ is designed to prevent such haemorrhaging of local lucre and, as its organisers say, it is money that sticks to Brixton.

Water Ways

A question sent to Canada's *Globe and Mail* newspaper, specifically to the 'Collected Wisdom' column,[9] produced two complex reader responses. The question from Jay Miller of Parksville, British Columbia, was: 'Does a racing shell (a slim row boat designed for racing) travel faster in salt water or fresh water, all else being equal?' The first response explained that this was a more complex question than one might suppose. The saltwater being denser would mean that the boat would sit higher in the water and thus, with a smaller wetted surface, would present less friction; however, the greater viscosity of the saltwater would in turn present more resistance, but '… the shallower draft would mean less energy lost through the bow wave created (less water would need to be pushed out of the way), which would tend to increase speed', and the power achieved by each stroke of the oars would be greater in the denser saltwater because of the increased friction. This view was supported by a second reader who agreed that a boat in the denser salt water 'will float higher and have less drag'; the reader also confirmed that saltwater weighs 1,025 kilograms (2,260 pounds) per cubic metre (1.308 cubic yards) as opposed to freshwater's 1,000 kilograms (2,205 pounds). And in another density comparison story,[10] the Atlantis Resources Corporation says that recent trials successfully demonstrate that their new AS-series generator is the most efficient deep-water tidal turbine to be ocean tested. Because water is more than 800 times the density of air, tidal turbines with an equivalent power output to offshore wind turbines can be considerably smaller in size. Atlantis Resources is currently investigating possible installation locations including the Pentland Firth in Scotland. This remote location situated between the Scottish mainland and the Orkney Islands generates hugely powerful tidal currents of up to 140 kilometres (87 miles) per hour; the Atlantis proposal includes an array of submerged turbines generating up to 150 megawatts of electricity, with the biggest perceivable technical issue the successful transmission of such large amounts of power to the national grid in a part of the country not geared up for such loads. In a neat and synergetic move, the excess power produced by the tidal power scheme is used complementarily to supply energy to a 'small city of computer servers'[11] (forming a massive data centre) on the nearby island of Hoy, which, in addition, utilises the natural cooling of such a physical location. AD+

'McLean's Nuggets' is an ongoing technical series inspired by Will McLean and Samantha Hardingham's enthusiasm for back issues of *AD*, as explicitly explored in Hardingham's *AD* issue *The 1970s is Here and Now* (March/April 2005).

Will McLean is joint coordinator of technical studies (with Pete Silver) in the Department of Architecture at the University of Westminster. He recently co-authored, also with Pete Silver, the book *Introduction to Architectural Technology* (Laurence King, 2008).

Notes

1. www.soundforms.co.uk.
2. www.audialsense.com.
3. Joscelyn Godwin, *Athanius Kircher's Theatre of the World*, Thames & Hudson (London), 2009.
4. Al Seckel, 'The Man Who Could Read the Grooves', *Los Angeles Times*, 19 October 1987, Metro Section, p 3.
5. Margareta Zetterblom, 'Knitted Sound Absorbers: The Big Secret is Out', *Prospectus*, Swedish School of Textiles (Borås), 2009, pp 24–5.
6. http://brixtonpound.org.
7. www.site.transitiontownbrixton.org.
8. www.youtube.com/watch?v=Brq1NY2tiWA.
9. Philip Jackman, 'Collected Wisdom', *Globe and Mail*, 26 September 2009, p A19.
10. 'World's Most Efficient Tidal Turbine', *Environment Times Regional Roundup*, Vol 12, No 4, p 8. See www.environmenttimes.co.uk.
11. www.atlantisresourcescorporation.com/media/news/1-latest/7-news2.html.

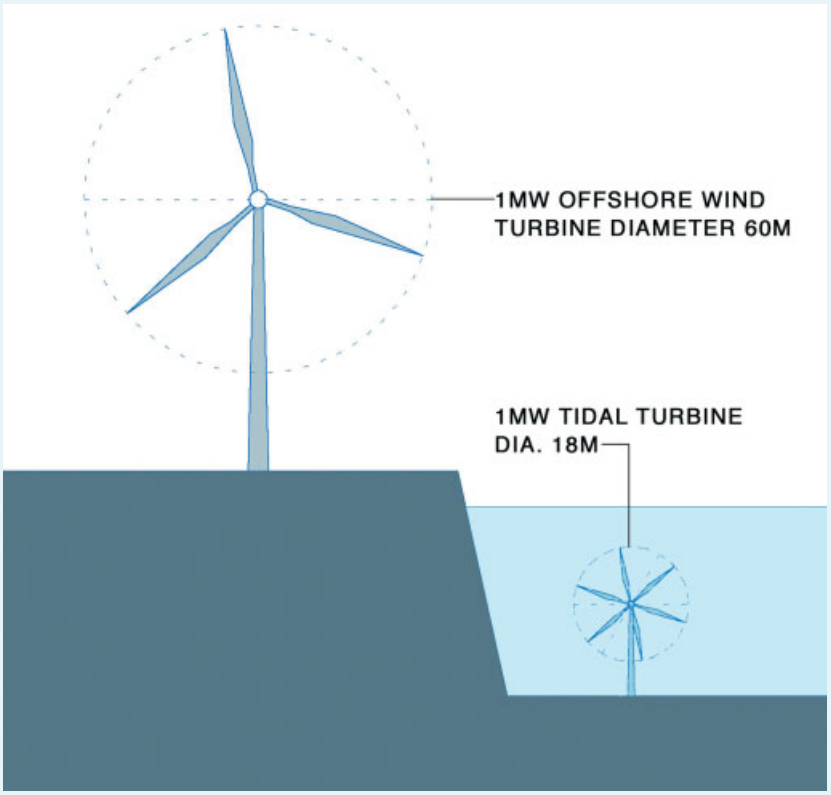
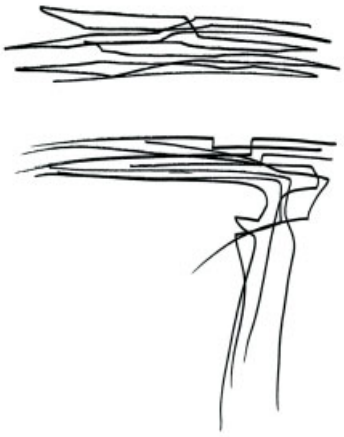


Diagram showing the equivalent size of 1-megawatt turbines in air and water.



MAXXI, ROME
ZAHA HADID ARCHITECTS

Mark Garcia, editor of *The Diagrams in Architecture* (John Wiley & Sons, 2010), one of the first significant accounts of the diagram in architectural design, provides a unique insight into the diagrammatic form of Zaha Hadid Architects' new MAXXI museum in Rome.

> *I wanted a democratic museum … I wanted a museum that has no predetermined route … I wanted confrontation, which does not mean having everything confront each other in the same room. I wanted a more transparent view … a work in a room devoted to a particular artist, and to always have other views possible of works in other rooms, even if it is just out of the corner of my eye … The labyrinth served this … I could lose myself and so be forced to find landmarks.*
>
> Johannes Cladders, 1999[1]

The competition for Rome's new Museo Nazionale Delle Arti Del XXI Secolo (MAXXI), won by Zaha Hadid Architects (ZHA) in 1998, provided an opportunity to create a masterpiece. The resulting museum, which opened in November 2009, was established to update and increase Rome's stock in the international contemporary art world. Before MAXXI, Roman modern art was served in meagre offerings with few choices in limited and unsatisfactory venues. MAXXI was commissioned to deliver a national museum and cultural centre focusing on art and design (including fashion, cinema, advertising and architecture). In addition to spaces for exhibitions and the museum's growing collection of more than 300 works (including art by Boetti, Kapoor, Kentridge, Merz, Richter, Warhol, Scarpa, Rossi, Nervi, Ito, Rota and de Carlo), the MAXXI complex also consists of an auditorium, library and media library, bookshop and cafeteria, outdoor spaces, offices and leisure and retail spaces. At a cost of 150 million euros, and with a total site area of 29,000 square metres (312,153 square feet) – on an L-shaped site between two main streets and at an intersection of smaller roads that formerly housed jeep-manufacturing facilities and a military barracks – this new museum is expected to draw up to 400,000 visitors a year.

MAXXI was conceived of primarily as a diagram. Hadid's planimetric diagrams of MAXXI are also its most iconic image, aerial views visible only from a plane or obliquely from nearby hills and high-rises. These can also be linked to non-architectural diagrams: geological/geographical diagrams (found in MAXXI's geological, fluvial, landform and field morphologies), organic diagrams (which come from the branching, dendritic, snaking aspects of MAXXI), textile diagrams (from its network of intertwined, stranded, plaited, unravelling and threaded strips), and urban diagrams that evoke the power and

Zaha Hadid Architects, MAXXI, Rome, 2009
below left: Pilotis in the piazza, eastern elevation and ground floor.
below centre: Ground-floor external view of the northeast elevation and third-floor gallery cantilever from the north to southeast.
below right: MAXXI study painting. Aerial perspective of the River Tiber, the Olympic Stadium and MAXXI (micro and macro superimposition) from central Rome, south of MAXXI, 1998.
bottom: Plexiglass presentation model, 1998.
opposite left: Elevation from the southwest of the site to the northwest.
opposite right: MAXXI diagram, 1998.

controlled violence of high-velocity trajectories of raking, civic engineering, infrastructures and armatures found in rail tracks, bridges, canals, autostradas, tunnels, locomotives and streets. There is also a luminous set of diagrams derived from the reflecting, refracting, diffracting, deflecting qualities of rays, streaks, stripes, trails, beams and diffusing gradients of light. These layers of diagrams and the spatioformal logics and operations they produce in the real spaces and experiences of MAXXI originate in Hadid's layered system of drawing in her design method.[2]

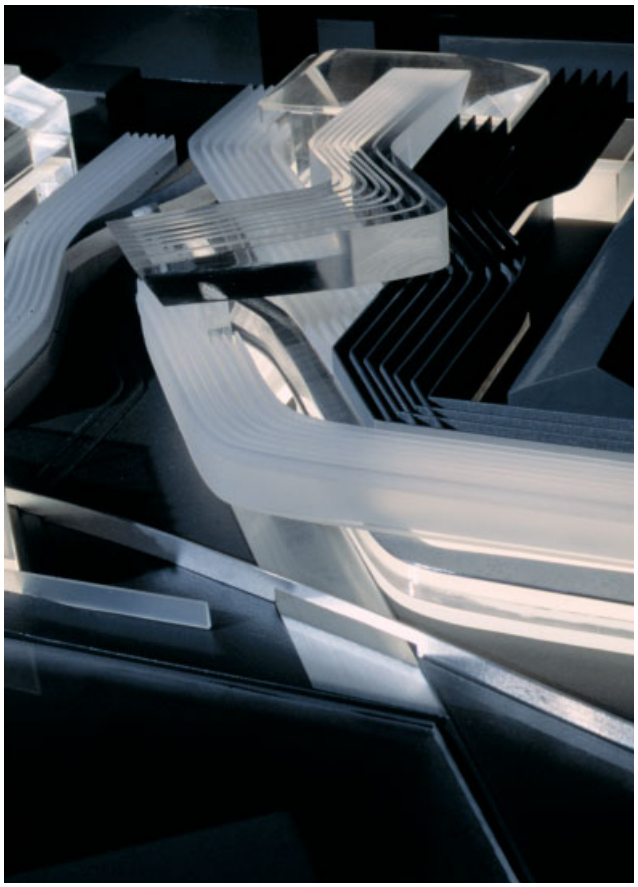
Elements of the MAXXI diagrams can also be found in other of Hadid's works.[3] The wraparound L-shape of MAXXI's diagram (recalling ZHA's Madrid Museum for the Royal Collection, 1999, and Landscape Formation 1 of 1996) also addresses its context through its registry and its reticulated redesign of its locality. Its successful translation into a real building is therefore partly an index of, and partly a reformation of, its context, achieved through the absorption, implosion and extension of its site vectors. MAXXI is thus a projective genealogical excavation and a generative condensation, a blurring inflection and archaeological amplification of its urban grid into a higher resolution. It maintains the height of adjacent buildings and generously provides building- and street-line inflecting landscaping around itself with a public piazza. The public piazza unfortunately closes at night.

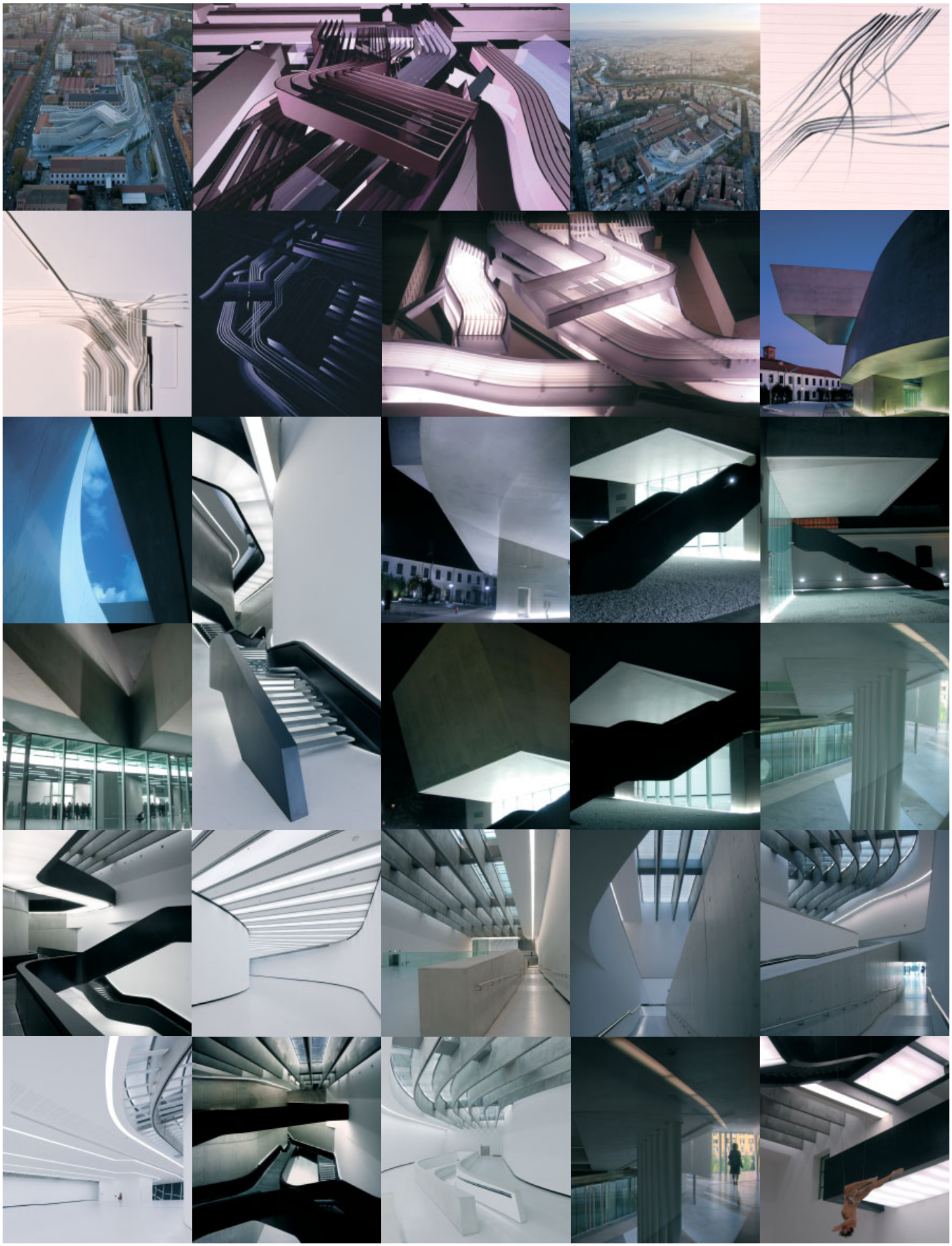
The completed complex has elements of Constructivism, Productivism, Futurism, Deconstructivism, Surrealism and Brutalism. And in parts its high-performance engineering pushes it towards High-Tech, Structural Expressionism and Minimalism. The functions and effects produced through Hadid's diagrams thus create a range of integrated programmatic, contextual and psychological effects.

MAXXI's pultruded diagram connects the museum to its external urban context, taking the existing circulatory and morphological flows of the city and streamlining these across three floors into the five interlinkable, or separable, 'suites' of galleries within the museum. This gives MAXXI an unusual capacity to accommodate more subjective, unexpected dimensions in its aesthetic effects. It orchestrates and materialises a sequence of layered views into theatrical, spectacular and arcade-like spaces that drift into each other, enabling the distracted, peripatetic and nomadic *passeggiata* described by Siegfried Kracauer[4] and theorised by Walter Benjamin[5] in the concept of the *flâneur*. Together with the museum's material organisation, the routes and views constitute a set of effective and efficient content and experience-management tactics and strategies.

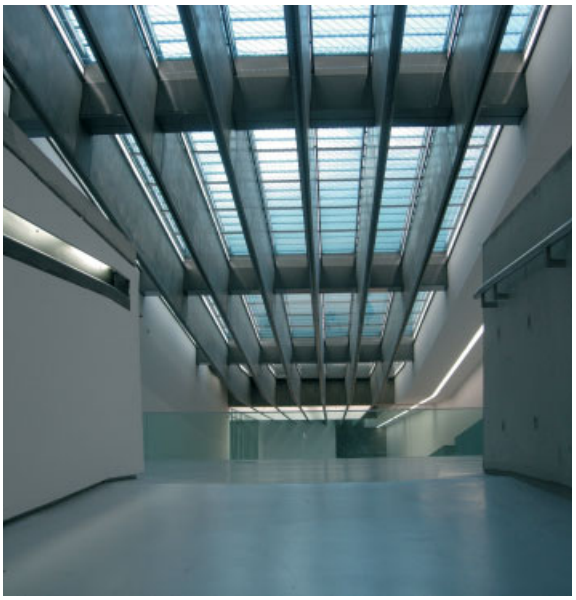
MAXXI partly deconstructs Modernist object and exhibition space taxonomies and traditional, historical museological aesthetic classification systems and their simplistic linear movement and view itineraries. This delinearisation creates possibilities for more unpredictable and variable visual displays, allowing individuals to interrogate the museum through a number of different narrative and circulation sequences and through the co-presencing, intervisibility and interaccessibility of the spaces. These enrich the number and density of the different views of the artworks and their





Zaha Hadid Architects, MAXXI, Rome, 2009
right:View into the piazza and to the atrium facade from above, also with a view of the interior of the bridge to the exterior northeast. *far right*:View down the centre of the first-floor gallery to the northwest. *opposite from left*: Aerial view of the museum to the west of Rome and the Tiber; Computer rendering, 1998; Aerial view; MAXXI diagram, 1998; MAXXI card study model, 1998; Study painting. Aerial perspective from northwest to southeast; Internally lit presentation model, 1998; Ground-floor interior entrance hall to the north; External view upwards from below the bridge in the piazza; Ground-floor entrance hall and grand staircase to the northwest; Ground-floor external view of the northeast elevation and third-floor gallery cantilever from north to southeast; Ground-floor external view under the cantilever from the northwest corner towards the northeast; Ground-floor external view under the cantilever from the northwest corner towards the south; Ground-floor gallery from the exterior/ piazza to the northwest; External view of the Cardiff Opera House 'jewel-like' cantilever from the ground floor, from the northwest corner towards the north; Ground-floor external view under the cantilever from the northwest corner to the northeast; View into the piazza and the atrium from above, inside the bridge to the exterior north; First-floor interior walkway to the north; Ground-floor gallery interior to the northwest; View down the centre and down the ramp of the first-floor gallery to the northwest; View into the second-floor southeast corner from the bottom of the bridge-linked ramp on the first floor; View from the ramp on the second floor in the southeast corner; Second-floor gallery cantilever looking north and northeast to the exterior and out of the Cyclopean cantilever window; Second-floor interior of the entrance hall to the north; Second-floor gallery to the south end of the museum; View from inside the bridge to the exterior north and exterior west side of the bridge; Ground-floor entrance hall.



interrelations, multiplying their effects and provoking a more pluralist, subjective, critical, emergent yet stochastic interpretive process of review and revision of the art.

MAXXI's choreographed congestion of these social, spatial and aesthetic effects is a consequence of its diagram's proliferation and balancing of spatial and formal diversities and the self-similarities within its five suites of galleries. Its surprising and kaleidoscopic isovists create some aesthetic and psychological dislocations and disjunctions which also (ironically) create what has become a staple of the best new museums: a subjective relocation of the shifting interactive links between object, vision, idea, exhibition, building, city and space through personal and bodily presence.[6] One of the most interesting things about MAXXI, then, is that it is a museum of museum spaces and museology,[7] in fact if not in possibility.

These spatial effects are also intensified through their materialisation, significantly with the use of glass to enhance vanishing, veiled views and grand curving deviations into other galleries or into divergences to the outside (and sometimes illusory images that combine three, four and more of these at once). The flexible system of partitions (suspended from the ceiling-track system of lacerating concrete-clad fins) and the connections of spaces accent these effects. The meandering, swerving and switch-back ramps and anthracite staircases that float over fluorescent light-boxes and hang in veering, swaying swags seem to swing rhythmically in precipitously cantilevered branching terraces over vertiginous voids to create some uncanny and plunging warpings of multiple, multilevel bridged and labyrinthine perspectives and vanishing points that recall Piranesi's Carceri, Moses King, Erik Desmazières and FW Murnau. All of these spatial effects rely on an austere, ascetic palette of exposed concrete, glass, white walls, grey steel, white floors and light.

Once the art is installed this year, MAXXI's success will be sealed, for any artist or curator will be able to find or make space here appropriate to their objects and intentions. Ultimately, Hadid's museum will propel the 'Eternal City' into the future of the international artistic avant-garde. But then the genius of art, space and time has always been part of Rome and of Zaha Hadid. AD+

Mark Garcia is an academic, author and journalist. He has worked in industry as Research and Development Manager for Branson Coates Architecture and has held academic research and management posts at St Antony's College, Oxford, and in the Department of Industrial Design Engineering at the Royal College of Art. He has taught MA and MPhil/PhD students in the departments of Textiles and Industrial Design Engineering, and in the Department of Architecture where he was most recently Research Co-ordinator and an MPhil/PhD supervisor. He is the guest-editor of the *AD* issues *Architextiles and Patterns of Architecture*, and editor of the book *The Diagrams of Architecture* (John Wiley & Sons, 2010).

Notes

1. Johannes Cladders, cited in Hans Ulrich Obrist, *A Brief History of Curating*, JRP Press (Zurich), 2008, p 63.
2. See P Jodidio, *Zaha Hadid Complete Works*, Taschen (Cologne), 2009, p 12.
3. For example, the Quatar Museum (1997), IIT Campus (1998), Graz Art Museum (1999), Reina Sophia Museum (1999), the Quebec Library (2001), BMW Leipzig (2001), Grande Mosquee de Strasbourg (2000), Sagaponac Villa (2002), Guggenheim Singapore (2006), Jesolo Retail Centre (2006), Energy Research Centre, Aachen (2006), BBVA Bank (2008), Naples-Afragola station (which also has similar stripes of rooflight tracks) and in the later Issam Fares Institute Beirut (2006–11). It is also present (vertically) in the Singapore Guggenheim (2006) and (in deep elevations and sections) in the Pierre Vives, Montpellier (2002). The only work of architecture not by Hadid that bears any resemblance to the MAXXI diagram is Greg Lynn's model of the Stranded Sears Tower (1993).
4. See Siegfried Kracauer, 'Once again in the street', *Theory of Film: The Redemption of Physical Reality*, Oxford University Press (New York), 1960.
5. See Walter Benjamin, *Das Passagen-Werk or The Arcades Project* [1927–40], ed Rolf Tiedemann, trans Howard Eiland and Kevin McLaughlin, Belknap Press (New York), 2002.
6. K Message, *New Museums and the Making of Culture*, Berg (London), 2006, p 62, and R Krauss, 'Postmodernism's museum without walls', in R Greenburg, BW Ferguson and S Nairne (eds), *Thinking About Exhibitions*, Routledge (London), 1996, p 347.
7. I Karp and SD Levine (eds), *Exhibiting Cultures: The Poetics and Politics of Museum Display*, Smithsonian Institution Press (Washington DC), 1991, p 7; Greenburg, Ferguson and Nairne, op cit, p 3; and BM Carbonnel (ed), *Museum Studies: An Anthology of Contexts*, Blackwell (Malden, MA), 2004, p 2 all theorise this.

ARCHITECTURAL DESIGN

GUEST-EDITED BY
DAVID GISSEN

TERRITORY: ARCHITECTURE BEYOND ENVIRONMENT

Cross-disciplinary contributions come from geographers, historians and theorists

Ila Berman
Javier Arbona
Ben Campkin
Edward Eigen
Matthew Gandy
Nicholas de Monchaux
Antoine Picon
Mitchell Schwarzer

Features

Patrick Blanc
Gilles Ebersolt
Future Cities Lab
Fritz Haeg
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Kuth/Ranieri
The Living
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WEATHERS

Advancing a new relationship between architecture and nature, *Territory* emphasises the simultaneous production of architectural objects and the environment surrounding them. Conceptualised within a framework that draws from physical and human geographical thought, this title of AD examines the possibility of an architecture that actively produces its external, ecological conditions. The architecture here scans and modifies atmospheres, arboreal zones, geothermal exchange, magnetic fields, habitats and toxicities – enabling new and intense geographical patterns, effects and sensations within architectural and urban experience. *Territory* charts out a space, a territory, for architecture beyond conceptualisations of context or environment, understood as that stable setting which pre-exists the production of new things. Ultimately, it suggests a role for architecture as a strategy of environmental tinkering versus one of accommodation or balance with an external natural world.

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BEYOND ENVIRONMENT

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