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Graham Stevens: Atmospheric Industries

McLean, W.

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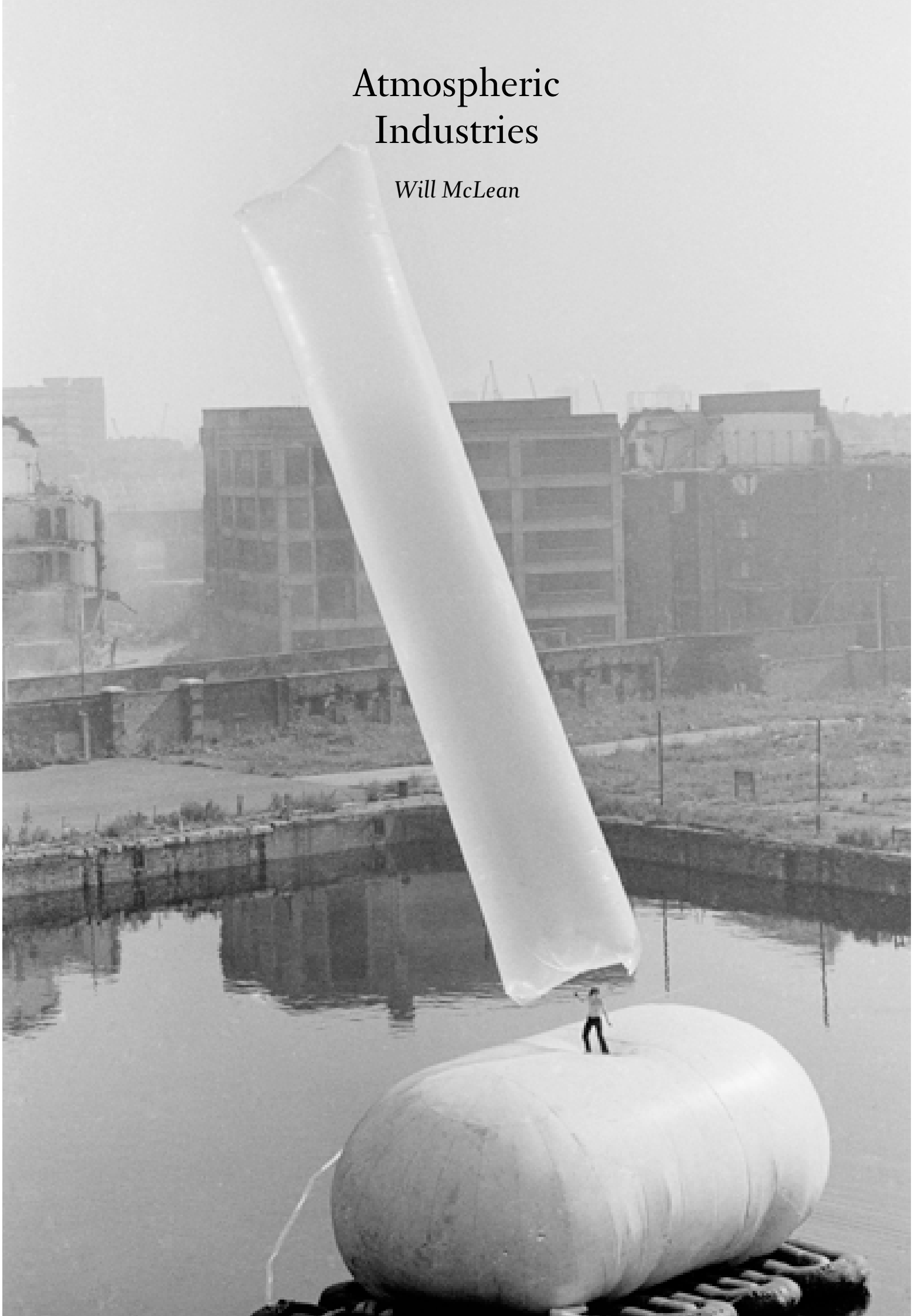
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Atmospheric Industries

Will McLean



Several years ago I visited Woolsthorpe Manor in Lincolnshire, the home of Isaac Newton, acting on a long-held fascination for the experiments he made in refracted light, so poetically described in his *Opticks* (somehow, I had convinced myself that only a visit to Newton's south-facing study would provide clues to his prismatic revelations). Born in Woolsthorpe in 1642, Newton returned there in 1665 after his studies at Cambridge. Over the following 18 months he discovered the principle of differential calculus, discerned laws governing planetary motion and made visible the colours of sunlight – 'not bad for a year and a half of sitting in one's room thinking', as his biographer Todd Timmons drily observes. Newton was a 'natural philosopher' and his descriptions of the prism experiments, in particular, can be read as both scientific and sculptural endeavours, inasmuch as their arrangement refers to the physical properties of light and the spatio-temporal relations of the sun, his room and its associated artefacts.

I was reminded of the blurring of these boundaries when I first encountered the English artist Graham Stevens, not another Newtonian whose scientific discoveries achieve a kind of artfulness, but a sculptor whose works featuring plastic membranes and pneumatic structures are manifestly inventions; experiments that explore a human relationship with the physical forces of nature. Stevens had first encountered the dynamism of kinetic art as an undergraduate architecture student at the University of Sheffield in the early 1960s. At the time the school encouraged its students to work across a number of departments, especially psychology and physics. The real impetus behind this approach was Stevens' professor, J K Page, a member of the Independent Group and the UK's first chair of environmental science in a school of architecture, as well as the author of the famous note 50 of the World Meteorological Organisation report *Climate in Towns* (1959), which definitively stated for the first time that 'buildings articulate climate'.

It was this education that quickly enabled Stevens to bring both his analytical and creative energies to bear on each new work as both artist and inventor. Even before graduating he began experimenting with thin lightweight membranes, and soon afterwards started testing and researching the architectures of fluid dynamics and more complex multi-layered surfaces. From the outset, these pursuits were not conceived as a collaboration between art and science, but were imagined more intuitively as the exploration of sculpture through the absorption of various natural and environmental systems. Half a century on, the more myopic tendencies of artistic and scientific institutions have meant there has been a failure to acknowledge his work, or even simply to recognise that his sculpture and architecture may also usefully operate as science and technology. In the same way that Buckminster Fuller is labelled the 'dome guy' by sneering architects

*For in those days
I was in the prime of
my age for invention.
Isaac Newton, 1718*

protective of their illusive craft, Stevens' pneumatic art, and that of like-minded colleagues, is still footnoted in art and architectural history as just a kind of trend or passing novelty, rather than an exploration of human comfort and the dematerialisation of architecture.

In Stevens' first air sculpture *Spacefield* (1966), fabricated with fellow architecture students at the University of Sheffield, a large inhabitable structure was created to explore the physiological effects of a single colour field, a participatory artwork of heat, light, sound and after-image; a kinaesthetic experience. The success of early prototypes encouraged Stevens to purchase his own plastic welding machine, and his studio in the then semi-derelict St Katharine's Dock adjacent to London's Tower Bridge became the site (playground, even) for a series of large-scale air sculptures of various material densities culminating in *Atmosfields* (1970).

Encouraged by the success of these works, Stevens' next projects took on an almost biblical dimension, enveloping the body (his own, in the first instance) in an inflatable pod so that the user could literally walk on water. One of the by-products of these 'transmobile' works was that in first filling plastic membrane structures with water, Stevens inadvertently invented the waterbed – an example of which was exhibited as part of the 'Pneumatic Environment' exhibition in Battersea during Gustav Metzger's 1966 *Destruction in Art* symposium. The same exhibition also featured another Stevens design – an air-inflated landscape on which you could climb, walk, bounce and generally interact. Henceforth known as a bouncy castle, this was another accidental (or serendipitous) discovery that Stevens made whilst exploring the new possibilities of more tactile, kinetic and interactive art.

The designers Theo Botschuijver and Jeffrey Shaw were among the first visitors to the Battersea show and soon afterwards they approached Stevens to work together on *Waterspelen* (Water Plays), commissioned by Sigma Projects. The project, designed for an Amsterdam park and canal in 1967, was to develop a series of structures 'for play, on land, water, or air ... including water bags'. Shaw and Botschuijver subsequently formed the Eventstructures Research Group, which would go on to produce the famous helium-inflated pig pictured on the 1976 Pink Floyd album *Animals*. Other 'transmobile' sculptures were all first tested by Stevens over the water next to his St Katharine's Dock studio before being redeployed in other

Atmosfields, St Katharine's Dock, London, 1970
GASACT © Graham Stevens,
photo Andrew Tweedie

aquatic and terrestrial settings. Among these was *Hovertube* (1970), which was formed of a single pneumatic sculpture that snaked for a quarter of a mile over and above Coverack Bay in Cornwall. A similar, though smaller, design called *Pontube* was installed in a lake in Holyrood Park, Edinburgh the same year. By now Stevens had actually developed six methods of walking on water including inflated tubes, inflated bubbles and inflatable boots. Each required few resources or external energies, and essentially only comprised a thin polythene skin, a negligible air-pressure differential and pneumatic integrity created with a low-powered fan unit. The James Bond movie *Diamonds are Forever*, from 1971, had Sean Connery make full use of both a waterbed and the walking-on-water *Transmobile*, but did not credit Stevens with either.

The Bond producers Harry Saltzman and Cubby Broccoli were not alone in appreciating the originality of these inventions, as this period saw numerous artists and artist groups move into dematerialised territories, abandoning the confines of the gallery in favour of an engagement with a wider physical and social environment. In retrospect, Stevens' work can be identified as a part of this changing artistic response or sensibility, and he participated and co-curated the influential 1967 show 'The Unstable Environment: The Use of Pneumatics in Art and Architecture' at the Institute of Contemporary Arts, London. The following year he was invited to exhibit in the 'Structures Gonflables' exhibition organised by the Utopie group at the Musée d'Art Moderne, Paris, which in turn prompted the influential US artist and curator Willoughby Sharp to invite Stevens to take part in the 'Air Art' group exhibition in Philadelphia in 1968. Alongside work by Robert Morris, Marcello Salvadori and Andy Warhol, there was Stevens' *Sensory Activation Chamber*, a pneumatic environment fabricated from complementary coloured fluorescent fabrics. The show would later tour six more cities in North America.

In the following years there was a subtle but notable shift in Stevens' work, as he began to write extensively on pneumatic structures in a series of comprehensive articles for *Architectural Design*. Much of this writing synthesises Stevens the artist – presenting his own projects – with Stevens the scientist – offering informed appraisals of various conferences and developments in the field. These include 'Pneumatics and Atmospheres' (*AD*, March 1972) and 'Pneumatics Report on the Delft Symposium', co-authored with Bodo Rasch, the long-standing collaborator of Frei Otto (*AD*, January 1973). Stevens' exposure to this wider community began in 1967 when he attended the 1st International Colloquium on Pneumatic Structures (organised by the International Association for Shell Structures) at the University of Stuttgart. The colloquium hosted an outstanding group, representative of this rapidly evolving technological art – among them Walter Bird,

Victor Lundy, Heinz Isler, Dante Bini, Nikolaus Laing, Cedric Price and chaired by Otto. It was here that Stevens first met Price, and he subsequently took regular counsel with the architect and his friend, the engineer Frank Newby. With this, his own pneumatic sculptures quickly grew in size and complexity. The physicist Laing also proved to be especially influential, sharing his interest in the overlaps between air structures and solar energy. Many of these ideas were also guided by Farrington Daniels' key book, *Direct Use of the Sun's Energy*, published in 1964, which had been recommended to Stevens by Price.

Knowledge and expertise in the field of pneumatics continued to be disseminated largely through conferences and symposia, even if Stevens' report on the Delft event registers Price's concern that the excessive secrecy surrounding specific technologies could be 'detrimental to the successful development of this new industry'. To counteract any apparent furtiveness, Price and Newby established their Lightweight Enclosures Unit. Out of this came the 1971 publication of *Air Structures: A Survey*, co-authored with Robert H Suan, which offered a remarkable and comprehensive documentation of the history, technology and engineering analysis of pneumatic structures. Their unit also published a separate, detailed bibliographic index of relevant manufacturers, *Air Structures Bibliography* (1972), and Stevens has more recently acknowledged the importance of both sources of shared knowledge, alongside the volumes produced by Otto's Institute for Lightweight Structures. These connections also fed back into his projects, notably the collaborative role he played in Price's Phun City (Sussex, 1970), which featured one of Stevens' 'transmobile' environments – a huge pill-shaped pneumatic cinema and event space that hosted Detroit band MC5 and a brief appearance from the American novelist William Burroughs.

At the same time Stevens began exploring other media with which to explain and document his projects and ideas, not least film. Two such documentaries, *Atmosfields* (1971) and *Desert Cloud* (1974), capture both the essence and technological interests of the key phases of his work. Perhaps the most ambitious of these was the eponymous *Desert Cloud*, an elevated canopy that represented a radical departure from the earlier 'transmobiles', in seeking out the supportive properties not of water but of solar radiation. Locating the project where he would have guaranteed light and cloudless days – the Arabian desert in Kuwait – Stevens was able to place the work not only within the ritualistic histories of sun worship, but at the epicentre of the OPEC oil crisis.

Characteristically marrying both rational and intuitive impulses, Stevens paraphrased the technologies he adopted for *Desert Cloud* as ART, his own acronym for Absorption, Reflection and Transparency. Accordingly, solar energy is absorbed through the transparent skin of the

'cloud' (in actuality a 12 × 10 × 2m silver cushion), which then converts high-frequency radiation into low-frequency radiation (in other words, light into heat) through a system of black internal structural webs. This conversion is accelerated further by reflection generated from the membrane's silver fabric. In the process, the air inside the cushion heats up and expands, which then inflates the membrane and the rising heat creates buoyancy, which lifts the whole cloud. Tethered to the ground by ropes, it floats like a shimmering kite, while its underside provides much-needed desert shade. This, then, was a structure that required no electricity, contained no moving parts, and was reliant only on an abundant and freely available energy resource. Stevens even demonstrated how the structure could condense or capture water on its surface, miraculously managing to create ice from a clear desert night sky.

If there is an icon for the work of Graham Stevens then surely *Desert Cloud* is it – a huge inflated artificial cumulus held aloft only by natural buoyancy and the inventive mind of its creator. Despite the fact that this was the first of Stevens' works that did not require his own immediate involvement (unlike all those inflatable tubes and pods which he bravely piloted), it is perhaps the project that most amply describes a relationship between architecture and spaceship earth, and by extension new, more dynamic interactions between humanity and our living systems. In the scale of this ambition it also harks back to an earlier utopian cloud: in 1958 Buckminster Fuller, working with Shoji Sadao, designed Cloud Nine, a series of floating tensegrity living spheres. Half a mile in diameter, these floating cloud communities of 1,000 inhabitants were also to be made buoyant by the sun's natural heating of their internal air – a structural system detailed by Fuller in his book *Critical Path* (1981), in which he argued that the cloud's size-to-weight ratio was such that a rise in internal temperature of only one degree Fahrenheit could literally levitate a whole community. Fuller, then, as ever, was thinking big. This was clearly also something quite fantastical; yet Stevens' successful launch of his own cloud suggests otherwise.

As Stevens explains it now, '*Desert Cloud* was a move away from the singular notion of shelter as a protection against the outside, towards a new conception of shelter in which you experience the atmosphere, the environment.' More radical still, it posited the idea of buildings becoming part of

energy production – an idea he developed further in a paper for UNESCO in which he proposed that future buildings should be solar collectors, wholly self-sufficient in terms of energy. Fuelled by both the radicalism and feasibility of this idea, Stevens went on to form Atmospheric Industries Ltd – a co-operative which advertised its responsibilities through the keywords of its remit: Water, Agriculture, Industry, Building, Transport, Communications and Invention. The organisation soon attracted a number of partners, including the sugar producer Tate & Lyle, which was exploring the technology of greenhouses in the desert, and the engineering firm Arup. Significant funds were raised to commercialise the technology of *Desert Cloud* and to develop Stevens' patented work on the optical properties of membranes. However, despite this, and despite Stevens' prescient faith in the infinite resource of solar energy over the finite supply of fossil fuels, the project remained unrealised. No doubt disillusioned, Stevens found some kind of solace in the fact that his immersion in the legal intricacies of patent applications somehow opened up another career. After the collapse of Atmospheric Industries Ltd, he studied law and soon became a member of the Inner Temple.

When architects ducked the environmental and social imperatives of the mid-1970s for more formalist renderings, the profession (such as it is) suffered a seemingly unrecoverable credibility problem. Yet the work of Graham Stevens suddenly makes the discipline seem more plausible, even sustainable – a more persuasive understanding of architecture that radiates not only from the now historical projects he produced in the 1960s and 1970s, but from what he is still saying today. For Stevens remains fully committed to the importance of the architecture of the environment and has become a leading advocate for the adoption of blue-green technologies. In this capacity he has recently fought hard against the multi-billion pound tideway tunnel (or super-sewer) for London. Super-sized neo-Victorian engineering is not, he thinks, a responsible use of considerable public funds, when a more stealthy and not to say lightweight family of technologies exist to resolve the issue. For Stevens, we should always be looking to environmental phenomena as a way out of the limitations of engrained architectural practices. He cites condensation as the perfect example – the build up of moisture on the inner surface of a space is always perceived as a problem for the designer, or as an indicator of poor craftsmanship, yet rather than obliterating condensation, the water a building naturally produces should be harvested. And in the end, we should really take Stevens seriously when he talks about what this might mean for architecture and the way we inhabit our buildings. After all, this was the man who walked on water and then successfully manufactured it in a desert.

Clockwise from top left:

Hovertube, Coverack Bay, Cornwall, 1970;
Transmobile, 1969; Pneumatic Environment,
 Paris Biennale, 1971; *Pontube*, Edinburgh, 1970;
 Anthea and baby (and waterbed), Glastonbury,
 1971; Phun City festival, Patching, Sussex, 1970;
Transmobile, St Katharine's Dock, London, 1970

All images GASACT © Graham Stevens,
 photos Andrew Tweedie

Overleaf: Desert Cloud, Kuwait, 1974

GASACT © Graham Stevens







Contributors

Joseph Bedford is a doctoral candidate at Princeton University, the founding editor of the audio journal *Attention* and co-founding director of The Architecture Exchange. He has practised, curated and filmed architecture, and his articles have appeared in journals such as *ARQ* and *Log*.

Jean-Louis Cohen holds a chair in the history of architecture at New York University's Institute of Fine Arts and is a guest professor at the Collège de France in Paris. He has published more than 30 books, including *Architecture in Uniform* (2011), *The Future of Architecture Since 1889* (2012) and *Le Corbusier: An Atlas of Modern Landscapes* (2013), and curated numerous exhibitions, including the centennial show 'L'aventure Le Corbusier' at the Centre Georges Pompidou (1987); 'Scenes of the World to Come' at the Canadian Centre for Architecture (1995); and 'Architecture in Uniform' at Rome's MAXXI (2015).

Irina Davidovici is an architect and author of *Forms of Practice: German–Swiss Architecture, 1980–2000* (2013). Formerly senior lecturer in the history and theory of architecture at Kingston University, she is currently engaged in postdoctoral research at the GTA Institute of ETH Zurich, writing on the history of social housing in European cities.

Diane Ghirardo teaches at the University of Southern California and has been visiting professor at MIT and the University of Cape Town. In 1979 she co-founded and edited *Archetype* and was executive editor of the *Journal of Architectural Education*, 1988–99. Her books include *Building New Communities: New Deal America and Fascist Italy* (1989), *Mark Mack* (1993), *Out of Site: A Social Criticism of Architecture* (1991), *Architecture After Modernism* (1996), *Le duchesse, le bufale e l'imprenditoria femminile nella rinascimento ferrera* (2009), *Italy: Modern Architectures in History* (2013) and the English translation of Aldo Rossi's *Architecture of the City* (1982).

Nicolas Groszpiette is a Warsaw-based artist who was awarded the Golden Lion (together with Kobas Laksa) at the 2008 Venice Architecture Biennale for their 'Hotel Polonia' installation at the Polish pavilion. More recent exhibitions have included 'The Self Fulfilling Image', Cueto Projects, New York (2009), 'The Glass Trap', Raster Gallery, Warsaw (2010), 'One Thousand Doors, No Exit', Graham Foundation, Chicago (2011) and 'The Oval Offices', State Gallery of Art, Sopot (2013). His monograph, *Open-Ended*, was published in 2013.

Andrew Higgott is an architectural historian who taught at the AA, where he also worked on exhibitions and publications on the work of Eric de Maré (1990) and F R Yerbury (1987), and at the University of East London, where he led history teaching from 1995 to 2011. His publications include *Mediating Modernism: Architectural Cultures in Britain* (2007) and the co-edited book *Camera Constructs: Photography, Architecture and the Modern City* (2012). He is currently working on a book introducing the work of key modern architects.

Susan Holden is a lecturer in the School of Architecture, University of Queensland and a member of the ATCH Research Centre. In 2012–13 she was a visiting professor at the Vrije University, Amsterdam as part of the 'Métamatic Research Initiative'.

Diego Inglez de Souza is an architect, urban planner and teacher at the Universidade Católica de Pernambuco (UNICAP). He was the assistant curator of the 2013 architecture biennale of São Paulo, and is the author of *Reconstruindo Cajueiro Seco: Arquitetura, política social e cultura popular em Pernambuco, 1960–64* (2010) in addition to many articles on architecture, social housing and urban history.

Sam Jacob is principal of Sam Jacob Studio and was one of the co-founding directors of FAT Architecture. He is also a writer, critic, curator and teacher, contributing editor for *Icon* and a columnist for both *Art Review* and *Dezeen*; author of *Make It Real: Architecture as Enactment* (2012); co-curator of the British Pavilion at the 2014 Venice Biennale; and professor of architecture at the University of Illinois at Chicago, visiting professor at Yale School of Architecture and director of Night School at the AA.

David Jenkins is an architectural writer and editor. In the early 1990s he worked for Phaidon Press before establishing an independent publishing unit within Foster + Partners in 1998, which he directed for more than 15 years, producing numerous titles, including the Foster *Works* volumes. In 2014 he founded his own design imprint, Circa Press, which recently published *Jan Kaplický Drawings*, in tandem with an AA exhibition of a number of Kaplický's drawings.

Andrew Leach is professor of architectural history at Griffith University, Australia, where he also holds an Australian Research Council Future Fellowship. Among his books are *What is Architectural History?* (2010) and *Manfredo Tafuri* (2007).

Will McLean teaches at the University of Westminster and has co-authored four books with Pete Silver, most recently *Air Structures* (2015). In 2008 he established Bibliotheque McLean, an independent publisher of architecture books, whose first publication was *Quik Build: Adam Kalkin's ABC of Container Architecture* (2008). More recent titles include *Building With Air* by Dante Bini (2014) and a reprint of *Experiments in Gothic Structure* by Robert Mark (2014).

Paul Mason is economics editor of Channel 4 News and the author of a weekly column for *The Guardian*. His books include *Why It's Kicking Off Everywhere: The New Global Revolutions* (2012) and *Rare Earth: A Novel* (2012), and his new book *Postcapitalism: A Guide to our Future* will be published later this year. He is currently producing a feature-length documentary following the first months of the Syriza government in Greece, and he tweets as @paulmasonnews.

John Miller was born in London in 1930 and studied at the AA before working first for Lyons, Israel & Ellis and then Leslie Martin. In 1961 he established an office in partnership with the architect and historian Alan Colquhoun. While in practice he also taught at the AA, Cornell and Princeton, before becoming head of the newly formed architecture school at the RCA, which he directed between 1975–85. In 1990 the office was reformed as John Miller + Partners and continued to build a number of projects largely for housing, art galleries and educational institutions until Miller's retirement in 2008.

Dietrich Neumann trained as an architect at the AA and in Munich and is a professor of the history of modern architecture at Brown University. Among his publications are *Film Architecture: Set Design from Metropolis to Blade Runner* (1996), *Richard Neutra's Windshield House* (2002), *Architecture of the Night* (2002), *The Structure of Light: Richard Kelly and the Illumination of Modern Architecture* (2010), *Visualising the City* (2012) and *Cities of Light* (2014).

Richard Rogers was born in Florence in 1933 and moved to England during the Second World War. He studied at the AA and at Yale University, where he met Norman Foster and with whom shortly afterwards he established the practice Team 4. In 1967 he created a new office with his first wife Su Rogers, which then evolved into a partnership with Renzo Piano. Soon after the completion of their Pompidou Centre, he founded his own office with Mike Davies, John Young and Marco Goldschmied. More recently the firm has evolved again and become Rogers Stirk Harbour + Partners, and currently maintains offices in London, Shanghai and Sydney.

Renzo Piano was born in Genoa in 1937 and studied architecture at the Politecnico di Milano, graduating in 1964. In 1969 he moved to London where he taught at the AA and the Polytechnic of Central London, and soon afterwards met Richard Rogers with whom he set up a collaborative practice. Following their success with the Pompidou Centre, Piano created a new shared studio with the engineer Peter Rice, and then in 1981 founded his own Renzo Piano Building Workshop, which today employs over 150 people in three separate offices in Genoa, Paris and New York City.

Juergen Schulz (1927–2014) was professor of the history of art at Brown University from 1968–95. His research focused on medieval and Renaissance Venice, resulting in books and articles on Romanesque palaces, painted ceilings, and printed maps, plans and views of Venice, such as *The New Palaces of Medieval Venice* (2005) and *La cartografia tra scienza e arte: Carte e cartografi nel Rinascimento italiano* (2006).

Goswin Schwendinger is a photographer and architect. He taught photography at the AA between 2000 and 2013 and has also collaborated with Paul McCarthy on *Paul McCarthy at Tate Modern: Blockhead and Daddies Big Head* (2003). He is currently preparing a body of photographic work called *The Slasher Series*.

Gavin Stamp is an architectural historian and writer who taught the history of architecture at the Mackintosh School in Glasgow between 1990–2003 and is a former founder and chairman of the Twentieth Century Society. His books include *The Changing Metropolis* (1984), *Telephone Boxes* (1989), *Alexander 'Greek' Thomson* (1999), *Edwin Lutyens: Country Houses* (2001), *The Memorial to the Missing of the Somme* (2006), *Britain's Lost Cities* (2007), *Lost Victorian Britain* (2010) and *Anti-Ugly* (2013). *Gothic for the Steam Age*, an illustrated biography of George Gilbert Scott, is forthcoming.

Mark Swenarton is emeritus professor of architecture at Liverpool University. From 1977 to 1989 he taught at the Bartlett where in 1981, with Adrian Forty, he set up the first masters course in architectural history in the UK. He was co-founder and editor of *Architecture Today* 1989–2005, head of Oxford Brookes school of architecture 2005–10 and inaugural James Stirling professor of architecture at Liverpool University 2010–15. His first book was *Homes fit for Heroes* (1981) and his most recent (with Tom Avermaete and Dirk van den Heuvel), *Architecture and the Welfare State* (2015). His next book, *Cook's Camden*, will examine social housing in Camden in the 1960s under its borough architect Sydney Cook.

Jesús Vassallo is an architect and writer from Madrid, currently based in Houston where he is an assistant professor at Rice University. He studied architecture at Harvard Graduate School of Design and Escuela Técnica Superior de Arquitectura de Madrid. After completing his PhD, he is now working on two book manuscripts stemming from his dissertation, which focus on a series of exchanges between architecture and documentary photography.

Paul Vermeulen is a partner in the Ghent-based firm De Smet Vermeulen architecten and an architectural writer. He has been a member of the editorial board of *Archis*, a professor of architectural criticism at the Catholic University Leuven, a design tutor at KU Leuven and TU Delft and a visiting lecturer in architecture schools in Belgium, the Netherlands, Sweden, the UK, Ireland and Switzerland. An anthology of his texts, *Moderne Tijden*, co-authored with Maarten Delbeke and Christophe Van Gerrewey, was published in 2007.

Enrique Walker is associate professor at the Graduate School of Architecture, Planning and Preservation, Columbia University, where he also directs the Advanced Architectural Design programme. His publications include *Tschumi on Architecture: Conversations with Enrique Walker* (2006) and *Lo Ordinario* (2010).