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Speculations in Contemporary
Drawing for Art and Architecture

Edited by Laura Allen
and Luke Caspar Pearson

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The Bartlett School of Architecture
 University College London
 140 Hampstead Road
 London NW1 2BX
bartlett.ucl.ac.uk/architecture

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The Past, Present and Futures of Drawing

A conference on drawing in a world in which architecture is almost entirely based on computation might seem something of a paradox. Less than 30 years ago, the appearance of new software, first in engineering companies and then in architectural practices, triggered a debate about the changing nature of architectural drawing and about how what was previously drawn was becoming standardised and normalised through a singular language, a common identity and, perhaps most controversially, a normative creativity. Today, all architects work with programmes such as AutoCAD, Autodesk and Catia, and their projects conform to recognised standards of digital modelling and Building Information Modelling (BIM). However, we believe that this has not homogenised creativity – on the contrary, we believe that it has expanded it in unforeseen and inspired directions – and *Drawing Futures* stands as a testament to this.

To see drawing as bound to modern technology is to forget that in the Renaissance it was transformed by the ubiquity of printing and, concomitantly, by widely disseminated treatises by Palladio, Serlio and Vignola. Drawing soon became a technical tool, an instrument of codification that organised proportion and order; and such norms were reproduced again and again in manuals throughout the following centuries. The wide circulation of books such as Durand's seminal *Precis des Leçons d'Architecture* (1809) meant that drawing became an academic tool, defined to some degree by the rules of the École des Beaux-Arts. Its neoclassical conventions became a global standard (as recognised by the eponymous 1976 MOMA exhibition, *The Architecture of the École des Beaux-Arts*).

The idea of a 'creative architecture', of an experimental architectural aesthetic that privileges drawing as an expressive tool, emerged less than a century ago. Aside from the utopian drawings of the eighteenth century – the visionary expressions of Boullée or Ledoux and the unlikely prisons of Piranesi – drawing found its true expressive value when space was liberated and it could become a free domain, an open field. The various movements of the modern avant-garde sought to make the drawing an instrument both critical and creative. Think of the Gläserne Kette, the drawings of Bruno Taut, Erich Mendelsohn, the Luckhardt Brothers, Hans Poelzig, Theo van Doesburg and the De Stijl movement, and the colour experiments of Bart van der Leck or Gerrit Rietveld. Think of the wildly redefined strategies of architectural conception, from Bauhaus to Mies van der Rohe, from the Constructivists to Le Corbusier.

Each architectural movement of the twentieth century contributed to this enrichment of the field and scope

of drawing. We could name more, from Team X to the techno-utopias of the Metabolists and Archigram, or the radical architectural dystopias of Archizoom or Superstudio. Even critics of these movements understood the value of the drawing as a conceptual tool – witness, again, the work of Aldo Rossi, Massimo Scolari and La Tendenza, the diverse explorations of Peter Eisenman, the fictions of Madelon Vriesendorp or the paintings of Zaha Hadid. With Peter Cook, who described drawing as a "motive force", at the helm, The Bartlett School of Architecture also took the radical step of prioritising the status of drawing as a conceptual and critical tool, partly by way of its focus on portfolio work. Peter Cook, and after him Neil Spiller and Iain Borden, published books on architectural drawings, cementing the status of drawing as a fundamentally important expressive tool.

Today, *Drawing Futures* take its place within this tradition. It explores new relationships with art and other disciplines, offers alternative – often subversive – looks at computational resources and ultimately, along with the conference, navigates its way through myriad new territories that will define the future of drawing for decades to come.

Drawings seduce, and the drawings in this book are tantalising evidence of this. Yet the aim of *Drawing Futures* is to illustrate how drawing works as an abundantly rich, diverse, inventive, critical and serious research domain. In this regard, it is a ground-breaking study of the point and promise of drawing; a first of its kind, which both explores the microscopic detail of the craft and envisions the radical possibilities inherent in its expression. The academics, artists and architects whose work lies within conceive of drawing as a rigorous, liberating form of expression. Their contributions work together as a manifesto for the future of an artform that is capable of both utter simplicity and infinite complexity.

Our call for works attracted over 400 submissions from more than 50 countries and 120 institutions and practices. There are many people to thank for such an endeavour – firstly, all the contributors and speakers, especially our keynotes. Our peer reviewers, Lara Speicher and Chris Penfold at UCL Press, and the colleagues, students and associates behind the scenes. We also wish to thank our designers, A Practice for Everyday Life, for their vision, and our proofreader, Dan Lockwood, for his tirelessness. Finally, we wish to thank and congratulate editors Laura Allen and Luke Caspar Pearson and communications team Eli Lee and Michelle Lukins Segerström for operating as the driving force behind the entire project. It was their vision that began it and their relentless commitment that made it happen.

Professor Frédéric Migayrou
Chair, Bartlett Professor of Architecture

Professor Bob Sheil
Director of the Bartlett School of Architecture

Drawing Futures

While planning the inaugural *Drawing Futures* event and this book, which accompanies it, we were both intrigued by how to define what drawing practice is today and how it remains a vital part of both art and architecture.

In 2012, Yale School of Architecture held a symposium asking a rather morbid question: is drawing dead? At The Bartlett: no, most certainly it is not, and any attempt to kill it would surely only see it return as some form of zombie – imbued with new attributes and behaviours. So, alive or (un)dead, where might this drawing-creature be heading?

In the hope of answering this, we established the *Drawing Futures* conference as a venue for the discussion of, debate about and exhibition of the energetic life of drawing. Of course, it would be naïve to talk about drawing without recognition of the changing context in which it is produced, displayed and communicated. Understanding that this conversation must encompass contemporary technologies, emerging practices and the history of drawing itself, we established a series of themes for both the first conference and this accompanying book.

We saw these as general lines of inquiry – attempts to somehow categorise the diverse fields of drawing practice and, by implication, offer definitions of contemporary drawing to either build upon or summarily reject.

With *Augmentations*, we explore how the act of drawing may be extended through new technologies and materials. Can we augment or replace the hand, and how might we engage with new substrates for recording drawings on? *Deviated Histories* discusses how we might redefine or break from the history of drawing. How might critical re-readings of established histories offer new approaches for the future, and how might reframing the past shake the fundamental notions that we take for granted in drawing practice?

Future Fantastics delves into drawing as an act of vision and speculation. How does drawing continue to hold its role as a vehicle for exploratory proposals that captivate us and allow us a window into the future? In what forms can unsteady and fantastical speculations prosper in a future that appears increasingly tied to swathes of data and precision? On the subject of all that information, *Protocols* asks how we might encode new data through drawings, and what new types of drawing practice will need to be invented to help articulate our digital world.

In each chapter, then, we establish different terms of engagement for discussing drawing today. It is a testament to the diversity of the work in this book that not only do we have 60 projects slotted into each of these chapters, but each project could easily be applied to another.

We hope that this will be clearly evidenced by our keynote speakers, who present as idiosyncratic a panel as one could hope to find. In *Augmentations*, we talk with Madelon Vriesendorp about the extents of her saturated 'world' and how her incredibly influential drawings mirror her own life. Pablo Bronstein's exquisitely drawn architectural proposals that open *Deviated Histories* twist historical London through a series of salacious scenarios that he explores in graphic detail. We embark on our *Future Fantastics* journey with the remarkable drawn works of Neil Spiller, whose work surely demonstrates the speculative drawing as a philosophy in itself. And in *Protocols*, Hsinming Fung takes us through the drawings of Hodgetts + Fung, including the wonderful graphic novel world of *Cyberville*, to explain the "shift in the balance of design intelligence".

So as you read through these pages, we hope that you will find there are many borders being crossed and clichés being exploded.

AUTHENTICITY

The great master of chiaroscuro-meets-zoning-law, Hugh Ferriss, once remarked that "there is a difference between a correct drawing and an authentic one". For Ferriss, an 'authentic' drawing could hold the desires of the client or indeed those of the society from which it was borne. A 'correct' one might be well-rendered, yet still leave one cold. We can assume that Ferriss felt that his drawings alone were the vehicles of authenticity. But their success was closely tied to architectural technology. His charcoal renderings perfectly captured the heft of a steel and terracotta Gotham, driving the city into what Koolhaas called a "murky Ferrissian Void". Cometh the hour, cometh the drawing. And then architectural technologies changed. The glazed curtain wall of modernism did not lend itself to charcoal in the same way. Ferriss and his shadows could no longer be authentic in a world of transparency. The history of his career shows us at least two things about drawing: that it walks hand in hand with technology, and that it can be a capricious pursuit.

The *Drawing Futures* project really started with trying to establish what 'authentic' drawing practice might be in contemporary art and architecture. If that sounds like an act of hubris, then we should say that the suspicion from our side was that the answer would be a field of different methods intertwining rather than any one overbearing dogma.

Blogs, Tumblr and Pinterest give one vast swathes of visual material to sift through and unprecedented access to imagery that was once the preserve of university libraries and select collections. Walking around the studios of The Bartlett, one can see the many drawn influences pinned up on walls or flashing on screens. However, one could say that much of this rapid-fire transmission of imagery lacks any accompanying intellectual context – and this is often true in the world of reposts and pins

– but that does not denigrate the fact that sharing inspiring drawings is a large part of internet culture for students, architects and artists today. Given the media by which drawing is communicated now, we decided that this first edition should be drawn from an open call online. After all, what better way to understand the state of things than to dive into where the action is?

By opening up *Drawing Futures* through a public call for works, we sought to allow artists and designers from diverse fields to contribute to the project and to compile work into a broad-ranging anthology of contemporary drawing practices. As this book is composed of projects selected from over 400 submissions from more than 50 countries around the world, it is safe to say that we have done our fair share of sifting through digital imagery.

We always conceived of this book as more than a record of the proceedings of the conference – as an expanded look into all the many types of drawings being produced or discussed that might not fit into a conventional academic structure. So within these pages, you will find 26 projects and papers presented at the 2016 conference and 34 further works selected for their distinct interpretation of our call. We will leave it to the reader to attempt to distinguish between them.

THINGS TO COME

We have collected projects from architects, artists, illustrators, historians, theorists, computer scientists and more besides. Each of these fields carries its own protocols and approaches to the act of drawing that may seem incongruous or illegitimate to another industry. For instance, drawing is clearly not limited solely to the hand any more, and much writing asserting the importance of the hand-made might overlook the imaginative subjectivity also possible in digital image creation. Yet there is still something about the direct transmission of material onto paper that seems to defy the march of technology. Our hope with this book is that you

will encounter work that pushes at the fringes of what you might consider drawing.

Although The Bartlett is a school of architecture, it has always mined inspiration from far and wide, and so it seems appropriate to us that this book takes such a diverse view on what drawing is (and will be). As a school, we wouldn't have it any other way. We hope that this first iteration of the *Drawing Futures* conference – and this book – will exist as a record of all the weird and wonderful ways to explore drawing in 2016.

Of course, we hope that this serves not only as a marker of what drawing currently is, but also as a sign of drawings yet to come.

ACKNOWLEDGEMENTS

We must also thank those who have made this project and book possible. Many thanks to Frédéric Migayrou, Chair and Bartlett Professor of Architecture and Bob Sheil, Director of The Bartlett School of Architecture, for their generous support in bringing this project, which has been a number of years in the making, to fruition. And thanks to Eli Lee and Michelle Lukins Segerström for all their tireless assistance in the development, editing, promotion and production of this book and conference.

As every project was selected through our extensive double-blind peer review process, we must also extend our thanks to all the reviewers who contributed their time and expertise to sort through the numerous submissions and help us to compile this book: Roberto Botazzi, Matthew Butcher, Marjan Colletti, James Craig, Penelope Haralambidou, Jonathan Hill, Perry Kulper, C.J. Lim, Bob Sheil, Mark Smout and Mark West.

Laura Allen
Luke Caspar Pearson
Drawing Futures Editors and Co-Chairs

Drawing has always had an implicit relationship to technology. While drawing is often framed as an instinctive and intuitive act, we should not forget that many of the principles we take for granted today were developed through technologies as much as through the hand. Alberti's devices for perspectival drawing helped the artist manage the complexities of perspective and in turn assisted its proliferation as a representational mode. Piranesi's *Carceri* were distributed as one might buy a contemporary mass-produced art print, the etching plate and the printing press working in combination. We might also think of tools like the pantograph as the precursor to systems of reproduction and replication used today.

Nowadays, it seems there is a tendency to frame drawing and computational technology as difficult bedfellows – representation pitted against simulation. We can take two positions in respect to this. We might point out that there are now innumerable surfaces and interfaces that rely on the interpolation of gesture to function, giving us many means to extend drawing practice through new technologies and materials. Or we might take any tension as a positive energy and move forward into weird and wonderful – perhaps even awkward – confluences of the technical and the intuitive. In this chapter, we will see projects examining the future of drawing through such approaches. *Augmentations* takes us from drawing the microscopic world of bacteria to virtual drawings, from representations embedded on the retina to radical, politicised CAD blocks. In each case we see the drawing practice expanded and challenged through the presence of technology as a fundamental collaborator.

MEGABEAM

Syd Mead

This illustration was produced for a commission from an advertising agency in Cape Town, South Africa. The idea was to depict mega-projects that would challenge contemporary techniques in architecture, space exploration and extreme climatic adaptation. I created *MEGABEAM* as an architecture project anticipating the future of materials that would allow massive self-supporting structures to serve as habitat.

The construct is anchored at its lowest end at the edge of the bay, with the upper end resting (also anchored) on the top of a small mountain. The hexagonal cross section is a robust choice for this huge structure. Essentially, it is a load-bearing beam large enough to use as a self-contained city. The structure is still in its finishing process, as evidenced by welding light sources visible at its centre, a hoist apparatus manoeuvring a frame section into position and the foreground view of a mobile contractor capsule.

A feature restaurant and club will open in the vertical column and projecting 'hood' shape. The terraces and various transport routes on the vertical and upward-facing exterior surfaces of the *MEGABEAM* provide access to any point. All necessary infrastructure is inside the *MEGABEAM* for utilities, transport links to 'surface' routes and delivery of goods and services to residents. The population would be in the neighbourhood of 6,000 residents. Lifestyle residences would range from extensive terraced 'estates' to view-homes primarily on the two vertical 'side' surfaces.

MEGABEAM illustrates an ambitious projection of massive proportions as an engineered reality. It is at once an imaginative idea and a comment on future possibilities in architectural design.

Fig. 1 (previous): Syd Mead, *MEGABEAM*.

Protocols

Our world is saturated with data. We speak of smart cities that might regulate themselves and metrics that give us information about every facet of our society. New tools for reading and recording space challenge the primacy of the line as arbiter of dimension and scale. Artificial intelligence systems can produce artworks through deep learning via smartphone applications. Our world is striated by new infrastructures such as the internet, which can only be mapped by means of unforeseen representational methods – the 'ping'. What this suggests is that far from finishing representation off, computation and all it entails will require increasing amounts of drawings. Turning raw data into digestible information – diagramming – is ever more important as our world of networks becomes increasingly complex.

Each of the projects in the following chapter investigates the encoding and transformation of information through drawing. We see LiDAR-scanned data compared to traditional drawing techniques, artificial intelligence as a collaborator in the drawing process and the use of robotic drawing arms and custom-built software to transcribe three-dimensional space into the planar. We even see cities created on the 'virtual graph paper' of Microsoft Excel. All of these projects explore ways in which drawing may take on new agency in relation to the plumes of data accessible to us, allowing us to sort our way through space and resolve that data into information – something readable by another. Whichever technological direction the work takes, we are always returned to one of the essential and everlasting properties of drawing: communication.

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Recording of Heritage Buildings: From Measured Drawing to 3D Laser Scanning

Bernadette Devilat

This essay explores different techniques used to record existing buildings through time and the application of the most recent ones in the case of Zúñiga, a heritage village in Chile affected by a major earthquake in 2010, which had a magnitude of 8.8 Mw scale. Because earthquakes are common in Chile, regularly destroying built heritage, the idea of the record for reconstruction, replacement and replica provides a rich field of inquiry.

The aim of this study is to examine whether 3D scanning could be an effective way – in terms of time and resources – of accurately recording historical dwellings compared to measured drawing. By describing and superimposing 3D scanning and hand-measured drawing of one dwelling, the limits and benefits of 3D scan technology are explored. The implications of this tool as a recording method are also addressed, establishing the future challenges for drawing and the idea of replication that it presents.

Currently, one of the main reasons why heritage buildings are recorded is for preservation, but it was not always thus. Before the nineteenth century, recording of existing buildings was done to extract design criteria from them for construction aims, such as Vitruvius' *Ten Books on Architecture*. Although it was not written with the aim of documenting existing buildings, because it shows how buildings were constructed in around 20–30 BC, it has now become an important piece of historical documentation.

According to Siwicki¹ and Choay², the idea of preserving heritage is rather new. Others argue that the preservation of existing buildings always existed, although some suggest that it became a proper 'movement' in the nineteenth

and twentieth centuries. Most early literature about heritage conservation stems from around the fourteenth century.³ This entails a question: how did buildings survive prior to their preservation and conservation? Lowenthal⁴ offers a theory based on tradition, where people respected and used that which was left from previous generations. This re-use of existing buildings can be seen as a form of preservation; by protecting them from vandalism and ruination, not consciously but merely as a tradition, the job of conservation is carried out.

In later eras, the risk of buildings disappearing due to war, conflict or various other developments generated a series of new conservation tasks. These efforts were known as the 'Conservation Movement'.⁵ Buildings were turned into heritage sites via a series of regulations that were created in order to protect them as much as possible for future generations. This was when the recording of buildings became systematically guided by heritage institutions and the establishment of heritage charters. This record can then be used as a basis for future restoration and reconstruction.

There is plenty of technical literature about how to plan and execute a survey of historic buildings using a range of methods, from hand-drawing to laser scanning. Measured drawing was used as the primary survey tool for heritage recording and preservation until the most recent recording technologies, such as photogrammetry and 3D laser scanning, displaced the role of drawing for this purpose. However, the hand-measuring method is still currently the most popular for recording existing buildings. It is cheap and anybody can do it. It consists of taking the measurements of a construction using a measuring tape and then translating those measurements into a drawing. It has obvious inconveniences, such as the speed of the process, the impossibility of reaching heights and other inaccessible spaces and the need for the person(s) carrying out the survey to reliably determine its accuracy. Technical architectural drawings based on hand measurements taken on site have become more and more exact over the years as measurement techniques have improved. The introduction of handheld lasers and the use of photography have improved the results of heritage surveys further. "Photography offered as well an unprecedented type of crutch: it introduced 'a new standard of evidence'".⁶

Despite photography's lack of measurements, it is probably the most used recording method nowadays because it is efficient and easily available. Although not accurate, measurements can be extracted from photographs using algorithms to correct perspective and distortions. This is the starting point of photogrammetry, which revolutionised the way heritage buildings were recorded. It began to be



Fig. 1: Bernadette Devilat, *Zúñiga*, 2016. Top view from the 3D scanning model of the central part of Zúñiga, Chile, using the data obtained on-site in 2013.



Fig. 2: Bernadette Devilat, *Domesticity*, 2015. Axonometric view from 3D scan data from 2013 of the interior of House 2 in Zúñiga, Chile.



Fig. 3: Bernadette Devilat, *House and vegetation*, 2014. Elevation image from the 3D laser scanning done in 2013 of House 1 in Zúñiga, Chile.



Fig. 4: Bernadette Devilat, *Dwelling the Record*, 2014. Plan and section obtained using the 3D laser scan record from 2013 of an inhabited ruined house (House 1) in Zúñiga, Chile.

widely used from the 1960s onwards and thereafter was implemented by heritage institutions. As confirmed by the relevant bibliography, the use of photogrammetry to document historic buildings was suggested by heritage institutions – such as ICOMOS (1968) – as a way to preserve them, especially endangered constructions, encouraging governments to carry out surveys to record as much as possible of their architectural past. Similar attitudes can be found in recent years referring to 3D laser scanning.

3D laser scanning is a quick recording technology (Fig. 1) that provides a three-dimensional point cloud from which any view can be extracted later and any dimension can be obtained within an accuracy of millimetres (Fig. 2). The result is a measurable 3D digital model of reality. Images, technical drawings (Fig. 3), videos¹ and even physical models can be generated from this data. The amount and precision of data collected with this technique are certainly the best possible so far, which has implications for new and existing architectures and poses a question about the use of traditional drawing in a context where high-quality data can be obtained in less time than ever before.

Aside from the specificity of surveying heritage buildings after disasters to planning and designing after earthquakes, the record is also relevant as a practical tool for intervention. As a post-earthquake survey tool, 3D laser scanning provides quick and accurate information that can also be accessed at any time in the future,

which is especially relevant when studying why a building might have failed. There is a common need for a safe, quick and economic survey of damaged built heritage, and the usefulness of the 3D laser scanning for this task has been proven.⁷ All these aspects convert this method to an economic documenting tool – in comparison to traditional recording methods such as hand-measured drawing and photography – with the potential for replication in similar cases around the world.

Architectural plans of the houses that are part of Chilean historical areas are usually not available, either because they have not been designed using technical drawings or because they are too old to be found in archives. Thus, most of the records and surveys have to be done after an earthquake. Following the 2010 earthquake, documents and plans including as-built dimensions were needed as a basis for any repair or reconstruction. Usually, dimensions are taken on site by hand and then transferred to a digital drawing, which tends to be a slow process. This work is habitually carried out by architectural students volunteering for that purpose, which frequently happens after an earthquake. Other techniques such as photogrammetry and 3D scanning were not massively used on houses after the earthquake – only on significant buildings, as special commissions – as it was considered too expensive, even for dwellings that were part of declared heritage areas.

It is interesting to compare the amount and quality of data obtained and the time invested by using traditional surveying methods and 3D laser scanning, based on previous experiences where the author has been involved. During the 3D scanning survey of 2013, most of the insides of the houses were scanned, but the focus was set to scan most of the historic area from its streets. 176 3D scans were taken in three days by two people.

The comparison has been drawn for House 2^a In Zúñiga. It is not only a house inside the 'typical zone', but also it has been declared a historic monument for its distinctive features on its access portico and façade. Thus, a detailed plan has been obtained, which was compared with a study of the same property done by Estudio 360, Beatriz Valenzuela & Associated Architects in 2012. Her practice was in charge of developing several retrofitting and reconstruction projects for dwellings in Zúñiga. That intervention was designed using traditional survey methods, based on handmade dimensioning and drawing. Fig. 5 shows a comparison between the digital drawings based on the hand measurements and the 3D laser scans, where it is possible to identify a series of problems with the hand-measured drawings. First, in the 2012 survey, elements of the construction are assumed to be rectilinear, such as its windows, doors, walls and heights. Second, the survey does not identify the relevant distortions and cracks, but only the most damaged walls that require reconstruction. Third, one part of the dwelling has an angle of rotation in relation to the main façade, which was only captured in the 3D scanning survey. Fourth, heights and other

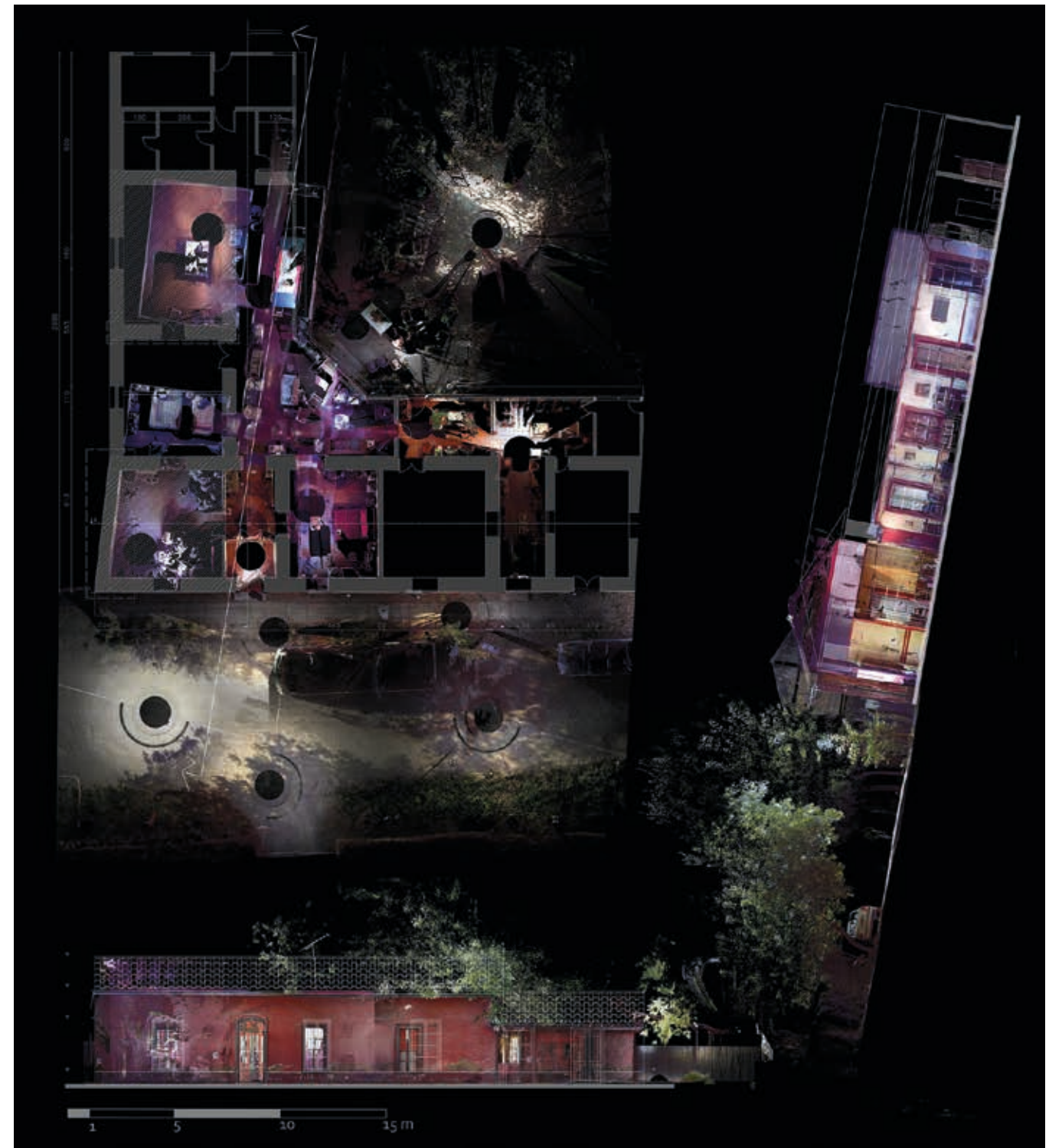


Fig. 5: Bernadette Devilat, *Drawing vs. 3D scanning*, 2016. Superimposition of 3D laser scanning data from 2013 and hand-measured drawings from 2012 of House 2 in plan, elevation and section in Zúñiga, Chile.

measurements are also incorrect when compared to 3D scan data that has a precision of millimetres.

3D laser scanning has several limitations. In this case, a terrestrial laser scanner – Faro Focus 3D – was used. As it records surfaces only, the position and alignment of the equipment before data collection is critical depending on the target. Also, mishandling the equipment can result in data loss. However, even when data collection is done correctly, some objects and areas can not be adequately recorded, such as shiny and transparent surfaces. However, as a tool that is being continuously updated, its limitations might soon be out of date and/or resolved by new developments in software and hardware.

The uniqueness of this type of record for Zúñiga sets a precedent, not only as the first 3D laser scanning of the village but also in terms of how it might acquire more relevance if its structures continue to be destroyed by earthquakes in the future. Although the availability of records can always be considered positive because they contain key information from a particular period, the 3D scan record can also override other forms of documentation. Its accuracy and completeness might frame the scanned iteration as the most 'authentic' one, over previous versions only existing in drawings and photographs. It is relevant to remember that the 3D scan will always be the record of a specific moment of a building and the amount and accuracy of the data collected with it does not transform it into the truthful and real version that should be preserved in future

interventions. This is particularly important in seismic contexts such as Zúñiga where destruction and reconstruction are regular and continuous processes.

The availability of these records poses an interesting question for the conservation of buildings, regarding how we might preserve a three-dimensional digital version that could justify both its demolition and replacement or its replica. As recording technologies advance, the record of buildings is becoming enough justification even to return the building to a state that has not been physically present for years. We have come to a point where reconstruction is highly dependent on the availability of previous records, thus the importance given to them is enormous. Yet in heritage contexts where destruction is a regular process, recording is not. Despite that, reconstruction is a consistent – usually not critically questioned – process. These aspects are further explored as part of the author's ongoing doctoral research, titled: "Reconstruction and record: exploring alternatives for heritage areas after earthquakes in Chile", supervised by Professor Stephen Gage and Dr. Camillo Boano at the UCL Bartlett School of Architecture.

Finally, the comprehensiveness and accuracy of 3D laser scanning change the role of hand-drawing where the documentation of heritage building is concerned. 3D scans are descriptive, complete and close to a perfect record of a particular moment of a building. In contrast, hand-drawing would have to be understood as a vehicle for action and transformation.

Riots

Owen Duross

Architectural representation relies on an implicit vernacular to communicate intent, where the means by which communicating this intent is layered and complex. Drawings give visual description to architecture in a language that privileges translation over transcription, revealing specificity and difference in a composite of codified entities. The methods used to communicate this information rely on the translation of its qualities and the potency of its content. Within these methods are logics that seek to mediate interpretation with a mutual syntax, yet also to negotiate in a malleable process where distinctness and ambiguity coexist. When interlinked with digital protocols, generative drawing techniques in architecture have the capacity to augment imaging and abstraction into active conditions for the development of the unknown. The act of drawing incorporates this with computation and visualisation techniques as forms of spatial generation replete with useful representational languages. In their modified state, these languages introduce a series of relationships with complex spatial encounters and atypical non-sequiturs for dynamic investigation.

Motivated by the continuous mediation between digital modelling and representational drawing techniques, *Riots* attempts to use drawing as more than a static portrayal of likeness through explanation; these are amalgamations of embedded histories with variable identifications, to be understood through a catalogue of multiplicities. This develops a method where each drawing is related to one another, impregnated with the residual automata of interconnected generations of drawings in translation. Each drawing is an artefact of this recursive process, embedding information that links its making and memory. Because of this, the making of each drawing is just as

important as the resulting drawing itself. These drawings do not capture the representation of a singular object. They are comprised of systems that constantly resituate and redefine through intervention and interference, resulting in fragments with uncertain origins.

The resultant complexity is compounded by iteration, introducing new overlaps and juxtapositions to proliferate matter into offspring for repetitive manipulation. Through iteration, new matter is produced from the drawn entity, building on its transformative conditions, and repositioned to create a relationship through its informational history to the extracted original. Its effects shift what were once its emergent qualities into systemic patterns and explicit results to then be mined for the invention of new devices that nurture deviations from the legibility of the drawing space. As the methods that comprise these devices become operative, extraction and invention become interchangeable as drawing and model present shifted realities and undefined transgressions of time and matter, providing opportunities for opposition and conflict. Geometries collide, nestle and misalign to create adjacencies within complex surfaces and dense zones of data.

Three-dimensional form is veiled by mapped surfaces of shadow and figure, making the full fidelity of objects in the drawing half-known. Objects rendered as images are folded back into the geometry of the drawing space, merging rendered image with modelled form. Figural shapes and obfuscated geometries dissemble for new readings of dimension and proportion. Hidden geometries are exposed with representational logics of space and measure, as depth is revealed through shadow and line, only to become flat between planes of information. This notation beguiles form into sprayed screens and scraped mass, expressing architectural data in sporadic clusters of saturated grit and debris. Graphical marks reveal plotted logics with descriptive symbols and registrations, but posit formal anomalies and spatial disjunctions which produce distant misinterpretations and visual interruptions, collapsing into a layered field of foreign matter. These operations reveal new patterns and emerging systems that become new sources for extraction and reinvention back in the drawing scene.

Accidents and corruptions are valued as effects that provoke a new capacity for operation, magnifying the perceived verity of the native manoeuvres and fractured imagery. These simulated breaks alter the expected or conventional systems of communicating information, fostering distributed interpretations of absolute formal depictions. As incorrectness and interruption infuse the conventional structures of normative architectural description, the relationships they manufacture are interrogated, delivering false readings that alter their definition. Architectural representation uses notation to identify and deliver a relationship of graphical logic to formal complexity and spatial indeterminacy – a language that these drawings seek to reinterpret and exploit.

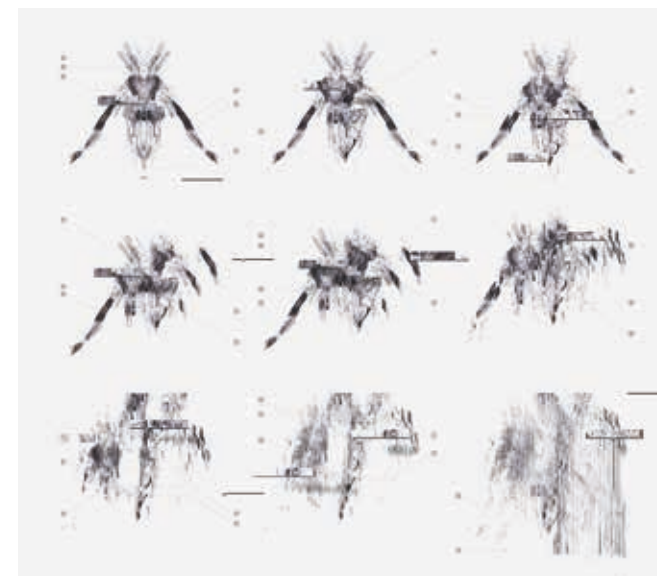


Fig. 1: Owen Duross, *Proxy Cast*, 2015. Each bust is sequential, caught in a state of unstructured narrative characterizing an inexactness that intuits the individual and the destruction of their half-familiar figure.

¹ Christopher Stephen Siwicki, "Architectural Restoration and the Concept of Built Heritage in Imperial Rome", (Ph.D. diss., University of Exeter, UK, 2015).

² Françoise Choay, *The Invention of the Historic Monument* (Cambridge: Cambridge University Press, 2001), 9.

³ Jukka Jokilehto, "A History of Architectural Conservation. The Contribution of English, French, German and Italian Thought towards an International Approach to the Conservation of Cultural Property", (PhD diss., University of York, 1986).

⁴ David Lowenthal, "Heritage Ascendant" in *The Heritage Crusade and the Spoils of History* (Cambridge: Cambridge University Press, 1998).

⁵ Miles Glendinning, *The Conservation Movement: A History of Architectural Preservation: Antiquity to Modernity* (London: Routledge, 2013).

⁶ Choay, *The Invention of the Historic Monument*, 9.

⁷ Bernadette Devilat, "3D laser scanning for recording heritage areas in post-earthquake reconstruction. The cases of Lolol and Zúñiga in Chile", in VI AISU CONGRESS, Catania, Italy, 12 – 14 September 2013. Scrimm Edizione, November 2014, p. 2013–2024. Available at: <http://bit.ly/1QItFW2>.

⁸ Video of House 2 in Zúñiga available at: <https://vimeo.com/125778121>.

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¹ Howard T. Fisher to Turpin C. Bannister, 2 March 1954, *Papers of Howard T. Fisher*, Harvard University, Cambridge, MA (hereafter HTFP).

² Timothy W. Foresman, "GIS Early Years and the Threads of Evolution" in *The History of Geographic Information Systems: Perspectives from the Pioneers*, ed. Timothy W. Foresman (New York: Prentice Hall, 1998), 3. The use of overlaid layers to create complex maps itself became common in the nineteenth century, and found its roots even earlier; Louis Alexandre Berthier used hinged overlay maps at the 1781 siege of Yorktown to show troop movements to his own commander, Rochambeau, as well as General Washington.

³ Fisher to Phil Christiansen, memorandum, 18 July 1966, HTFP.

⁴ Howard T. Fisher, biographical sketch, dated August 1930, HTFP.

⁵ Ibid.

⁶ Fisher to Frederick Fisher, 24 March 1944, HTFP.

⁷ And here, a moment of unexpected disclosure: as I learned only in 2012 – partially through the surprising inclusion of a 1959 Christmas letter typed by my grandmother, business-machine programmer Nell de Monchoux in Fisher's Harvard archive – Fisher's housemate in Tegucigalpa was my grandfather, French-Australian business machine consultant Emile de Monchoux. And as a result his summer-time assistant in housing work in Bogota, Colombia, in 1952, was my then sixteen-year-old father, Jean Pierre de Monchoux. His recollections were an unexpected delight in developing a full sense of his character, although the thesis and argument of this essay was crafted in the archives beforehand.

⁸ Edgar M. Horwood, *Using Computer Graphics in Community Renewal; Computer Methods of Graphing, Data Positioning and Symbolic Mapping* (Seattle: University of Washington, 1963), 5.0–1.

⁹ Roger Tomlinson, "The Canada Geographic Information System", in *The History of Geographic Information Systems: Perspectives from the Pioneers*, ed. Timothy W. Foresman (Upper Saddle River, NJ: Prentice Hall PTR, 1998), 21.

¹⁰ Department of Forestry and Rural Development, *Data for Decision* directed by David Millar (1968; Ottawa, National Film Board of Canada).

¹¹ "My basic approach to involvement with computers..." Howard T. Fisher, in an undated manuscript, HTFP.

¹² Fisher to Louis Winnick, 14 January 1965, HTFP.

¹³ Fisher to the Committee to Review the Laboratory for Computer Graphics and Spatial Analysis, memorandum response, 22 May 1974, HTFP, 1–2.

¹⁴ William A. Doebele Jr., Associate Dean for Development, memorandum to George Bennett, Treasurer, GSD, 'Ford Foundation Grant of \$294,000 to the Graduate School of Design for Training and Research in Computer Map-Making,' 1 April 1966, HTFP.

¹⁵ Fisher, memorandum response, 22 May 1974, HTFP, 1–2.

¹⁶ Chrisman, *Charting the Unknown* (Redlands CA: ESRI Press), 21.

¹⁷ Ibid., 26.

¹⁸ Standing for FORMula TRANSLation, the programming language had been introduced by IBM in 1957. See Cerruzi, *History of Modern Computing* (Cambridge MA: MIT Press, 2003), 67.

¹⁹ Fisher, memorandum response, 22 May 1974, HTFP, 1–9.

²⁰ Howard T. Fisher, memorandum response, May 22 1974, HTFP, 1–5.

²¹ Ibid., 1–8.

²² Fisher to Don T. Hill, 27 July 1971, HTFP.

²³ Carl Steinitz, "Hand-Drawn Overlays: Their History and Prospective Uses," *Landscape Architecture* 66, no. 5 (September 1976): 444–55;

²⁴ Ian L. McHarg, *Design with Nature* (Garden City, NY: Natural History Press, 1969), 20.

²⁵ Carl Steinitz and Peter P. Rogers, *A Systems Analysis Model of Urbanization and Change; An Experiment in Interdisciplinary Education* (Cambridge, MA: MIT Press, 1970). For a comprehensive explanation of Steinitz' activities in this period (albeit not mentioning Fisher), see Catherine F. McMahon, "Predictive Machines – Data, Computer Maps, and Simulation", in *A Second Modernism: MIT, Architecture, and the 'Techno-Social' Moment*, ed. Arindam Dutta (Cambridge, MA: SA+P and MIT Press, 2013) 436–73.

²⁶ Fisher to Mrs. Jack [sic] Dangermond, 24 January 1973, HTFP.

²⁷ Jack Dangermond C.V., 1970, HTFP.

²⁸ Jack Dangermond C.V., 1970, HTFP.

Of the twelve projects listed on Dangermond's 1970 CV, four are listed as using SYMAP; as discussed below, SYMAP also served, certainly in Fisher's opinion, as the basis for much of the other work as well.

²⁹ "SYMAP and [...] one or more programmes that are based on SYMAP." Fisher to Dr. D. R. F. Taylor, Department of Geography, Carleton University, 2 June 1970, HTFP.

³⁰ Dangermond to Howard T. Fisher, 27 July 1970, HTFP.

³¹ Fisher to Jack Dangermond, 17 May 1971, HTFP. While Dangermond had initially demurred, he finally came to Cambridge with Fisher's encouragement to speak with then GSD dean Maurice Kilbridge. However, he wrote shortly after to both Fisher and Kilbridge, "I would like *at this time* to say no to your offer, but would very much like in the future to participate in the Laboratory's activities." Jack Dangermond to Dean Maurice Kilbridge, Graduate School of Design, 7 June 1971, HTFP.

³² Jack Dangermond, "A Classification and Review of Coordinate Identification and Computer Mapping Systems", in *Urban and Regional Information Systems: Information Research for an Urban Society, Papers from the Tenth Annual Conference of the Urban and Regional Information Systems Association, August 28–September 1972, San Francisco, CA*, vol. 2 (Claremont, CA: Claremont College Printing Service, 1973), 185.

³³ A subsequent exchange of letters then takes place between ESRI and a 'distressed' Laura Dangermond (with Jack Dangermond abroad in Japan at the time, by her telling). Fisher presses Dangermond most of all on whether ESRI was or remained a nonprofit; hence the question that opened this discussion. "To fail to give full credit to SYMAP in accordance with customs and traditions of the academic world gives the impression that you are trying to take credit for something improperly [...] of course, if you are a strictly business enterprise – and that is [made] obvious – then people wouldn't expect you to have the same standards, but the title of your organization is definitely such as to imply that you are above the mere [...] standards of the marketplace..." Fisher to Jack Dangermond, 8 January 1973, HTFP. In fact, ESRI had reconstituted itself as a for-profit corporation only three days prior. 'Business Incorporation Certificate for Entity # C0672337, Environmental Systems Research Institute, Inc.,' *California Secretary of State*, accessed 30 June 2015, <http://kepler.sos.ca.gov>.

³⁴ F. P. Brooks Jr., G. A. Blaauw, and W. Buchholz, "Processing Data in Bits and Pieces" and "Architectural Philosophy" by F.P. Brooks Jr. in *Planning a Computer System: Project Stretch*, ed. Werner Buchholz (New York: McGraw-Hill, 1962), 5–17.

³⁵ While a commercial failure, Stretch provided essential technology for the real-time computing of NASA's Mission Control Centre, and also led directly to the highly successful System/360 product line. Cerruzzi, *History of Modern Computing* (Cambridge MA: MIT Press, 2003), 151–57.

³⁶ Michael Helft, "You Can't Kill Jack Dangermond's Company. Try, And It Will Only Get Stronger," *Forbes*, 31 March 2015, <http://www.forbes.com/sites/miguelhelft/2015/03/31/you-cant-kill-jack-dangermonds-company-try-and-it-will-only-get-stronger/>.

³⁷ '#628: Jack Dangermond', *Forbes*, accessed 30 June 2015, <http://www.forbes.com/profile/jack-dangermond/>.

³⁸ Carl Steinitz, *A Framework for Geodesign: Changing Geography by Design* (Redlands, CA: Esri Press, 2012). Full disclosure – I was invited as a speaker to the 'Geodesign' meeting held at ESRI in 2011, where I received an audience-voted award.

³⁹ To its great credit, especially given the \$10,000+ cost, ESRI has consistently allowed free or heavily discounted use of its desktop software by nonprofits and academics – including me. This has not incidentally served to cement the software's ubiquity.

⁴⁰ The phrase appears in Alfred Korzybski, 'A Non-Aristotelian System and its Necessity for Rigour in Mathematics and Physics' (paper presented at a meeting of the American Association for the Advancement of Science, New Orleans, LA, 28 December 1931). Reprinted in Alfred Korzybski, *Science and Sanity* (Lakeville, CT: International Non-Aristotelian Library, 1933), 747–61.

Editors

LAURA ALLEN is Professor of Architecture and Augmented Landscapes at The Bartlett School of Architecture, UCL, where she teaches U11 on the MArch Architecture. Smout Allen, her practice with Mark Smout, focuses on the dynamic relationship between the natural and the man-made and how this can be revealed to enhance the experience of the landscape. Laura's work is instantly recognisable and has featured in many publications, exhibitions and collections. Smout Allen teach, lecture and exhibit internationally. They have been selected for both the Venice Biennale (2012 and 2016) and Chicago Biennale (2015). In 2005, they won the Summer Exhibition Award for Architecture at the Royal Academy of Arts. They have successful carried out collaborations with international individuals and institutions, including the University of Southern California Libraries, Williams F1 Advanced Engineering, the Centre for Land Use Interpretation (CLU), Los Angeles, the British Council and the Land Art Archive, Nevada.

LUKE CASPAR PEARSON is a designer and teacher at The Bartlett School of Architecture, UCL, where he has taught since 2009. He is the founding partner of You+Pea, a design research practice that was a member of a collaborative team from UCL that designed and fabricated the Universal Tea Machine for the London 2012 Olympic Games. Their recent work has been exhibited at the RIBA and Peckham Levels, and they were the curators of UP-POP at the 2015 London Festival of Architecture. Luke has been the previous recipient of the RIBA Bronze Medal and a Leverhulme Trust Grant. He is currently undertaking a PhD in Design in Architecture at The Bartlett, exploring videogames and architecture, and was awarded the UCL Graduate Research Scholarship for this work. As part of this research, he is developing a videogame in collaboration with games studio Shedworks Interactive. Luke's work has been exhibited in the Royal Academy, as well as being published in journals and magazines such as *ARQ*, *Architect's Sketchbooks*, *CLOG*, *The RIBA Journal* and *Interstices*.

Executive Editors

FRÉDÉRIC MIGAYROU is Chair, Bartlett Professor of Architecture at The Bartlett School of Architecture, UCL, and Deputy Director of the MNAM-CCI (Musée National d'Art Moderne, Centre de Création Industrielle) at the Centre Pompidou, Paris. He was the founder of the Frac Center Collection and of ArchiLab, the international festival of prospective architecture in Orléans. Apart from recent publications and exhibitions (De Stijl, Centre Pompidou, 2011; La Tendenza, Centre Pompidou, 2012; Bernard Tschumi, Centre Pompidou, 2013; Frank Gehry, Centre Pompidou, 2014; Le Corbusier, Centre Pompidou, 2015), he was the curator of Non-Standard Architectures at the Centre Pompidou in 2003, the first exposition of its kind devoted to architecture, computation and fabrication. More recently, he has curated Japan Architects 1945–2010 (21st Century Museum of Contemporary Art, 2014); Frank Gehry (Foundation Louis Vuitton, Paris, 2014) and Naturalising Architecture (ArchiLab, Orléans, 2013). In 2012, he founded B-Pro, The Bartlett's umbrella structure for post-professional architecture programmes.

BOB SHEIL is an architect, Director of The Bartlett School of Architecture, UCL, Professor in Architecture and Design through Production and the School's Director of Technology. He is a founding partner of sixteen* (makers), whose work in collaboration with Stahlbogen GmbH '55/02' won a RIBA award for design in 2010 and also includes a ten-year catalogue of experimental projects both internationally published and exhibited. He is an educator, critic, researcher, collaborator and practitioner, as well as an experimental designer who is fascinated by the intersections between making, craft and technology. He has played a leading role in the School's investment in digital technologies since he took over as Director of Technology in 2007, including founding the Digital Manufacturing Centre (2009) and later evolving it into The Bartlett Manufacturing and Design Exchange (B-Made). He has recently founded The Protoarchitecture Lab at UCL, where he is currently developing new strands of collaborative research between making, performance and 3D scanning in collaboration with the Royal Central School of Speech and Drama, SHUNT and ScanLAB Projects.

Contributors

HARSHIT AGRAWAL is an HCI researcher who builds tools to study how technology can blend with and enhance human creative expression. He has presented his work at international HCI and electronic arts conferences (SIGGRAPH, UIST, UbiComp, TEI, ISEA). Harshit believes that one of the key narratives of our age is about how we build tools using machine intelligence and how they interact with humans. His work seeks to expand the horizon of such explorations.

JOSEPH ALTSHULER is an architectural designer, writer and founding editor of *SOILED*, a periodical of architectural stories that makes a mess of the built environment and the politics of space. Joseph designs affordable housing with Landon Bone Baker Architects in Chicago, and is also a founding partner of Could Be Architecture LLC, an architectural design practice that explores storytelling, humour and character in architecture. His writing and design work has been published widely in journals and online media, including *Log*, *PLAT*, *CLOG*, *Cite*, *Pidgin*, *Post*, *MAS Context* and Steppenwolf Theatre's blog. Joseph holds a Masters in Architecture from Rice University, where he also assistant-taught architectural history and theory.

ANNA ANDRONOVA is a recent architecture graduate from Kazan State University. Her academic group is part of TIArch Studio, an educational workshop in experimental design led by Inar Akhtiamov. She also has a BA from the University of East London. The 'My Breathing City' project was awarded second place in the d3 Natural Systems competition (USA), the 'Mediatheque' project got an ISArch Special Mention award (Spain) and an extract of her thesis received third prize in the International Shopping Plaza Design Competition (China). Her professional interests lie in social construction, spatial imagination and developing a strong graphic language.

MATTHEW AUSTIN is a PhD candidate and an associate lecturer in architecture at the University of Technology, Sydney. Matthew's expertise in advanced digital processes has been invaluable in establishing a research agenda that focuses on the critical exploration of the architectural potential offered by the 'glitch' and glitch aesthetics. Specifically, this interest is a valuable lens into understanding how the glitch, as an example of an aberrant digital process, can be used critically to resist valuing architectural objects solely as instrumental outcomes of explicable processes.

ALESSANDRO AYUSO is a senior lecturer at the University of Westminster and an MArch thesis supervisor at The Bartlett School of Architecture, UCL. Before moving to London, he taught at universities including Virginia Tech and Marywood University, co-founded a practice in New York, exhibited in venues such as the McCaig-Welles Gallery in Brooklyn and studied as a fellow at Syracuse University in Florence.

KIRSTY BADENOCH works between architectural urbanism and territorial landscapes. Educated at the University of Liverpool and Aarhus Architecture School, Denmark, she graduated in 2011 under the tutelage of C.J. Lim and Chris Thurlbourne of The Bartlett School of Architecture, UCL. Her thesis project, 'New Lohachara', has won numerous awards, including the RIBA President's Medal Serjeant Award for Excellence in Drawing, and has been widely published and exhibited internationally, including in the *RIBA Journal*, *The Architectural Review* and the IAAC's *Self-Sufficient Habitat*. Kirsty was awarded a series of grants from the Danish Arts Fund for her private artistic research project into rising sea levels, 'The Disappearing Islands'. In 2011, she founded the drawing company 'Drawn by Numbers' and she actively pursues representation as a form of architectural investigation in and outside of architectural practice.

THOMAS BALABAN established TBA in 2009 as a multidisciplinary studio focusing on architecture and design. The office seeks out every opportunity to challenge conditions, expand current conventions and create better environments. Thomas Balaban, OAQ AAPPQ MRAIC, received his professional architecture degree from McGill University. He has worked for Frank O. Gehry & Associates/Gehry Partners for several years in Los Angeles, as well as for Saucier + Perrotte in Montreal. In 2012, he was appointed professor in practice at the School of Architecture at Université de Montréal. He was previously an adjunct professor at McGill University's School of Architecture, teaching design from 2006 to 2012.

SOPHIA BANOU studied architecture at the National Technical University of Athens in Greece and at the University of Edinburgh. She currently teaches architectural design and theory at the University of Edinburgh and Newcastle University (UK), and she is an editor for the architectural design research journal *Drawing On*. She has recently completed a PhD in Architecture by Design at the University of Edinburgh. Her thesis, 'The Kinematography of a City: Moves into Drawing', was funded by the Bodossaki Foundation in Greece and focused on the concept of space as a temporal and ephemeral condition and the understanding of drawing as a situated experience. Her work has been published and presented in exhibitions internationally and is also in the permanent collection of the Benaki Museum in Athens and the archival collection at Virginia Tech, USA.

JAMIE BARRON is a designer from Los Angeles. He received his Bachelors of Science in Architecture from the University of Illinois at Chicago in 2011 and his Masters of Architecture from the University of California in 2016.

PETER BEHRBOHM is an artist, architect and filmmaker based in Berlin. Peter studied in Stockholm and Berlin and holds a diploma in architecture from Berlin's University of the Arts. In 2014, he received the BDA-SARP Award from the German Architecture Association and the Association of Polish Architects for best graduation project. For his urban interventions and short films, he was awarded the Baumgarten Scholarship twice, and in 2012 he received the Rudolf Ladders Award for his architectural approach to the Esso Houses in Hamburg. At Brandlhuber+, he was in charge of the exhibition 'Archipel' at n.b.k. and K.O.W. (both galleries in Berlin) in the same year. Currently, he is working on a book/exhibition about the work fetish.

ADAM BELL undertook both his BA Hons and MArch at the University of Greenwich on a part-time basis while working for a small architectural practice based in Kent. 'The Restored Commonwealth Club' formed the thesis project of his MArch. Following graduation, 'The Restored Commonwealth Club' received the SELSA Award and the Serjeant Award (RIBA President Medals). Adam is currently undertaking the Part 3 qualification at the University of Greenwich while working at Foster + Partners.

KYLE BRANCHESI is currently an architect for The Office Of HH The Crown Prince of Dubai and a graduate of the Southern California Institute of Architecture. He is a founder of the collaborative TALL. Through exhibitions, publications, loose imagery and whatever else they can get their hands on, TALL challenges the assumed depth of objects within the current creative economy.

JESSIE BRENNAN is a London-based British artist whose practice explores the representation of places through drawing and dialogue, informed by their changing contexts and a direct engagement with the people who occupy them. She graduated from the Royal College of Art in 2007 and has exhibited nationally and internationally, including: REGENERATION!, HS Projects, London (solo and publication, 2015); Progress, The Foundling Museum, London (2014); Talents Contemporains and François Schneider Foundation, France (2014). Jessie is a freelance educator, visiting university lecturer and current artist-in-residence at Metal in Peterborough, where she is developing her Arts Council England-supported project 'Inside a Green Backyard'. She is currently (2016) a visiting research fellow at The Bartlett School of Architecture, UCL.

PABLO BRONSTEIN is an Argentine artist based in London. He attended Central Saint Martins at the University of the Arts, London, the Slade School of Fine Art, UCL, and Goldsmiths, University of London. In 2015, Bronstein had solo shows at both Nottingham Contemporary and Chatsworth House, Derbyshire, as well as at the Museo Marino Marini, Florence, and The Museum of Fine Arts, Houston. Other solo exhibitions include: REDCAT, Los Angeles (2014), Centre d'Art Contemporain, Geneva (2013), The Institute of Contemporary Art, London (2011), Kunsthall Charlottenborg, Copenhagen (2011), Sculpture Court, Tate Britain, London (2010) and The Metropolitan Museum of Art, New York (2009). Bronstein's work is currently exhibited as part of the touring 8th British Art Show (2015–17). Previous group exhibitions include: Collected By Thea Westreich Wagner and Ethan Wagner, Whitney Museum of American Art, New York (2016), L'Année Dernière à Marienbad, Kunsthalle Bremen, and History is Now: 7 Artists Take on Britain, Hayward Gallery, London (2015), Folkestone Triennial, curated by Lewis Biggs, Folkestone, Kent (2014), Curiosity – Art and the Pleasures of Knowing, curated by Brian Dillon, Hayward Touring exhibition (2013–14), Ideal Standard Forms, Galleria d'Arte Moderna, GAM, Turin (2013),

Arkhaiologia: Archeology in Contemporary Art, Centre PasquArt, Biel (2011), Scene Shifts, Bonniers Konsthall, Stockholm (2010) and MOVE: Choreographing You, Hayward Gallery Touring (2010–11). In 2013, König Books published a major monograph, *A is Building, B is Architecture*. Other solo publications include *Enlightenment Discourse on the Origins of Architecture* (2014), *Gilded Keyholes* (2013), *A Guide to Postmodern Architecture in London* (2011), *Pissoir* (2011), *Ornamental Designs* (2008) and *Description of Casa Scaccabarozzi* (2008).

KONRAD BUHAGIAR is an architect and founding member of the Architecture Project network. He is associate professor at the University of Malta, a tutor at the Centre for Sustainable Heritage at The Bartlett School of Architecture, UCL, and at the International Summer School in Aix-Marseille Université, France. Previously, Buhagiar was an architect in the Antiquities Section of the Ministry of Public Works of Malta and President of the Heritage Advisory Committee of the Malta Environment and Planning Authority. Buhagiar has been a member of the Expert Committee of the European Prize for Urban Public Space since 2012. He co-edited the book *The Founding Myths of Architecture* (2016).

MATTHEW BUTCHER is a lecturer in architecture and performance at The Bartlett School of Architecture, UCL, where he is also director of the undergraduate BSc Architecture programme. Recent projects and exhibitions include 'Stage City' (exhibited at the V&A Museum, Prague Quadrennial and the Royal Academy), '2EmmaToc/Writtle Calling', a temporary radio station in Essex, which was named in *Artforum* as one of the best projects of 2013, and 'Flood House', a floating architecture developed in collaboration with Focal Point Gallery in Southend as part of their Radical Essex programme. Matthew is also co-founder and editor of the architectural newspaper *P.E.A.R.: Paper for Emerging Architectural Research*.

BRYAN CANTLEY received his BA in Architecture from UNCC and his Masters in Architecture from UCLA, and is a Professor of Design Theory at CSUF. His work is in the permanent collection at SFMOMA, and he is a recipient of a Graham Foundation grant. He has lectured and had solo exhibits internationally, including at SCI-Arc and The Bartlett School of Architecture, UCL. His first monograph, *Mechudzu*, was published in 2011 by SpringerWein. His solo exhibition 'Dirty Geometries + Mechanical Imperfections' was installed at SCI-Arc in 2014.

NAT CHARD is Professor of Experimental Architecture at The Bartlett School of Architecture, UCL, following professorships at the Royal Danish Academy, Copenhagen, the University of Manitoba and the University of Brighton. He taught at The Bartlett throughout the 1990s and has also taught at North and East London Universities. His work has been published and exhibited internationally. His research practice develops means of discussing uncertain conditions in architecture and his recent work has been acted out through a series of nine types of drawing instrument.

GRÉGORY CHATONSKY is a French artist based in Montreal and Paris. He has a PhD from UQAM, a Masters in Multimedia and Hypermedia Art from ENSBA-ENST, a DEA in Aesthetics and a Masters in Philosophy from Paris I-La Sorbonne. In 1994, he founded the netart platform incident.net. Grants and awards he has received include Dicream (2014), CAC (2013), CALQ (2012), CRSH (2011), Cap Digital (2010), Arcadi (2010) and CNAP (2008). In 2013, he launched 'Telofossils' at the Museum of Contemporary Art, Taipei. In 2015, 'Extinct Memories' was showed at IMAL (Brussels). He has participated in group exhibitions including 'Erreur d'impression, Jeu de Paume' (Paris), 'The Beginning of The End' (Timisoara), 'Mois de la Photo' (Montréal), 'Extimitat' (Palma), 'Der Untergang – Doomsday' (Berlin), 'Connect the dots and see the unseen' (Roma), 'Interlife Crisis' (Seattle), 'The Radius' (Chicago), 'Il Pardoosso Della Rupetizone' (Roma), 'Augmented Senses' (Shanghai) and the Biennale Montréal.

DOMINIQUE CHENG is an architect (by training) and illustrator/ installation artist (by choice). He received a Masters in Architecture from the University of Toronto (2007) and has since worked for numerous firms across the US. In 2012, he co-formed WE-3, a collective of architects, graphic designers and designers interested in creating experiences that are layered in meaning, specifically/spatially located and impeccably executed. He is the recipient of the OAA Architectural Concept Award (2016) and is currently a finalist for the prestigious Arte Laguna Prize in Venice (2016).

JANA ČULEK is an architect from Croatia, living and working in the Netherlands. A graduate of the Berlage Center for Advanced Studies in Architecture and Urban Design in Delft (Netherlands), the focus of her design projects and research has been architectural representation and narrative. Her thesis project at The Berlage looked at representational and narrative methods in Dutch architecture and visual culture. The project 'A Flat Tale' was published in the book *Scenes from the Good Life* and presented and exhibited at the 'Scenes from the Good Life' symposium, held at the TU Delft Faculty of Architecture in January 2016.

NICHOLAS DE MONCHAUX is Associate Professor of Architecture and Urban Design at the University of California, Berkeley, where he serves as director of the Berkeley Center for New Media. He is the author of *Spacesuit: Fashioning Apollo* (MIT Press, 2011), an architectural and urban history of the Apollo spacesuit, winner of the Eugene M. Emme award from the American Astronautical Society and shortlisted for the Art Book Prize, as well as *Local Code: 3,659 Proposals about Data, Design, and the Nature of Cities* (Princeton Architectural Press, 2016). His design work has been exhibited at the Biennial of the Americas, the Venice Architecture Biennale, SFMOMA and the Museum of Contemporary Art in Chicago. He is a Fellow of the American Academy in Rome.

BERNADETTE DEVILAT is an architect, and co-founder of Devilat Lanauz Architects and the Tarapacá Project, an initiative to address reconstruction in heritage villages affected by earthquakes, created after the 2005 earthquake occurred in the northern area of Chile. Her work has been exhibited at the Expo Shanghai (2010), Venice Architectural Biennale and Architecture Biennial of Chile. Her Masters thesis was awarded in two national competitions and also exhibited at the Architectural Biennale of Chile (2010). She was also a lecturer at the Architectural Design Studio at PUC in 2009–10.

DRAWING ARCHITECTURE STUDIO was founded by architect Li Han and designer Hu Yan in Beijing, China. Drawing Architecture Studio (DAS) is a creative platform integrating architecture, art, design, urban study and pop culture that aims to explore new models for the creation of contemporary urban culture. Li Han is a National Class 1 Registered Architect in China. He received a BArch from the Central Academy of Fine Arts in Beijing and a MArch from RMIT University in Melbourne. He worked as a senior architect at the China Architecture and Research Group in Beijing for seven years before establishing DAS. His current practice includes architecture design, urban research and publication. Hu received her BFA from Concordia University in Montreal, Canada. She has years of experiences in branding and product design.

GUILLAUME DREYFUSS is an art historian and heritage consultant at Architecture Projects (AP), based in Malta. Guillaume obtained a MSc in Sustainable Heritage from UCL and is co-editor of *The Founding Myths of Architecture* (2016). Before joining AP, Guillaume gained experience of museum curatorship and exhibition management in France.

OWEN DUROSS completed his BA in Architecture from the University of Kentucky, College of Design (UK/CoD) in 2015, and is currently pursuing his Masters in Architecture. He was a research assistant and project designer at D.O.T.S. (Design Office Takebayashi Scroggin) in 2014, and is currently a project designer for Martin Summers at PLUS-SUM Studio in Lexington, Kentucky. His ongoing research is in conjunction with the 'Point of Departure' Studio at UK/CoD as a team member and project designer. As a multidisciplinary project with the Center for Applied Energy Research (CAER), it was awarded a University of Kentucky Sustainability Challenge Grant in 2014 and 2015 to pursue design and construction of sustainable bus shelters on the UK campus. He is currently collaborating with social media group Super//Architects.

ECOLOGICSTUDIO is an architectural and urban design studio co-founded in London by Claudia Pasquero and Marco Poletto. The studio focuses on 'systemic' design, a method defined by the combination and integration of ecological thinking, computational and interaction design and digital prototyping. Claudia Pasquero graduated from Turin Polytechnic in 2000 and completed her graduate studies at the AA. She has exhibited in the London and Venice Architectural Biennales with an installation called STEM and is co-director of the Fibrous Structures Project. Claudia has taught and lectured internationally. She leads the Urban Morphogenesis Lab for the MArch Urban Design programme at The Bartlett School of Architecture, UCL. Marco Poletto is an architect, author and educator. He has taught at the AA (London) and IAAC (Barcelona). Poletto and Pasquero are the authors of *Systemic Architecture – Operating Manual for the Self-Organizing City* (Routledge, 2012).

BENJAMIN FERNS is currently employed at Hopkins Architects in London. As a student of MArch Unit 12 at The Bartlett School of Architecture, UCL, he has developed a profound knowledge of Italian postwar architecture and the Italian Baroque. He graduated with distinction and subsequently received the RIBA Serjeant Award, SOM Fellowship and Sir Banister Fletcher Medal.

HSINMING FUNG has been principal and co-founder of Hodgetts + Fung since 1984, a studio with expertise in the design of unique places for learning, cultural events and civic functions. H+F’s approach is multifaceted, embracing visitor experience, technology and iconic presence in a disciplined process, resulting in a bold, uncompromising architecture. The firm’s award-winning projects include the redesign of the Hollywood Bowl, Menlo-Atherton Performing Arts Center, CalArts’ Wild Beast Pavilion, Jesuit High School Chapel and Nashville’s new Ascend Amphitheater. Current projects include the renovation of Culver City’s historic Robert Frost Auditorium and a West Hollywood mixed-use development. H+F has been awarded the AIA Gold Medal and the AIA CC Firm of the Year Award. Following an eight-year relationship with the Southern California Institute of Architecture (SCI-Arc) as Graduate Programs Director and Design Studio faculty, Ming was appointed to the position of Director of Academic Affairs in the fall of 2010, and then in 2015 was appointed to serve in her current role as Chief of Strategic Advancement and International/Special Programs. She has taught at Yale, Ohio State and Cal Poly Pomona. She is a past president of both AIA Los Angeles and the Association of Collegiate Schools of Architecture. She has been a recipient of the National Endowment for the Arts Rome Prize Advance Fellowship. She was appointed by Bill Clinton as a Council Member of the National Endowment for the Arts and has served as a national peer for General Services Administration.

PABLO GIL MARTÍNEZ is an architect with eleven years of postgraduate experience as a professional practitioner. After graduating from The Bartlett School of Architecture, UCL, he worked for David Chipperfield Architects, Richard Rogers Partnership and Yael Reisner Architects, and then founded GilBartolomé Architects with Jaime Bartolomé. He completed a PhD at The Bartlett, supervised by Professors Stephen Gage and Marcos Cruz. He also teaches architecture at the Univerisdad Europea de Madrid. Previously, he taught at London Metropolitan University and the Instituto Empresa Business School, Madrid. His recent project 'The House on the Cliff' was covered by media throughout the world.

DAVID S. GOODSELL is an associate professor in the Department of Molecular Biology at the Scripps Research Institute in La Jolla, California. He is the author of *Bionanotechnology: Lessons from Nature* (J. Wiley and Sons, 2004), *Our Molecular Nature: The Body’s Motors, Machines, and Messages* (Springer-Verlag, 1996) and *The Machinery of Life* (Springer-Verlag, 1993).

PENELOPE HARALAMBIDOU is a senior lecturer at The Bartlett School of Architecture, UCL, where she coordinates the MPhil/PhD programmes and MArch Architecture Unit 24. Projects include 'Drawing Fix', an installation for the Museum of Modern Art, Athens, 2002, and exhibition designs at the RIBA, London, 2003, and the Art Directors Club, New York, 2003. Her current work lies between architectural design, art practice and curating, experimental film and critical theory, and has been published and exhibited internationally. Curatorial/research projects include 'Spatial Imagination' (2006), 'The Blossoming of Perspective' (2007) and 'Speculative Models' (2009). She is the author of *Marcel Duchamp and the Architecture of Desire* (Ashgate, 2013) and *The Blossoming of Perspective: A Study* (DomoBaal Editions, 2007), and has contributed writing on themes such as allegory, figural theory, stereoscopy and film in architecture to a wide range of publications.

SIMON HERRON trained at the AA, London, and Städelschule Frankfurt. He is currently Academic Leader in Architecture at the University of Greenwich and postgraduate design studio tutor for Diploma Unit 16 with Nicholas Szczepaniak. His current research interests reflect on architecture in the age of the Anthropocene. Previously, he was a Senior College Teaching Fellow at The Bartlett School of Architecture, UCL, and has taught at the University of Westminster, SCI-Arc Los Angeles and at the AA, London. He worked for Michael Hopkins Architects before joining Ron Herron Associates, where he became a partner in 1989.

HIPOTESIS is an independent publishing platform created in 2009 by Francisco G. Triviño, Fernando Nieto, Katerina Psegiannaki and José Manuel López Ujaque. Francisco García Triviño trained in architecture at the University of Granada and has a PhD from ETSAM, Madrid.

He is an associate teacher at ESNE and UCJC, Madrid. Fernando Nieto graduated from the School of Architecture in Valladolid and has a Master of Advanced Studies in Collective Housing and a PhD from the Department of Architectural Design at the School of Architecture in Madrid. José Manuel López Ujaque trained in architecture at the University of Alicante and is a PhD candidate at ETSAM. Katerina Psegiannaki is an architect from the University of Thrace, Greece, holds a PhD from ETSAM and is an associate teacher at the International University of La Rioja.

ANNA HOUGAARD received her diploma in architecture from The Royal Danish Academy of Fine Arts, School of Architecture in Copenhagen (KADK) in 2007, where it received the Vola Prize. She has worked as an architect at Nobel Arkitektør (Copenhagen), Holgaard Arkitekter (Copenhagen) and Schultes Frank Architekten (Berlin), and has been a teaching assistant at the KADK since 2007. She recently handed in her PhD thesis 'The Animate Drawing', on the effect of computers on architectural drawing. She lives in Berlin with her family and since 2015 has been a member of the Berlin-based network of architectural researchers architekturwissenschaft.net.

ADRIANNE JOERGENSEN is an architectural designer and research coordinator for 'Tourism and Cultural Heritage: A Case Study on the Explorer Franz Wilhelm Junghuhn', a multidisciplinary travelling research project at the ETH Zürich Future Cities Laboratory (FCL) in Singapore, led by Professors Philip Ursprung and Alex Lehnerer. Her previous research has focused on the architectural structuring of views, especially in tourist contexts around southeast Asia. She has catalogued the design impact of plotlines on urban contexts from Chicago to Jakarta, and has been a visiting critic or lecturer at, among others, the National University of Singapore (NUS) School of Architecture and Yale-NUS College. Her design work has been published in *SOILED, The Draftery* and *The Economy Magazine* and shown at the Storefront for Art and Architecture and the Chicago Architecture Foundation. She holds a Masters in Architecture from the University of Illinois at Chicago (UIC) School of Architecture, where she was a graduate teaching assistant and organiser of the student-run Department of Urban Speculation.

RYAN LUKE JOHNS is a visiting lecturer at the Princeton University School of Architecture, adjunct assistant professor at Columbia University GSAPP and co-founding principal of GREYSHED, a design-research collaborative focused on advanced workflows and robotics within architecture, art and industrial design. Recent projects by GREYSHED explore nonlinear design workflows, which leverage interactive technologies, sensory feedback and robotic fabrication tools to reduce the divide between design conception and materialisation. Ryan holds a BArch from Columbia University and a Masters in Architecture from Princeton University. He has worked for KPF and DS+R, as a fabricator for Robert Lazzarini and as a research assistant for the Gramazio & Kohler Chair of Digital Fabrication, ETH Zurich.

EPHRAIM JORIS is a partner at the international architecture practice Architecture Project, with whom he produces work in renovation and restoration. Dr. Joris has a PhD from RMIT University, evaluating the idea of an architectural phenomenology that recasts history as the experiential content of speculative architectures. As Co-Director of Program at the Faculty of Architecture at KU Leuven University, he continues this research through projects concerning mobile tensile architecture that seeks to combine mechanical efficiency with local identity, culture and history.

DAMJAN JOVANOVIC is a tutor and research associate at Städtelschule Architecture. His MArch thesis won the AIV Master Thesis Prize in 2014. Damjan received his undergraduate degree in architecture in 2006 and completed an MArch at the University of Belgrade, Serbia, in 2008. His interests lie in computational design and his work explores the relationship between aesthetics and the computational medium. Recent projects include video installations for musical theatre performances staged in Frankfurt, Vienna and Warsaw, as well as software applications that are positioned between gaming and design culture.

ARNAV KAPUR works at the confluence of human-machine collaboration and machine intelligence. He explores how machines could emulate human cognition and in the process augment our own abilities. With his understanding of machine learning and artificial intelligence technologies and his passion for artistic and musical expression, he is excited by their close intersections. His previous experience includes work at MIT CSAIL, Harvard Medical School and the Google Lunar X Prize.

PARSA KHALILI is an architectural designer based in Vienna and Chicago. He spent a year at the Ecole Nationale Supérieure d'Architecture de Versailles (2005), where he was awarded the Earl Prize for Design Excellence and went on to graduate *summa cum laude* from the University of Illinois at Urbana-Champaign (2006). Parsa received his Masters at the Yale School of Architecture (2009). In 2013, he was awarded the Plym Fellowship by the University of Illinois to fund his speculative design project 'The End of Western Classicism, the End of the Near East: Structural Translations in/of Piranesi's Anachronistic Project'. Currently, he is Assistant Professor for Greg Lynn at die Angewandte, University of Applied Arts in Vienna. In Vienna, Parsa is developing his architectural practice, having entered and been recognised in a number of international design competitions, as well as collaborating with a number of offices in the design and construction of projects in Europe and Asia.

KEITH KRUMWIEDE was born in New Orleans and raised in single-family houses across the globe, from Bangkok to Washington, DC. His writing, teaching and design work explores the use and misuse of found forms, materials and words, in order to examine the world and imagine other ways it might have been and may still be. His work has been exhibited widely and published in numerous journals, including *Domus*, *306090*, *Perspecta*, *Praxis* and *Log*. In October 2016, Park Books published his book *An Atlas of Another America*, which includes the complete drawings of 'Freedomland', a satirical ideal city constructed with single-family houses. He has taught at Rice University, Yale University and the New Jersey Institute of Technology, where he is currently an associate professor and director of graduate architecture programs.

CHEE-KIT LAI set up Mobile Studio Architects in 2008, after working with a variety of award-winning architecture practices such as Featherstone Associates, Peter Barber Architects and Ken Yeang. A graduate of The Bartlett School of Architecture, UCL, Chee-Kit is a visiting critic at a number of the UK's leading universities, including UCL, Central Saint Martins, the University of Nottingham and the University of Westminster. He is also an RIBA Awards Assessor. Chee-Kit is a keen runner and is fascinated by airports and air travel.

CARL LOSTRITTO is Assistant Professor of Architecture at Rhode Island School of Design. He regularly exhibits drawings and conceptual works of architecture. His architectural agenda involves framing computation and representation conceptually. His modus operandi in practice and pedagogy involves writing software that controls machines and extends the role of the human author in the design process. He has written hundreds of programs and scripts that control vintage pen plotters, and has indexed, catalogued and written about the resulting drawings. A recent exhibit, 'Landlines', was shown at the MIT Keller Gallery. Lostritto studied in a post-professional research program at MIT within the Design and Computation Group.

RAY LUCAS is Head of Architecture at the University of Manchester. Lucas has a PhD in Social Anthropology on 'Towards a Theory of Notation as a Thinking Tool' from the University of Aberdeen, and works at the interface between architecture and anthropology, with a specific interest in drawing. Lucas recently published *Research Methods for Architecture* (2015) and will soon publish a study of and with axonometric drawing, *Drawing Parallels*.

ANN LUI is an assistant professor at School of the Art Institute Chicago's Architecture, Interior Architecture and Designed Objects department. With Craig Reschke, she is a co-founder of Future Firm, a Chicago-based architecture office focused on the intersections of landscape territories and architectural spectacle. Ann received her BArch from Cornell University and her SMArchS from Massachusetts Institute of Technology in History, Theory and Criticism. She was assistant editor of *OfficeUS Atlas*, the official publication of the US pavilion at the Venice Architecture Biennale in 2014; co-editor of *Threshold's* 'Scandalous' issue, MIT's peer-reviewed journal of art, architecture and culture; and is assistant editor of the forthcoming *Public Space? Lost and Found* with Gediminas Urbonas. Ann has been awarded fellowships and grants including the Schlossman Traveling Fellowship, the Eidlitz Fellowship and from the Council for the Arts at MIT.

ADAM MARCUS is an architect and educator whose work has been recognised, published and exhibited internationally. Adam directs Variable Projects, an award-winning design and research studio in Oakland, California, that operates at the intersection of architecture, computation and fabrication. He is also a partner at Futures North, a public art collaborative dedicated to exploring the aesthetics of data. A graduate of Brown University and Columbia University's Graduate School of Architecture, Planning and Preservation, Adam previously

practiced with Marble Fairbanks in New York City, where he served as project architect for a number of award-winning educational and public projects. Adam is Assistant Professor of Architecture at California College of the Arts, where he coordinates the Integrated Building Design curriculum, teaches design studios in computational design and digital fabrication and collaborates with CCA's Digital Craft Lab. He has previously taught at the undergraduate Department of Architecture at Barnard & Columbia Colleges, the University of Minnesota and the Architectural Association's Visiting School Los Angeles.

RYOTA MATSUMOTO is an artist, designer and urban planner, and a principal at award-winning interdisciplinary design office Ryota Matsumoto Studio in Tokyo. Born in Tokyo, Ryota was raised in Hong Kong and Japan. He received a Masters degree in Architecture from the University of Pennsylvania in 2007 after studying at the AA in London and the Mackintosh School of Architecture, Glasgow School of Art. His art and design work are featured in numerous publications and exhibitions internationally. His current interest gravitates around the embodiment of cultural possibilities in art, architecture and urban topography.

ERIC MAYER is a founding member of studioRON, a collective of architects and designers who have been selected to design and construct multiple installations by the Philadelphia AIA, Temple University and various private collectors. Eric received his Bachelor of Architecture from the Tyler School of Art at Temple University in Philadelphia, Pennsylvania. His architectural investigations consider productive methods of representation at the intersections of drawing, prototype, model and installation. The work explores representational methodologies which exploit the corporeal properties of materials, in conjunction with psychological theories of false memory applied to various communal and personal senses of nostalgia that are related to site, in order to develop architectural responses. The products of his architectural investigations have been on display at various galleries, including the WUHO Gallery of Art and Architecture in Hollywood, CA, and the AIA Philadelphia in Philadelphia, PA.

SYD MEAD is a 'visual futurist' and a neofuturistic concept artist. He is best known for his designs for science fiction films such as *Star Trek: The Motion Picture*, *Blade Runner*, *TRON*, *2010*, *Short Circuit*, *Aliens*, *Timecop*, *Johnny Mnemonic*, *Mission Impossible 3* and *Elysium*. Mead has a close relationship with a number of major Japanese corporate clients, including Sony, Minolta, Dentsu, Dyflex, Tiger, Seibu, Mitsukoshi, Bandai, NHK and Honda, as well as contributing to two Japanese film projects, *The New Yamato* and *Crises 2050*. In the 1990s, Mead supplied designs for two Japanese toy icons, 'The New Yamato' and all eight robot characters in the new *Turn-A Gundam* mobile suite series, which were also seen as characters in television shows. In 1993, a digital gallery comprised of fifty examples of his art with interface screens became one of the first CD-ROMs released in Japan. With the Gnomon School of Visual Effects, Mead produced a four-volume 'How To' DVD series, 'Techniques of Syd Mead'. His one-man shows, 'Cavalcade to the Crimson Castle', consisting of 114 original paintings and illustrations, and 'Syd Mead Progressions', have toured the US. In 2007, alongside director Joaquin Montalvan, he completed *Visual Futurist*, a documentary of his career.

ALISON MOFFETT is an artist and lecturer at the AA. Born in Knoxville, Tennessee, she studied art and anthropology in the US before coming to London to attend the MFA in Painting programme at the Slade School of Fine Art, graduating in 2004. Following an interest in architecture, she obtained an MA in Histories and Critical Thinking from the AA in 2011, where she has since been teaching. She lives and works in London and has exhibited internationally and in the UK.

MASSIMO MUCCI is an architect (University IUAV of Venice) and a professor of technology and technical drawings at the Technical Institute of Technology (ITTS) in San Donà di Piave (Venice). He is a PhD candidate at the University IUAV of Venice (Italy), currently in his first year of doctoral research. He worked as Adjunct Professor of History of Architecture at the University of Trieste and held lectureships at Trieste and Venice University. He has published the book *La Risiera di San Sabba. Un'architettura per la memoria* (1999), as well as several essays about architecture in Trieste after the Second World War.

TOM NGO is a Hong Kong-born visual artist based in Toronto. Tom's work explores the impact of logic and convention in design and examines the necessity of function in architecture. Tom's work has been exhibited in Canada and New York and published in print and online. His recent work was included in the exhibition 'TBD' at the Museum of Canadian Contemporary Art, Toronto, and in the publication *Imagine Architecture:*

Artistic Visions of the Urban Realm (2014). In conjunction with his visual art practice, Tom is also a senior designer at Moriyama and Teshima Architects and an instructor of architectural representation at the Daniels Faculty of Landscape, Architecture and Design at the University of Toronto.

THI PHUONG-TRÂM NGUYEN is a trained architect living in Canada. She also holds an MA in the History and Theory of Architecture from McGill University and is currently working on a practice-led PhD in Architectural Design at The Bartlett School of Architecture, UCL, where she is exploring the temporal encounter between the body and the space of wonder using anamorphic images. Her research encompasses a historical investigation into the development of anamorphosis in the seventeenth century, with a particular interest in the discoveries and advancements at the Minims Convent by Jean-François Niceron (1613–43). Her practice attempts to unfold the potential of encounters between the body and moving images in installations that combine film, sculpture and text.

NORELL/RODHE is an architecture studio founded in 2012 by Daniel Norell and Einar Rodhe. Norell/Rodhe's work draws from odd couplings of abstract architectural traits, such as proportion and frontality, with a gritty world of untamed materials and found objects. Their work to date includes competition-winning projects such as the new HC Andersen Museum in Odense, as well as the internationally acclaimed installation 'Erratic', first exhibited in Helsinki. Daniel Norell studied architecture at UCLA in Los Angeles (MArch 2006) and at the KTH Royal Institute of Technology in Stockholm. He has previously worked for Greg Lynn, Zaha Hadid and Kjellander & Sjöberg. He is a senior lecturer in architecture at Chalmers University in Gothenburg. Einar Rodhe studied architecture at the KTH Royal Institute of Technology in Stockholm (MArch 2009) and at the Royal Academy of Fine Arts in Copenhagen. He has previously worked for Anders Wilhelmson and Ghilardi + Hellsten. He is a lecturer in architecture at the KTH in Stockholm.

OĞUL ÖZTUNÇ holds a BArch degree from Istanbul Technical University's Architecture Department (2014). His graduation project, 'Zoetrope/Open Air Performance Museum', was selected as equal best project in the ITU Architecture Faculty Official Selection and won first prize at Archiprix Turkey 2014. He is a 2014 recipient of the Helmut Henrich Foundation Travel Bursary, and presented his research paper 'Transforming the Image of War Machines' at the Freie Universtät in Berlin. He has participated in and tutored many workshops, including at institutions such as the AA Visiting School, Politecnico di Milano, EASA 2012 Wastelands, Herkes için Mimarlık (Architecture for All), Atelier Bow-Wow, Istanbul Design Biennale and VBenzeri Design Marathon. He is a research assistant and tutor at Istanbul Bilgi University's architecture department.

MATTHEW PARKER completed his Masters of Architecture at the University of Calgary's Faculty of Environmental Design, where he received the AIA Gold Medal. Currently, he is a researcher at the Laboratory for Integrative Design (LID), an interdisciplinary research group that aims to develop protocols for navigating across different disciplinary territories through algorithmic thinking, computation, digital fabrication and material exploration. His current research explores how computer vision facilitates a class of inhuman architectural observers that augment the contexts in which images of the city are constructed, stored and retrieved. Additionally, Matthew is a studio designer and parametric consultant with Minus Architecture Studio and Synthetiques/Research + Design + Build.

GAVIN PERIN is a lecturer in architecture at the University of Technology, Sydney. With over 35 publications in national and international forums, Gavin's main research focus examines the disciplinary effects that emerging modes of digital representation have on architecture's processes and artefacts. Gavin's interest in digital representation has led to a range of cross-disciplinary design activities. Gavin is currently enrolled in a DPhil in Architecture at UTS. His thesis examines how the rejection of semiotics in digital architectural discourse in the period between 1990–2005 resulted in the development of a very specific formal basis by which architectural processes and objects were understood.

JULIA SEDLOCK is a designer, writer and founding partner of Cosmo Design Factory, an upstate New York design practice with several house projects currently under construction. Through a combination of commissioned projects and independent research, her work explores ways in which architectural form playfully engages with the world to solicit multivalent interpretation and to promote novel social and cultural interaction. In addition to their house projects, Cosmo Design Factory

recently completed temporary installations for arts organisations in New York City and the Hudson Valley and has work published in *PLAT Journal*, *MAS Context*, *SOILED* and *Conditions Magazine*. Julia has an MArch and an MA in Design Criticism from the University of Illinois at Chicago and is adjunct faculty in the graduate program at New Jersey Institute of Technology.

ELIZABETH SHOTTON is currently Director of Research, Innovation and Impact in the UCD School of Architecture, Planning and Environmental Policy. She teaches in construction technology and design, with an emphasis on sustainable building and development, at both undergraduate and graduate level. She holds undergraduate degrees in Commerce and Architecture, as well as a PhD in Architecture from UCD. In addition to teaching architecture, she was active in architectural practice from 1988–2006. Elizabeth's research focuses on the sustainable use of material resources through advances in materials, construction technologies and design processes. She is currently involved in a national research collaboration on the application of wood-welding to construction products and assemblies, Birch WoodWeld, the CASWOOD project led by Dr Ken Byrne, University of Limerick, to develop a model to assess the environmental impact of the cascade effect in wood flow in Ireland, funded by the Department of Agriculture, Forestry and Marine; and a study on the evolution of maritime structures, 'Minor Harbours of Ireland's east coast', funded by the Irish Research Council.

NEIL SPILLER is Hawksmoor Chair of Architecture and Landscape and Deputy Pro Vice-Chancellor of the University of Greenwich, London. Before this, he was Vice-Dean and Graduate Director of Design at The Bartlett School of Architecture, UCL. He guest-edited his first *Architectural Design*, *Architects in Cyberspace* in 1995 (with Martin Pearce), followed in 1996 by *Integrating Architecture* (1996), *Architects in Cyberspace II* (1998), *Young Blood* (2000), *Reflexive Architecture* (2002), *Protocell Architecture* with Rachel Armstrong (2010) and *Drawing Architecture* (2013). Neil's numerous books include *Cyberreader: Critical Writings of the Digital Era* (2002), *Digital Dreams: The Architecture of the New Alchemic Technologies* (1998) and *Visionary Architecture: Blueprints of the Modern Imagination* (2006). He is internationally renowned for his drawn architectural design work, which has been published and exhibited worldwide and is in many collections. His new book, *Surrealism and Architecture: A Blistering Romance*, will be published in October 2016 by Thames and Hudson.

JENNIFER THOROGOOD received her MArch degree from McGill University in 2009. Prior to her education in architecture, she studied fine arts at the University of Western Ontario in London. Her current practice focuses on three avenues of production: architectural work, installation and material and product research. Since 2009, Jennifer has worked at TBA, where she currently runs its research and development work. Its multidisciplinary approach to making ensures a systematic rigour while creating work that is memorable, engaging and responsive to contemporary culture.

MADELON VRIESENDORP co-founded the Office for Metropolitan Architecture with Rem Koolhaas and Elia and Zoe Zenghelis. Their work at that time was exhibited at the New York Guggenheim and Max Protetch galleries, the Centre Pompidou in Paris, the Stedelijk in Amsterdam, Berlin's Aedes Gallery and Gallery Ma in Tokyo, among others. From the mid-1980s, she taught art and design at a number of schools, including the AA and the Edinburgh School of Art. Over the last ten years, she has worked in collaboration with Charles Jencks, producing drawings and models to accompany many of his publications, and with her daughter, Charlie, on several books and art projects. Vriesendorp has produced illustrations for *Built*, *Domus* and *Abitare*, while working on costumes, built objects, paintings and short stories. She has exhibited internationally. She received an Honorable Fellowship from the RIBA in February 2009.

ANDREW WALKER is an architectural researcher and academic, founder of experimental practice Atelier14 and is currently working as a designer at Jason Bruges Studio. Through interactive luminokinetic props, immersive audiovisual installations and aleatoric/reflexive drawing environments, Andrew's work attempts to hack, subvert and destabilise our perceptual mechanisms, with the aim of creating more participatory spatial systems and conversational architectures that stir more active forms of occupation. Most recently, his work has been expressed through a series of deployable luminokinetic drawing machine prototypes, designed to be embedded within sites, forming new interactive sub-architectures – scotopic labyrinths of perpetual novelty and surprise.

YOU + PEA is a London-based architectural design practice founded by Sandra Youkhana and Luke Caspar Pearson. You + Pea has a fascination with the media that define modern cities. These forms of representation lead to work that examines the potential varying resolutions of architecture today. Their proposals celebrate the graphic and the immediate, and demand attention through a vibrant conversation both with local context and further afield. Their work encompasses different fields of architectural media, including drawing, digital fabrication and videogame development. Sandra and Luke teach on undergraduate and masters programmes at The Bartlett School of Architecture, UCL, where they both studied. They were the curators of UP-POP at the London Festival of Architecture 2015. Their research work has been featured in publications such as *Blueprint*, *Architect's Sketchbooks*, *CLOG*, *Architecture Research Quarterly* and *Interstices* and exhibited at the RIBA, Peckham Levels, Architecture Foundation and Royal Academy.

EMMANOUIL ZAROUKAS is an architect and lecturer on the MArch Urban Design programme at The Bartlett School of Architecture, UCL, where he teaches theories related to morphogenetic processes in the urban realm. Emmanouil holds a postgraduate degree in Digital Architecture Production from the Institute of Advanced Architecture of Catalonia (IAAC), Spain. He has co-taught the MSc Architecture: Computing and Design in the School of Architecture, Computing and Engineering, University of East London since 2011. He is a PhD candidate at the University of East London, UK, where his research on artificial cognitive processes and neural networks allows him computationally and theoretically to explore the possibility of creativity and novelty in non-human, non-neuronal cognitive processes, towards an alien ontogenesis of architectural form.

SNEZANA ZLATKOVIC is an architect and a PhD student at the University of Belgrade Faculty of Architecture, where she obtained her Masters in Architecture in 2012. Her diploma project, 'Extension of the Museum of Contemporary Art, Belgrade', was awarded first prize in the Sestre Bulajić Foundation's Student Graduates Awards Competition. After graduation, her portfolio was selected as one of the 33 best portfolios of young Serbian architects under the age of 33 by the journal *Arhitekton's* Portfolio 33 competition. Along with her PhD research, she has been involved in international projects and architectural interventions as an architect with Energoprojekt, and has taken part in various international and national architectural competitions, conferences and exhibitions.

EDITORS
Laura Allen, Luke Caspar Pearson

PROJECT EDITOR
Eli Lee

EXECUTIVE EDITORS
Frédéric Migayrou, Bob Sheil

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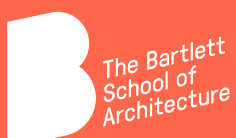
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Despite numerous developments in technological manufacture and computational design that provide new grounds for art and architecture, the act of drawing still plays a central role as a vehicle for speculation. There is a long and rich history of drawing that is tied to innovations in technology as well as revolutions in our philosophical understanding of the world. In consideration of a society now underpinned by computational networks and interfaces allowing hitherto unprecedented views of the world, the changing status of the drawing and representation as a political act demands a platform for reflection and innovation.

Drawing Futures is a compendium of the many approaches and directions in which drawing practice and research is heading. Featuring 60 projects from architects and artists to computer scientists and educators, the book opens up the discussion of how drawing may expand synchronously together with technological and computational developments. Produced alongside an international conference held at the Bartlett School of Architecture, UCL, *Drawing Futures* serves as a marker of what drawing currently is, and also as a signal of drawings yet to come.

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ERRATA

The printed and full online version of the book available at UCL Discovery has several errors that have been already amended in this partial .pdf:

Page 236, Paragraph 6. Last three lines:

BOOK SAYS: Photography offered as well an unprecedented type of crutch: it introduced "a new standard of evidence."6.

IT SHOULD BE: "Photography offered as well an unprecedented type of crutch: it introduced 'a new standard of evidence'."6

Page 240, Paragraph 2. Last line and word before the next column:

BOOK SAYS: futurev

IT SHOULD BE: future

CAPTIONS:

Only the caption of Figure 1 is correct.

- Figure 2 should have caption currently placed under Figure 5. The correct caption is: Bernadette Devilat. Domesticity. 2015. Axonometric view from 3D scan data from 2013 of the interior of House 2 in Zúñiga, Chile.

- Figure 3 should have caption currently placed under Figure 4. The correct caption is: Bernadette Devilat. House and vegetation. 2014. Elevation image from the 3D laser scanning done in 2013 of House 1 in Zúñiga, Chile.

- Figure 4 should have caption currently placed under Figure 2. The correct caption is: Bernadette Devilat. Dwelling the record. 2014. Plan and section obtained using the 3D laser scan record from 2013 of an inhabited ruined house (House 1) in Zúñiga, Chile.

- Figure 5 should have caption currently placed under Figure 3. The correct caption is: Bernadette Devilat. Drawing vs. 3D scanning. 2016. Superimposition of 3D laser scanning data from 2013 and hand-measured drawings from 2012 of House 2 in plan, elevation and section in Zúñiga, Chile.

These errors are not the responsibility of the author. They have been informed to the editors to be amended in future editions of the book.