Speculations in Contemporary Drawing for Art and Architecture

Edited by Laura Allen
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Speculative Drawing

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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 experimentational 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 Fantasticals 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 Fantasticals* 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

Augmentations

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.

The Head/Hand Dialogue

Madelon Vriesendorp

Drawing Futures: Your work is often described as 'a world', encompassing paintings, objects, games, etc. Where do you see drawings fitting in – what is the role of drawing in your world?

Madelon Vriesendorp: Paul Klee once said, "I take the line for a walk". Drawing is a universal, formal language. It's the hieroglyphs of communication. For me, drawing is like talking – it can formulate an idea, explain a thing or a possibility. It's important for me to translate my thinking process into an image, and drawing often pursues its own course while the brain just follows for a while, then suddenly you hit on an idea, and it sprouts from the pen. You can call it a creative shortcut. The brain/hand connection is crucial to any creative activity – being aware of it brings about a deeper understanding of what you are doing.

DF: How is your world evolving – what's new?

MV: My 'world', as you call it, centres at the moment around making things, installations, collaborations, folding. Mostly creating objects from cardboard or recycled materials.

DF: Tell us something about your collections of ephemera – postcards, toys, figures, etc. Are there any particular pieces that we can see the direct influence of in your own work? Does your collection include drawings, and if so, what kind?

MV: My collection is a constant inspiration. I rearrange families of objects or make collages with beautiful, mysterious or super-ordinary images combined. Some almost compose themselves. I draw cartoons and often start the day (a routine you could compare with brushing your teeth in the morning) with drawing monstrous teeth on a dictator or a celebrity on a newspaper. Or decorate a telephone bill while I'm talking to a friend on the phone. To start drawing – any kind of drawing – is preparing for this head/hand dialogue.

DF: You have a close working relationship with Charles Jencks, which you describe as 'sparring'. This suggests some kind of conflict, but it's clearly a productive rapport. Can you tell us more about the way you work and how drawing communicates between you?

MV: Charles and I have worked together for about twenty years now and he has been incredibly supportive and given me a lot of confidence over the years. His humour, enthusiasm and wealth of knowledge have been incredibly inspiring. While we talk, we sketch. I draw caricatures and cartoons while he conveys his ideas and I try to keep up – as Steinberg says, by "drawing as a sort of reasoning on paper". (Apart from his 'enigmatic signifiers', we produce watercolours and models of his designs).

DF: It seems you are often working in conversation with those writing about architecture. Do you see drawing as a way of stating things differently, or of extending ideas about architecture in ways written language cannot?

MV: Absolutely. One of my ongoing conversations is with Shumon Basar, who is the one that forced me to think about what I was doing. Hans-Ulrich Obrist was the first to call my collection an "Archive".

DF: You have said that being unfamiliar with your surroundings when you were generating ideas for 'Flagrant Delit', meant that you saw "the beauty of things obscure – the inspiration you get from not knowing, from speculating freely". Now, 40 years later, do you feel more 'knowing' and if so, how do this affect your work?

Fig. 1: Madelon Vriesendorp, *Après L'Amour*, from *New York Series*, 1975.

Fig. 2: Madelon Vriesendorp, *New York Juicer*, from *New York Series*, 1973.

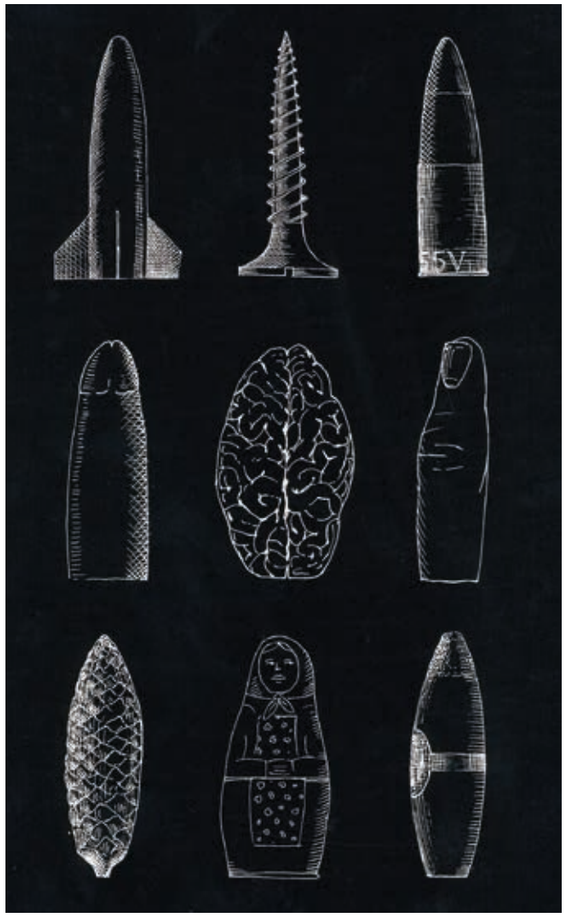


Fig. 3: Madelon Vriesendorp, *'Metaphorical Analysis' for Iconic Building* (with Charles Jencks), 2014.

MV: I don't feel I know anything. The cliché "the more I learn, the more I realise how much I don't know" still holds. Every revelation poses more questions. You keep looking for things that uniquely relate to your personal interests. You become a scavenger in the gigantic garbage heap of information. Every image or object informs and mystifies. All artists scavenge for the most unlikely and obscure, try to make sense of what they've found, and give it a place where it can be used at some opportune moment.

DF: The Manhattan Project was produced independently of *Delirious New York* but now they are synonymous; it forms part of its identity. In fact, much of your work has been used by others to illustrate book covers, magazines and much, much more. When you first made these works, they must have had a very different identity. You are the only person who knows their former life. Can you tell us what they meant and what they now mean to you? Does the work change in your eyes once others adopt it for alternative uses?

MV: No, THEY don't change identity, it's me who's changed. They are a timepiece relating to the time in which we lived in New York, collecting material, i.e. books and postcards for his book *Delirious New York*. These paintings were not produced for the book, independently made, but massively influenced by Rem's research on New York. It was Rem's editor who insisted in putting the painting on the cover. I was at first playing with 'Liberty', making her lie on a bed of Manhattan skyscrapers, like a fakir. Then played with skyscrapers. That's when Rem suggested putting the two in bed together. Saul Steinberg, another influence, had drawn a question and an exclamation mark in bed together. Rem's brother, an artist, had drawn two love-making airplanes in bed. So it happened quite naturally. Then Rem insisted that the Rockefeller Centre, representing modernity, would catch them in the act.

DF: Your drawings are part of some of the most influential texts ever written about architecture. Rem Koolhaas describes himself as a 'ghostwriter for the city'. How do you see your role in forming opinions and attitudes to architecture?

MV: I don't see myself as having a 'role', at least not within the 'practice of architecture'. I'm mostly concerned with the identity, or rather the 'personality' of buildings (male or female, etc.) and how they relate to each other. I collaborate with presentation only. I assume an outsider's role, I observe in a critical way. The skyscrapers of Manhattan were built largely during the Great Depression. There was a craving for optimism and it produced a celebrity culture and stardom, so buildings also became celebrities. Assuming personalities, they lifted the spirits, and inspired hope and admiration.

The same is happening right now. To lift us out of the recent depression, we build iconic buildings, again mirroring celebrity culture and the need for stardom. Now 'big' Architects build big, and 'big' artists make BIG art. I'm afraid we will always hopelessly reflect a vision of ourselves in whatever we do.

DF: The theme of this chapter is 'Augmentations: extending drawing through technologies and materials'. Is there any media or technology that you feel has fundamentally affected your work, particularly your drawing practice?

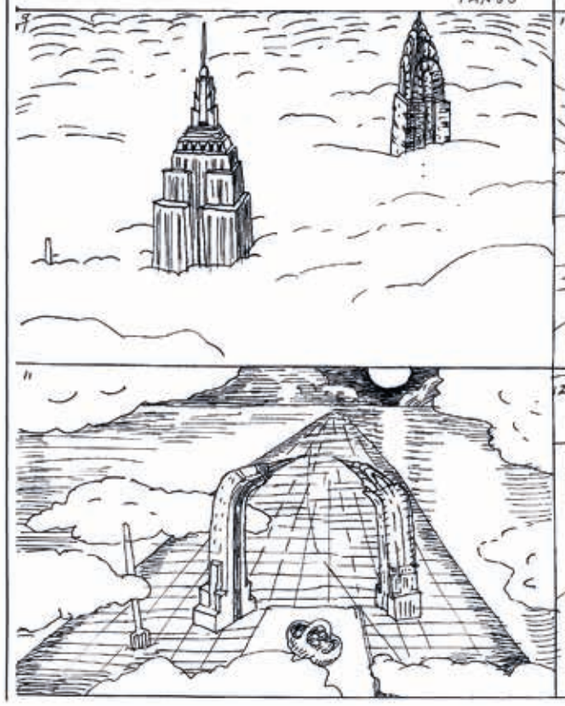
MV: Yes! A pen! I'm always in search of the ultimate pen – one that doesn't allow you to make a bad drawing (and computers drive me crazy).

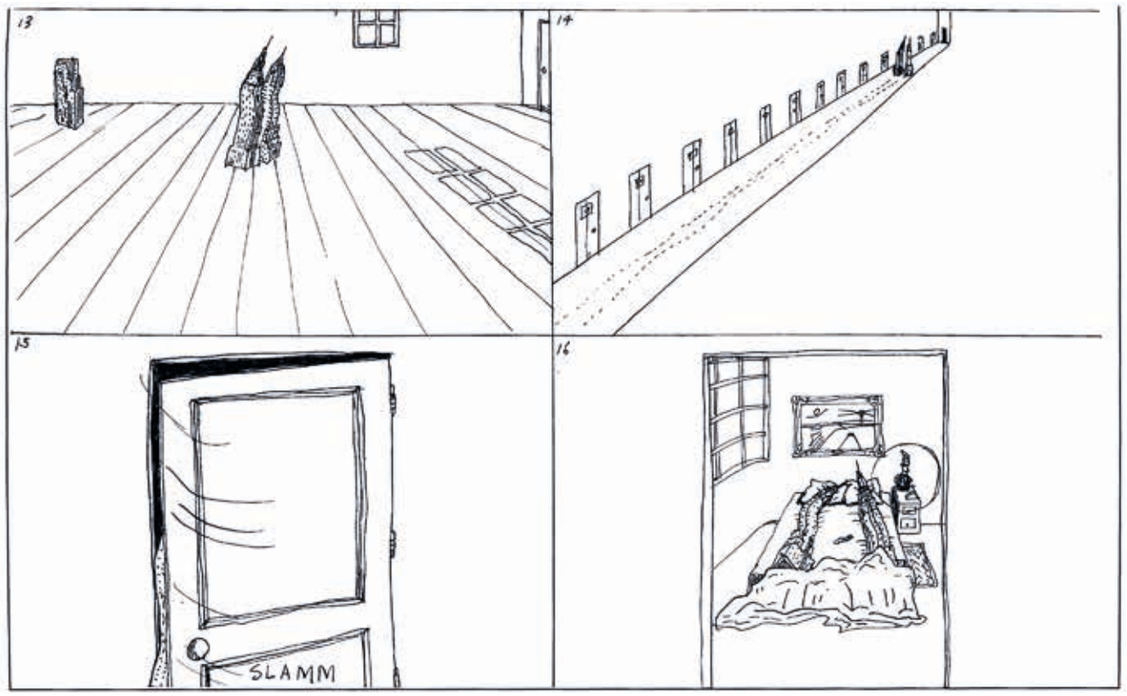
Fig. 4 (overleaf): Madelon Vriesendorp, *Storyboard for Animation: Flagrant Délit*, animation with Teri Wehn-Damisch for French TV, 1979.

(9) clouds moving higher
(10) and lower again while the '2' are coming slowly towards one another
(11) devotion (angelus) scene on manhattan grid
(12) walking to end of island, moon changing into sun, then zooming in on the '2'
(13) and zooming out again.
Showing them on a dancing floor, dancing a tango

(14) walking through a long corridor, along numbered doors, to enter a room at the far end
(15) slamming the door in front of us
(16) we get a look through the door, which has become transparant (see painting: 'après l'amour')

B

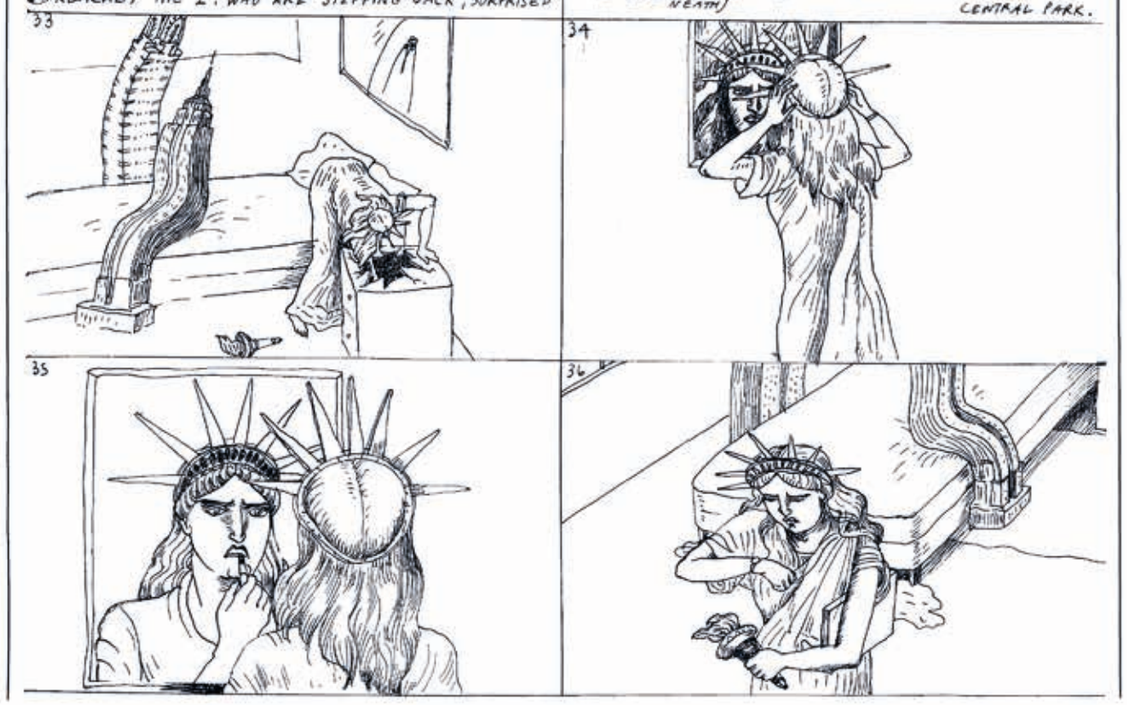


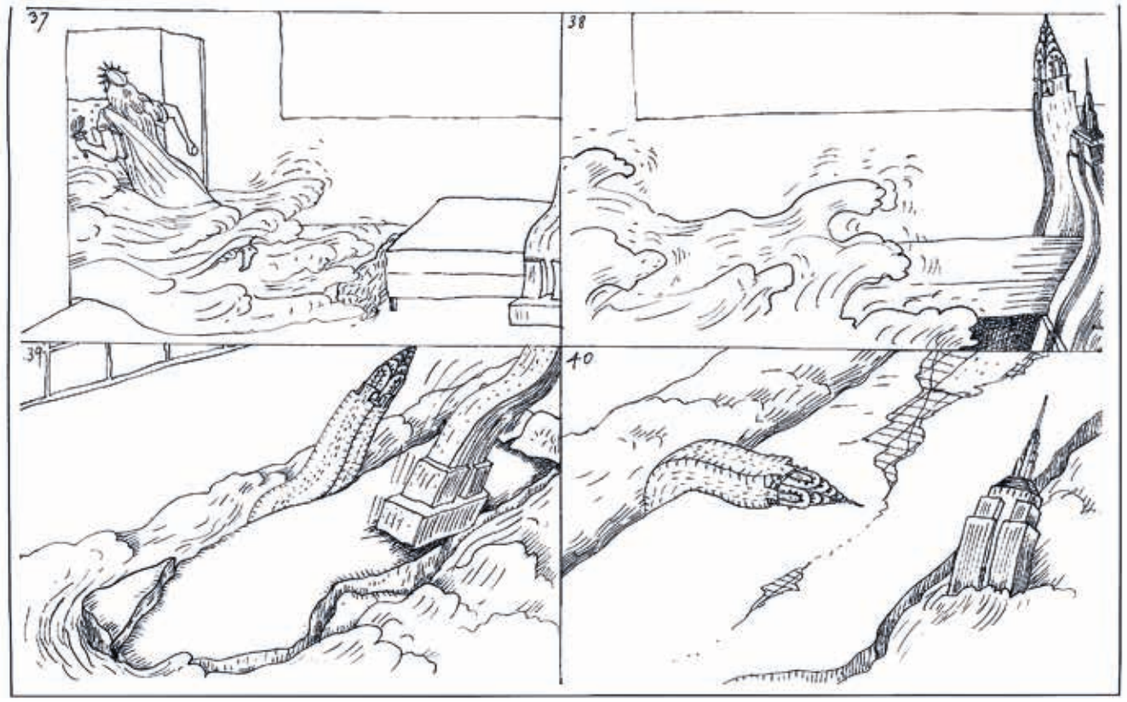


(33) she reaches back for her constitution (book)
(34) fixes her 'crown'
(35) paints her lips
(36) looks at her watch
(37) and leaves in a hurry,
opening the door, she struggles with an enormous wave; which soon
(38) reaches the 2, who are stepping back, surprised

(39) trying to find rescue on the bed
E.S. even jumps on top, but it breaks cracks under his 'feet'
(40) he falls back, ch.b. still struggling to get on top; while the bed keeps on showing cracks and beginning to look more & more like manhatten; its sheet tears & (under-neath) we see the manhattan grid & central park.

E





Drawing the Glitch

Matthew Austin
Gavin Perin

The introduction of glitches into the production of architectural drawing has the capacity to open up and transform what is understood to constitute digital-architectural production. Traditionally, the architectural drawing uses lines as codified indexical representations of existing or proposed real-world objects.[1] The representation of an edge between a floor and a wall, for instance, requires the line to function *through* analogy. Vidler[2] starkly points out that over the past two centuries architectural drawing has steadily become more abstract in its use of analogy and its representations of real-world objects. Digital technologies potentially transform the traditional analogue notion of the line from a projected analogy to an analogy in itself, made up of the discrete units used by digital technology, namely zeroes and ones and the pixel. However, the capacity for the *image* plays a central role in what architecture 'means' and how it is drawn and formulated.[3] The nature of lines, and by extension drawings, in the digital age has fundamentally shifted from being about abstractions of abstractions to "nothing more nor less than the mapping of three- or four-dimensional relations in two [dimensions]".[4]

The ubiquity of the computer in architectural practice means that the drawing is now a purely digital form of information communicated through the channels of the monitor and printer as a pixel array. The intention behind the drawing is usually to transfer this information seamlessly without distortion or deterioration. With traditional modes of drawing, and analogue media in general, duplication inevitably results in the degradation of the artefact, making it of lesser quality than the original.[5] in contrast, digital drawings are copied precisely because they exist as binary-numeric information. The *authentic* site of drawing is no longer the medium on which the line is placed but the way in which the line is digitally represented. This leads Mitchell to write: "A digital copy is not a debased descendant but is absolutely indistinguishable from the original".[6] The nature of the digitisation of drawings means that they can be easily and rapidly transferred, reworked and manipulated. In fact drawings – perhaps for the first time sitting outside explicit authorship and intent – are now open to multiple channels of transference and representation. The capacity to manipulate drawings according to channels means that lines are no longer the fundamental element of the drawing. Instead, the drawing is generated from the fundamental elements of the channel itself. The polymorphism of architectural drawing opens the drawing up to strategies and techniques that operate upon its different modes of representation, whether they are vector-, raster-, textually, sonically or numerically based.

Irrespective of the claim that digital architecture represents a new formal language for architecture, the processes used to deliver form reinforce the ambition for a clear indexical correlation between the form and meaning of the line. The one conversation absent in digital discourse is how the mediation of binary-numeric information opens the drawing up to glitches as this information courses through its various channels of re-presentation. The glitch, working within the hard/solid-state drive and/or RAM of the computer, disrupts the clear transformation of the pixel array as a faithful geometrical-mathematical representation of form. The glitch offers a level of abstraction to the act of drawing similar to that of algorithmic design but, unlike algorithmic processes, the glitch offers *resistance* to the representational capacity of a drawing instead of concerning itself with the production of complex forms.

ON THE NATURE OF DIGITAL DRAWING

With the introduction of computer technology into architecture, the hand gestures of drawing a line have been replaced by the pressing of 'keys', the clicking of 'buttons' and the moving of 'mice'. The act of drawing a line is no longer associated with the bodily movements of its traditional production, but is now the job of the algorithm. These algorithms look after the translation from user input to its visual representation in the design process. However, this opens up two important consequences. First, there is both temporally and mechanically a fundamental *gap* between the drawer (i.e. the designer) and the visual representation of the drawing on the pixel array. Second, the author has very little control over *how* the line physically appears once drawn; the pixels of a monitor or printer change colours as the device gives a digital approximation of the line.

The visual digitisation of the line has transmuted it from an analogy of a real-world – or at the very least a proposed real-world – object to an analogy in its own right. In this sense, the visual representation of the digital line, and by extension the digital drawing, is constructed from a finite set of numerical values mapping onto an orthogonal pixel array.[7] For Matthews,[8] this represents an important shift in the nature of drawing as "the discrete, individual nature of each pixel means that the line is no longer the dominant organising principle of image-making". However, the introduction of the pixel, which is the focus of much curiosity within the study of digital images, highlights an important fissure between digital drawings and pixel arrays; a pixel array can be understood both as a $m \times n$ grid of pixels (the space in which images are printed to monitors or printers) and a linear sequence of $m \times n$ sets of numbers (the space in which algorithms of image analysis and manipulation are designed), which in turn are also zeros and ones (the space in which the computer transforms and works with the drawing).[9] Thus, digital drawings, unlike their analogue counterparts, can be expressed not only visually (via monitors and printers), but also as mathematical sets and binary-numerically (as the information stored on a computer's hard or solid-state drives). For Davis, the visual representation of an image constitutes its 'surface' while other forms of its expression constitute its 'structure'[10] and "selective

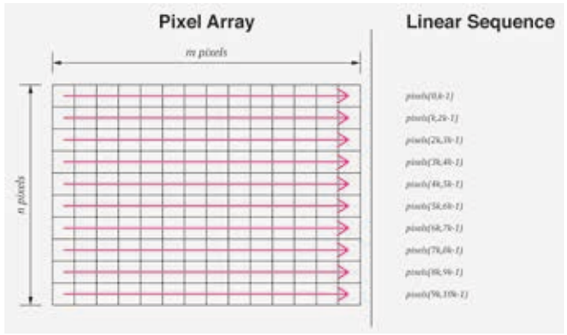


Fig. 1: Diagram showing how an image file can be understood as a two-dimensional array and a linear sequence of values on the computer's hard or solid-state drive.

focus onto the surface of an image greatly ignores the digital code of which the medium is entirely composed".[11] Further, Mitchell aptly points out:

> "It follows from the fundamental constitution of the raster grid that, just as the elementary operation of painting a picture is the brush stroke and the elementary operation of typing a text is the keystroke, the elementary operation of digital imaging is the assignment of an integer value to a pixel in order to specify (according to some coding scheme) its tone or color. Complete images are built up by assigning values to all the pixels in the gridded picture plane."[12]

However, it is common practice within the production of architectural drawings to work through abstract-mathematical representations of lines within vector-based CAD packages, rather than literally change the value of each individual pixel either through transformations of the pixel array or through its linear-sequence representations. In this sense, drawings may not necessarily always be stored on the hard drive as a linear sequence of pixels, but as a series of Cartesian points and geometric constructions around those points. This information is mathematically distorted into 'view space' (shown from the perspective of some 'camera' which may or may not be orthographic), then clipped to the viewport (the size of the image the 'camera' allows).[13] This abstract mathematical representation of objects is then discretised into two separate pixel arrays (the depth buffer, which in turn helps calculate the final pixel-colouring information)[14] and finally rendered directly onto the pixel array of the monitor. This highlights two crucial points. The first is that a wide variety of algorithms are fundamental to the translation of a drawing moving between the hard or solid-state drive and the pixel array. There is a difference in the way the computer 'opens' a vector file in comparison to a raster file, and there is a further difference in the way that the computer 'opens' different types of these files. Different algorithms are used to interpret a drawing for *every* individual file format; there are algorithms that open .JPGs, algorithms that open .PNGs, algorithms that open .DWGs, algorithms that open .DOCs, etc. These algorithms may transmute the drawing in different ways and thus subtly or significantly create different results upon the pixel array.[15] Further, once a digital drawing has been released to its respective audience, it "forestalls the capacity of the author to maintain control over the imaging process".[16] This in turn gives the original author very little control over not only what is done with their drawings, but also the software with which they are viewed (i.e. what algorithms are used to translate them from their binary-numeric representation to the pixel array of the monitor?). The second point is that two identical pixel array arrangements may have two drastically different structural representations, as revealed by Fig. 2.

ENTER THE GLITCH

In the early part of this decade, an artist-photographer named Melanie Willhide had her computer, backup drive and by extension digital-photographic work stolen by Adrian Rodriguez. Rodriguez had wiped the machine and was using it as his own until caught by the local authorities. After the machine was returned to Willhide, she ran recovery software in an attempt to restore her lost work.[17] The result was a series of fragmented and distorted copies of her original digital images. In 2012, Willhide exhibited the work in a show in New York titled 'To Adrian Rodriguez with love'.[18] This is a story which offers two important insights for the discussion around digital drawing.

The first is that Mitchell's assertion that "a digital copy is not a debased descendent but is absolutely indistinguishable from the original"[19] is thrown into question. If errors can enter the visual surface of the digital image via the very nature of the image being stored on a hard or solid-state drive, then quite equally other modes of storage and transference can result in debased copies. This should come as no surprise – Shannon highlighted that "since, ordinarily, channels have a certain amount of noise, and therefore a finite capacity, exact transmission is impossible".[20] Here, a channel is considered any medium that has the capacity to transfer information.[21] While there are modes of digital transfer between computers (such as email, Dropbox.com and external hard drives), the internal mechanism of the computer transfers the information of a digital drawing from its hard or solid-state drive to RAM, GPU(s) and CPU(s), as well as transferring

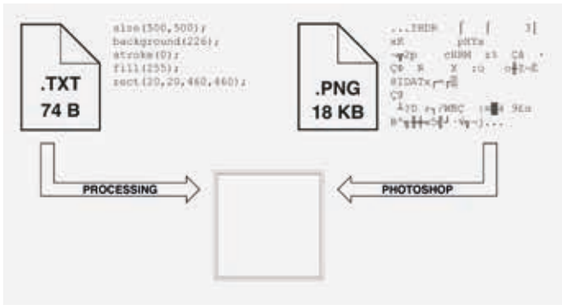


Fig. 2: A simple example of how a text file and an image file can create the same outcome if put through specific algorithms, in this case Processing and Adobe Photoshop respectively.

it to the monitor and/or printer. Mitchell's position on digital images arises from the ideal that "developers design their technologies in order that the user will forget about the presence of the medium, following the ideal logic of transparent immediacy".[22] In fact, computer science has gone to great lengths to check for transmission errors and attempts to correct them.[23] [24] The digital drawing has been designed to be copied and *appear* "absolutely indistinguishable from the original".[25] However, in reality, this is not the case.

The second, and more important, point is that this suggests a new method of working with digital drawings, through non-visually derived manipulations of a digital drawing's structural representations. The fetishised application of these techniques is colloquially referred to as 'glitching', with the distorted outcomes referred to as 'glitches'. Gaulon[26] formalises this colloquial definition as follows: "The digital glitch [...] is a way of seeing the code behind a document." And: "When a digital glitch occurs, it is not the image, the sound or the video that is changed, but their binary code."

It is worth noting that this definition of what constitutes a glitch is still problematic, as it refuses to engage with important phenomenological and technical issues of definition, highlighted by Moradi[27] and Menkman.[28] However, for the purpose of understanding what the glitch within the nature of architectural drawing constitutes, Gaulon's more colloquial definition suffices as a mechanism to explore these potentials.

GLITCHING ARCHITECTURE

For the purposes of this paper, a two-dimensional plan of the Barcelona Pavilion is used to visualise the results of a glitch being applied to a digital drawing. The preference for a plan drawing is based on the fact that three-dimensional drawing files are generally quite resistant to transformations because the glitch will likely result in invalid geometry. This is not to say that it is impossible – Mark Klink[29] highlights that the .OBJ file type has this capacity. However, the .OBJ is an AASCI format and as such the information is read by the algorithm as its literal textual interpretation; in other words, a point's Cartesian coordinates are exactly written in the file as their 'x', 'y' and 'z' values. A further issue is that the operations of manipulating a .OBJ file cannot distort the topology of the geometry, thus making it equivalent to algorithmic distortions available within modelling software.[30] Linear perspective carries with it the issue of literal interpolation. As a mechanism that deals with the 'void (of meaning)'[31] created by such a drawing, it is likely to confuse architecture with its image. This is strongly highlighted by !Mediengruppe Bitnik's H3333333k, in which the façade of a building is literally transformed to resemble the glitched image. Instead, for the sake of clarity, an exploration of the orthographic offers more jarring and difficult questions for architectural drawing in the digital age.

The most prolific and understood form of glitching is the process identified by Davis[32] as 'data bending'. Data bending is the act of transforming a file's linear sequence representations, which in turn causes a visual effect. This is frequently done through binary-numeric code, hexadecimal or even AASCI structural representations. An attribute that Broeckmann highlights is that "malfunction and failure are not signs of improper production. On the contrary, they indicate the active production of the 'accidental potential' in any product".[33] Virilio says that "the innovation of the ship already entailed the innovation of the shipwreck. The invention of the steam engine, the locomotive, also entailed the invention of derailment, the rail disaster".[34] The invention of new technology also implies its modes of failure. In the same vein, the file format implies how it renders its failures. It is impossible to give an exhaustive list of data bending as technologies and algorithms shift and change and file formats are invented, popularised and fall out of use. The way technologies glitch is *unique* to each medium. Nevertheless, there has already been a study done on how differing image formats glitch.[35] What is of interest here is how digital-architectural production can reconcile such transformations and interpret them spatially.

From the figures opposite, several things are now evident. The first, as mentioned previously, is that the figure of the plan is distorted in drastically different ways depending upon what file type is chosen to be glitched. The second is that the distortion is fundamentally at odds with the coherent surface that the pixel array of the digital-drawing attempts to present. The third is that some transformations may distort the drawing's structural representation to such a point that the figural analogy of the object that the drawing claims to represent is lost. Fourthly, the inherent RGB structure of an image is revealed, as greyscale values may break into their constituent parts. Finally, all these pixel array images introduce elements that are at odds with the notational conventions and internal relationships of what they originally represented. The glitched drawing *resists* the drawing's material and spatial notions to be decoded via the allographic rules of the drawing.[36] Thus, what spatial or generative properties does this resistance offer architecture?

The lack of a clear and singular interpretation of the glitched drawing forces the architect to reconfigure and re-evaluate what these drawings mean spatially. These re-evaluations are not spatially unique. For example, the top-left corner of Fig. 4 acts as an illusion, allowing it to be viewed as a plan with portions skewed or as an axonometric (Fig. 5), where the skewed moments in the drawing are vertical projections – however, what the marks on the now-folded surface imply is still unclear. Just as the traditional drawing attempts to narrow the number of valid spatial interpretations through the application of known disciplinary conventions – a property maintained by the surface of traditional digital drawing – glitch drawing disrupts the viewers' assumed allography of the images, forcing them to either reject the validity of the image or, more interestingly,

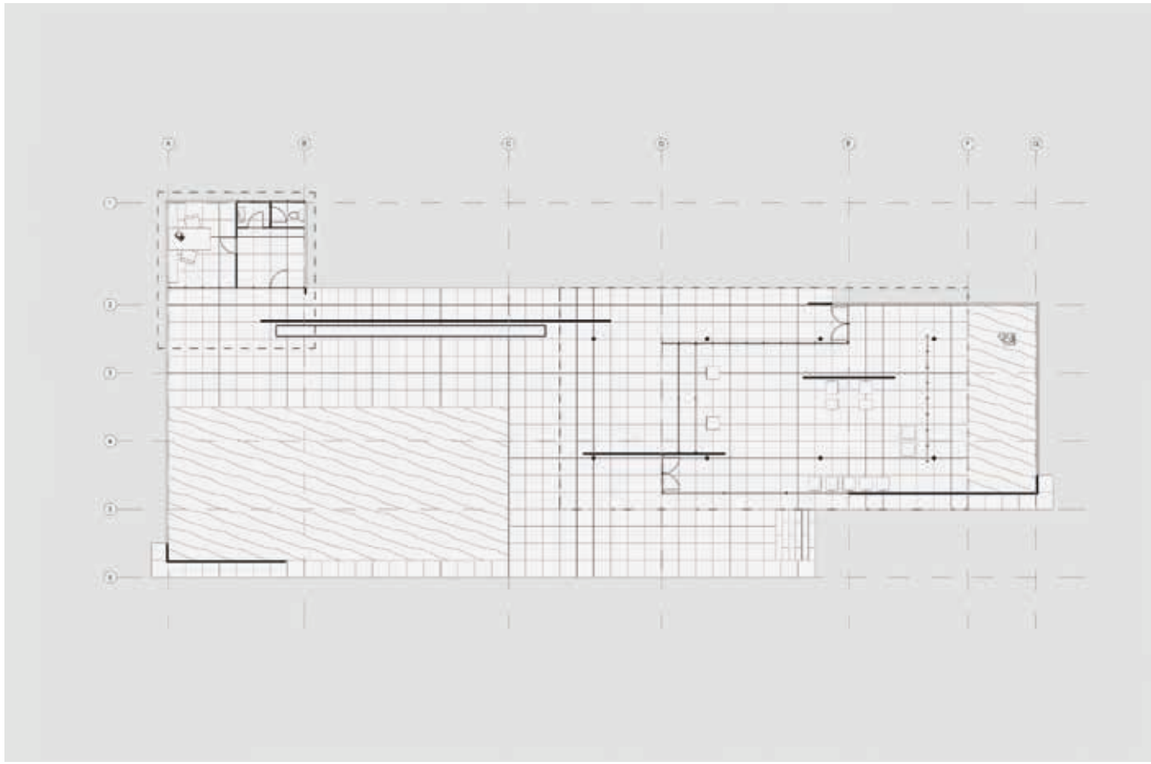


Fig. 3: A redrawing of the Barcelona Pavilion by Kieran Patrick.

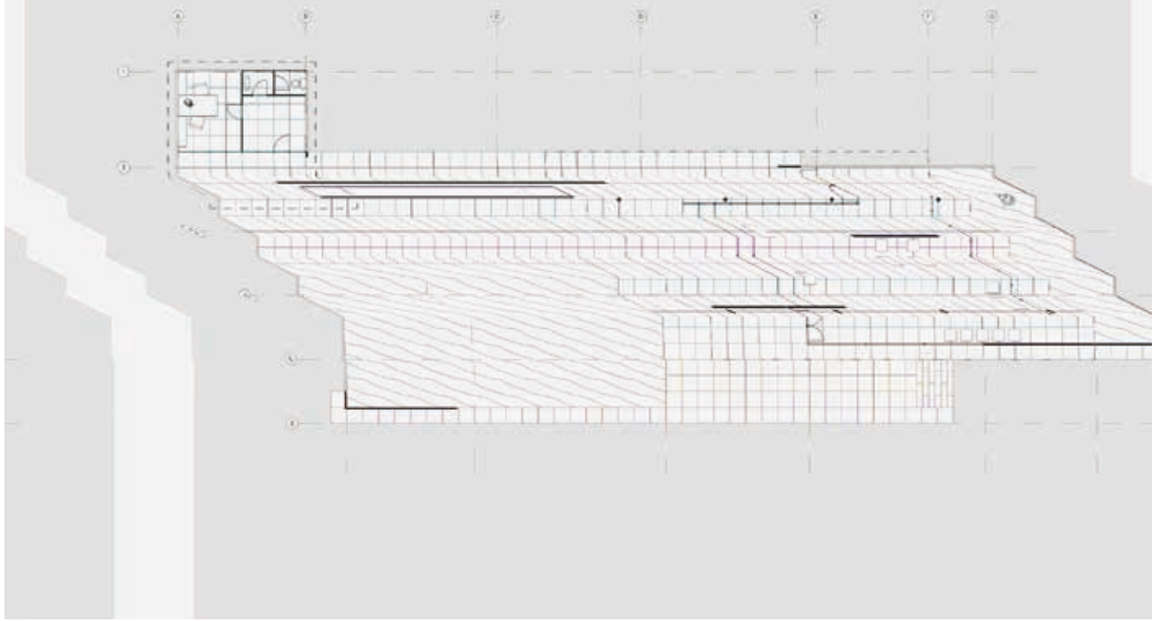


Fig. 4: A study matrix of how the same figure of the plan reconfigures itself depending upon binary-numeric transformations of the plan.

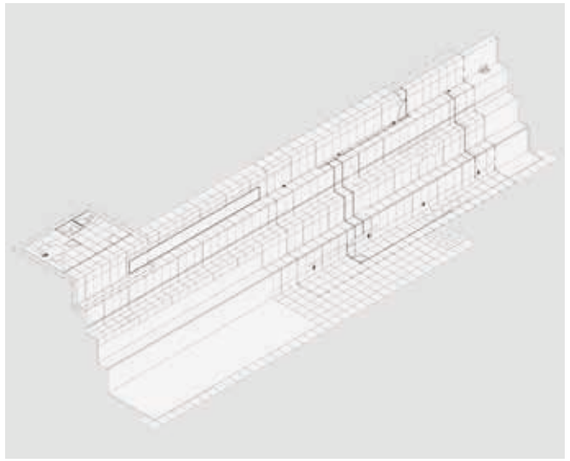


Fig. 5: Three-dimensional reworking of a valid interpretation of the data-bent image of the plan of the Barcelona Pavilion.

attempt to spatially reconcile what the bizarre, uncanny and jarring elements introduced by these processes mean. The glitch drawing forces distance between the spatial condition it purports to represent and the drawing's author. In the same way Eisenman used drawing as a method to deny himself spatial clarity,[37] the glitch has the potential to remove spatial clarity from *any* digital drawing. This is evidenced by Atwood's[38] 'Possible Table', in which otherwise ordinary computational objects are distorted in their projection to the pixel array, which in turn requires further investigation to reconcile what object the resultant projection represents if we assume the distortion had not taken place. The notational nature of drawing means that the glitch transforms it from "a work that is yet to be realised" to a work that cannot be realised without a reworking of what the drawing represents.

The glitched drawing is jarring due to the unconventional nature of its transformations – just as Hansen notes that Lazzarini skews objects, a technique that only makes sense within virtual worlds and computer logics.[39] Here, the glitch replaces translation, rotation and scale as the fundamental operations of geometric manipulation with alien techniques like skewing, fragmentation, interleaving, channel mixing, sliding and colour shifting – and whatever errors are associated with each particular mode of information storage. What does, for example, an interleaving of the Barcelona Pavilion mean spatially? The rotation, translation and scaling of a line or a drawing represents a clear architectural act, as these elements are analogous to an architectural proposition. However, the pixel array represents a line, in as much as its pixels' RGB values maintain enough contrast with the surrounding pixels and the pixels maintain their position in the array. Because glitch techniques work at the structural level of the image, the extension of the analogy of a line being maintained is *not* guaranteed. Although these techniques are new in the context of architectural production and an exhaustive investigation would be required to understand the value and nuances specific to each individual one, their value is that they all *resist* the very thing the drawing purports to represent.

It is evident that the glitching of a plan requires a complete reconsideration of the vertical nature of the result, and in turn the glitching of an elevation requires a reunderstanding of the plan. In fact, the glitch not only resists architectural convention, but also disrupts the relationship between architecture's different modes of representation. Further to this, architecture's other modes of representation (such as video) constitute a difference in technology and thus glitch in a fundamentally different way. The glitch has the potential to disrupt architecture at any point within its production to force a complete reworking of what the architectural drawing intends to represent.

Where traditional modes of digital drawing shift the line as the predominant organising structure of the drawing to the pixel,[40] the glitch shifts it from the pixel array to the unfamiliarity of non-visual representation. The drawing's hidden binary-numeric nature and polymorphism unite with the nature of digital media to offer architecture the capacity to resist its own disciplinary conventions. In this sense, the glitch of a drawing demands a reimagining of the grammatical assumptions of our representations. Instead of attempting to close down the interpretation of the drawing into a single unique spatial condition, the glitch denies the viewer this opportunity and is therefore dependent upon the individual's capacity to interpret and spatially reconcile a reworking of the surface representation of what the surface of the drawing originally represented.

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Drawing the Digital: From 'Virtual' Experiences of Spaces to 'Real' Drawings

Sophia Banou

The technological, social and economic commercial changes ushered in at the end of the nineteenth century led for the first time to a proliferation of images in our environments. This mediated reality, which has only increased over time, has deeply affected human behaviour. The origins of this displacement from a positively defined 'real' to an expanding virtual can be traced back to the emergence of the modernist space-time paradigm. The expansion of the capabilities of vision, the dissemination of photography and the cinematograph and the experiments of modern scientists contributed to an understanding of space that shifted from the idea of an *a priori* extensity of vacuum-versus-matter to a dynamic multiplicity of relations. Within this frame, new theories of visual perception posed a challenge to modernist artists, which resulted in new paradigms of visual representation (from Impressionism to Suprematism, Futurism and Cubism). But if modernist art extracted from modernity the dynamism of speed and novelty, architectural thought of the time was inspired by the rationalism of functionalist efficiency.

Despite the fixity suggested by longstanding convention, with its core principles holding from at least the fifteenth century, architectural drawing – a form of writing in its own right – can be considered itself a transition: the complex oscillation between the real and the conceptual takes place in it through a negotiation between convention and subjectivity. Architectural drawing convention historically appears not only to normalise the contingent multiplicities of architecture's objects, but also to fix the mobility of drawing's very subjectivity. However, this fixing of architectural representation is in essence phenomenal and antithetical to the ways architectural drawing and thinking proceed. Following the deconstructive and cartographic approaches of the latter half of the twentieth century, this paper will engage with the idea of drawing as a creative agent rather than a systematic language, and as a representational field of action rather than an order. The question of performativity that such an understanding suggests, although rooted in the experimentations of modernity, is not only still pertinent, but is put under new pressure via digital modes of representation.
In the emergence of architectural space as a space systematically and increasingly mediated by representations and the privileging of the image as simulation rather than representation, architectural drawing conventions are faced with the inadequacy of their codes in articulating new perceptions of spaces. Most importantly, however, what is challenged is the operation of drawing not as image or object, but as a distinct spatiality that mediates between the tangible reality of figuration and the speculative spatiality of projection.

TRIPS TO VIRTUALITY

Although the new perception of space had a direct impact on the representational arts, it was probably cinema that, through its inherent association with time and movement, best articulated the new paradigm. In his 1907 essay 'Creative Evolution', Henri Bergson discussed cinema as a model for human perception:

> "We take snapshots [...] of the passing reality, and, as these are characteristic of the reality, we have only to string them on a becoming, abstract, uniform and invisible, situated at the back of the apparatus of knowledge, in order to imitate what there is that is characteristic in this becoming itself. Whether we would think becoming, or express it, or even perceive it, we hardly do anything else than set going a kind of cinematograph inside us."[1]

If Bergson's analogy highlights the similarities between the mechanism of human perception and the cinematograph as mechanical means in the early days of the medium, works such as Dziga Vertov's *Man with A Movie Camera* saw cinema as the 'kino-eye' (an almost cybernetic fusion between man and camera); and with this, the possibility of the expansion of perception from mere observation to the construction of reality.[2] The focus of Vertov's 1929 film ranges from the daily life of the city's population to the labour of the cameraman, the film editor and even the spectators. The film presents a metanarrative of the semiotic function of cinema rather than a 'realist' narration. The laying bare of the commonly naturalised techniques of cinematic production[3] breaks the illusion of identification between cinematographer and spectator, dispersing subjectivity among multiple vantage points.[4]

Drawing from Bergson's concept of the *image*, Gilles Deleuze remarks on cinema's ability to produce *consciousness*:

> "Bergson was writing *Matter and Memory* in 1896: it was the diagnosis of a crisis in psychology. Movement, as physical reality in the external world, and the image, as psychic reality in consciousness, could no longer be opposed [...] The great directors of the cinema may be compared, in our view, not merely with painters, architects and musicians, but also with thinkers. They think with movement-images and time-images instead of concepts."[5]

Deleuze collates Bergson's *images* with the semiotics of Charles Peirce in order to interpret through the 'pre-verbal signs' of cinematic imagery the emergence of a conceptual discourse.[6] As he argues, semiology proceeds in cinema through a 'double transformation', which involves the reduction of the image to analogical utterance and the codification of the signs into a 'digital' structure. The assimilation of cinema to language can, then, only be an approximation that introduces false appearances through the analogical consideration of images as utterances. To the semiotic model of resemblance and codification, Deleuze then proposes *modulation* as enabling resemblance and code (figure and notation) by bringing them together into something new that exceeds both.[7]

According to Deleuze, rather than a language, cinema is the 'system' of this modulating image, which proceeds through processes of differentiation and specification.[8] Although 'utterable', it is independent from language, yet – due to its semiotic function – liable to transformations introduced by language.[9] In post-war cinema, Deleuze sees a transition from the analogical to the digital, and from actuality to consciousness, whereby the articulation of time as continuity overtakes space as the sum of intervals. Images no longer imitate a perception guided by consciousness, but through representations create a new present consciousness by blurring the distinction between the actual and the virtual. From a replica of the apparatus of human knowledge, cinema becomes "the organ for perfecting the new reality".[10]

Cinematography offered a new way of representing perception, through the active deconstruction and recomposition of the visual, laying the groundwork for the creation of new realities. Jonathan Beller's proposition that cinema and its 'succeeding' media, such as television, radio and the internet, function as 'deterritorialised' factories of visual labour, suggests that these modes of virtuality operate with regard to the structuring of consciousness and ideology in a similar way to cinema.[11] This further proposes that the modes of social relations emerging from these media transform visual perception from immediate experience into a form of 'alienated labour', which is not only external to the subject but also dissociated from 'natural language'.[12] Looking, constructed between the viewer and the medium, is no more a conquering, but instead the never-conquering of the 'real', as *visuality*[13] registers as the primary mode of experience. In this 'cinematised' society, natural notions of language become inadequate when the appearance and experience of reality is overwhelmed by the proliferation of imagery through cinematic modes of representation which are 'incompatible' with the linguistic model of representation.[14]

Beller's idea of the cinematised society finds justification in today's digital augmentation of the visual. The cybernetic 'kino-eye' is ubiquitous, through the mobile web, video and photography. The individual not only invokes but also encourages the visual labour of others through the mass production of idealised imagery.
As the power of the individual over space is substituted for power over the image, this recourse to 'fantasy' suggests a virtuality which does not enrich but contests the comprehension of reality. If the cinematic, emerging from the processes of early modernity, signified a return to the pre-verbal, its digital successors, culminating in the postmodern, suggest a return to the pre-representational. Within the virtual manifestations of space and time that they produce, the privileging of the image as simulation contests notions of representation as semiotic abstraction. It is therefore possible to suggest that within our extended (post)modernity not only the object but also the subject of architecture have been displaced. Architectural space emerges as a place not, as Diana Agrest has suggested, *of* representation,[15] but rather a place where both the subject and pre-existing orders of signification, such as language and drawing, are constantly required to redefine their position towards and within the 'real'.

THE SPACE OF DRAWING

In the 1960s, this crisis was expressed in philosophical discourse at the intersection of a linguistic post-structuralism and conditions of spatiality. This is perhaps most clearly illustrated in the theory of Henri Lefebvre, whose triadic conception of the production of space placed its focus on the interrelationship between spatiality and the representational expressions of knowledge and power. In his theory, the pre-verbal 'lived' and 'perceived' spaces are placed alongside the purely representational 'conceived' (directly associated with architectural conceptions and representations) as equally indispensable conditions of space.[16] There is therefore an expression of language to be discovered in the pre-verbal in the same way that there is a concrete spatiality emerging from the immateriality and ephemerality of experience.

In architecture, the emergence of new conceptions of spaces was perhaps most clearly expressed in the utopian architectures of the 1960s. Yet it was only in later speculative projects such as Bernard Tschumi's *The Manhattan Transcripts*[17] that the potential entailed in the representational interplay between actuality and virtuality would emerge as more than a questioning of architecture's object, through the grafting onto architectural drawings of diagrams akin to dance notations, and photographic elements that functioned/posed as fragments of an immediate reality. Such postmodern fusing of high and low culture, of actuality and virtuality, then opened the way for the contamination of convention.

Mark Dorrian develops a genealogy of the beginnings of these 'contaminations' by defining architecture's 'Cartographic Turn' as the implementation of cartographic strategies as generative tools for architectural design.[18] Dorrian challenges the idea of representation as a direct transcription of a mental image, arguing that the architectural image is constructed at the intersection of the conceptual intentions of an authority and a series of mental, material and performative modes.[19] These 'interferences' between the author/designer and the image produce, he suggests, alienation effects that mark the failure of representation as a direct projection of the

mental to the material, yet evoke acts of interpretation and thus open up room for speculation.[20] Representation shifts from reterritorialisation to deterritorialisation,[21] shifting the focus from object to process and revealing the intertextual nature of architectural design.[22]
The cartographic thus pursues a representation that is not effective in rationally representing, but in discovering, accumulating and excavating a density of knowledge that produces meaning and gains momentum from its origins as well as its transformations.

Dorrian explores this through the work of Daniel Libeskind and Peter Eisenman. Like Tschumi, his contemporaries Libeskind and Eisenman confront the exhaustion of functionalism in the context of a post-structuralist refusal of 'subjectification',[23] employing cartographic strategies to unground architecture from ideas of site and origin as understood in traditional architectural discourse.
In his earlier works, such as *Micromegas*, Libeskind moves from the formative powers of geometric orders to the 'intuition of geometric structure' as a pre-objective experience. In Libeskind's terms, both architecture and its representations demand a 'participatory experience.'[24] which is fulfilled through dedication to the craft of making and the transcendence of a textual script which is through an 'authentic abstraction' capable of creating an experience of transgression:

"These 'plans', the intention of making visible the abolished distance of architecture's reality, bring me no closer to building, yet nearer to dwelling. They show me that in abolishing distance and space, the realm between representation and participation – the awesome and unsettling nature of architecture comes into focus."[25]

By 'reclaiming' the self-referential nature of representation through metaphor, drawing emerges not as a mechanistic process of transcription but as an experience of participation: of dwelling in the real from within the virtual. Similarly, Eisenman's cartographic projects are defined, according to Dorrian, by the transition from the volumetric to the surface, through a series of operational strategies that are inventive, yet native to representation (superposition, repetition, scaling, nesting, etc).[26]
The dispersal of the subject through sequential effects of alienation eventually leads to the 'unmotivation of the sign'[27] and an architecture liberated from any teleology.[28]

The abstraction of representation as mere technique foregrounds the operations of architectural design, merging the real and the virtual and therefore expanding both. As a place of action, of dwelling and transcendence, drawing emerges from the post-functionalist cartographic practice as a space just as important as the built space of architecture. Function within drawing concerns not the utility of an external space, but the act of signification. This involves the ability of the architect to engage in an intertextual cohabitation of spaces, where meaning is derived from a collective subjectivity that is only possible through the transcendence into the virtuality of representation.

Fig. 1: Metis, *Mimetic Urbanism: Restructuring of the ex-Magazzini Generalli area of Verona,* 2000. Aerial view maps, digital image editing and CAD modelling contribute to the making of a combined-view drawing.

The uncovering of drawing's instrumental metanarrative, the revealing of its figure as the image of a Bergsonian objectified process[29] rather than a fixed destination, can also be found in Dorrian's own practice with Adrian Hawker in the context of their research design atelier Metis. Like Eisenman, they use an archival approach to reality, but rather than seeking the real in representation, they seem to seek the representational within the real (Fig. 1). While investigating the hidden potential of the real, they survey with equal rigour the possibilities of representation, creating opportunities out of its biases and limitations.[30] Metis reappropriate cartography to make use of the difference produced by the unsettling of pre-existing imaginaries, which they then inhabit by reperforming. The 'inhabitation' of these spaces occurs through making as well as reading, illustrating the performativity of representation. They therefore expand drawing into the physical space of the architect/performer, from the drawing board to the studio.[31]
Like Libeskind, they aim for transcendence, but only to get a better view of the *real* by dwelling in true abstraction: stripping the sign of its dominant meanings in order to make it mean *more*.

Cartographic attitudes rely on the fecundity of mapping, the dynamics of symbolic signification and the performativity entailed in drawing as a creative practice rather than a mere transcription. The result is indeed, as Dorrian points out, a return to figuration through the formalisation of the diagram,[32] but it is also the arrival at a kind of form that, within the intentionality of representation, constitutes itself a kind of text. This textual culture, or at least the understanding of drawing as textual, is what makes the transcription valid and possible through the emancipation of the signifier from the signified.[33]

NON-DRAWINGS AND OTHER VARIATIONS

Rather than cartography, David Gissen looks into the influence of geography on architecture.[34] Gissen's geographic approach differs significantly from the cartographic one. This difference is most accurately illustrated in his choice of words, which suggests a consciousness of representation, of writing the *map* (*la carta*), rather than the *land* (the gaia), as a datum of measuring, fixing and legitimising the image of a quantifiable territory. Gissen's engagement with the geographic 'turns' of architecture is wide and varied. On the one hand, it appears to refer to an architecture that calls on the performative aspects of mapping; on the other, it appears to rely on a quasi-realism revealed in concepts such as 'datascapes' and the ambiguous term 'research architecture', suggesting a kind of research limited to strictly quantitative processes of enquiry.[35] in this sense, it is easier to locate it in the work of architects such as the Dutch practices OMA, MVRDV and UN Studio and their engagement with visualisations of elements of programme and inhabitation, as well as with practices such as Foreign Office Architecture and their 'new pragmatist' studies of natural phenomena.[36] OMA and MVRDV are seen by Gissen as representatives of a geographic 'research architecture'. Although representation is still crucial to the development of the architectural projects, the geographic concern does not seem to entail the representational practices it is historically attached to, but a form of positivist research.

For Gissen, the potential that arises from the geographic is an architecture that, by holding onto the ground of reality and reason, would offer the possibility of a new 'cartographic reality'.[37] What is at stake, then, is once more a reconsideration of architectural drawing. But rather than resolving to a proliferation of signification, the attention this time seems to be shifting from representation to an act of simulation that fixes meaning. An example of this can be found in the work of UN Studio, where the diagram, originally derived from the writings of Deleuze,[38] was a key tool for what was meant to be a widely inclusive form of architecture.[39] Their representations were initially enhanced by, but later increasingly based on, digital technologies, as a means of modelling for both visualisation and surveying, resulting in the production of formally compelling imagery, completely distanced, however, from the symbolic abstraction of mapping or normative architectural representations.[40] What Gissen defines as the 'Geographic Turn' can therefore be considered to relate more to the digital or computational turn than to the cartographic. The mismatch between the cartographic and the geographic is discussed in Mark Foster Gage's response to Gissen.[41] Responding to Gissen, Gage writes 'in defence of design', making the point that by consistently seeking the phenomenal rationalisation that such 'geographic' practices suggest, what is questioned and unhinged is the symbolic and conceptual autonomy of architectural design; and that this is marked by a loss of the critical in favour of a deterministic architecture of problem-solving:[42]
Gage's claim is that such 'research architecture' in fact bypasses design rather than addressing it. Clearly, what he protests is the lack of invention and intuition: the lack of difference. Gage's interpretation suggests a saturation of information that substitutes the speculative spatiality of architectural representation for the stability of iconic imagery.

The quasi-scientific 'suspended empiricism' of the geographic, particularly in its digital instantiations, still reflects an architecture that dismisses the abstraction of its own symbolic order for visualisations: no longer drawings but models of a territory, which they fix rather than *remake*.[43] This suggests an abstraction that stabilises and therefore disarms the potentiality of drawing as architectural image. What is lost is the dual register of the drawing as symbol and icon. This separation of the spatiality of the real from the spatiality of representation occurs by either removing the notational function or removing the attachment to a referent spatiality for the sake of a purely virtual imaginary (digital modelling), but also by removing the figure function of the drawing by reducing spatial relations to forms of notation that remain extra-spatial (non-narrative text, statistical charts, etc). The loss of invention suggests the loss of 'language' as a passage to signification; it is the loss of the dwelling in the drawing as space and as event.

Digital technologies today, from Google Earth to GIS, GPS, large-scale 3D scanning and drone image capturing, offer an abundance of ways to observe and record the world. At the same time, parametric processes of fabrication and 'morphogenesis' seem to question the very relevance of architectural drawing, considering it merely a definitive instrument of prescription. However, I would like to argue that the real pressure for architectural drawing is not the 'threat' of the substitution of architectural drawing with 'automated' processes of visualisation, but rather the disassociation of its codes of convention from both its objects and its variously distinct conditions of subjectivity as they emerge in the consideration of drawing as a distinct field of action.
In the 'digitised' context, notions historically associated with maintaining the integrity of both design and drawing, such as the 'real', the 'true' or the 'rational', become highly contested, challenging not simply the object of drawing but of architecture altogether. The digitally produced imagery that has lately dominated architectural practice and press commonly involves representations that seek to imitate either the 'neatness'[44] of normative architectural projections (CAD drawings and section-like slicings of 3D models), the 'precision' of perspectival representations and photographs or the representations emerging from computational processes of modelling/design.[45] The first two constitute skeuomorphic imitations of previously known modes of representation, in that they imitate the appearance of plans, sections or photorealistic renderings, forgoing, however, the performative and productive aspects of architectural representation through the efficiency of a quickly attainable 'finished' look. As such, they have very little to do with either drawing conventions or the performative potency of drawing as a distinct space of creative transgression. The latter represents an entirely different

Fig. 2: Perry Kulper, *Spatial Blooms: Proto-formal drawing*, 2009, digital print, cut paper and transfer letters. Kulper consistently questions the 'languages of architecture and representation', experimenting with the speculative contingency embedded within the agency of drawing media and techniques, both in manual and digitally produced drawings.

approach: a computational process of invention grounded in geometric operations, but performed in simulated space rather than on a projective surface.

Architectural historian Mario Carpo finds in the history of architectural drawing, from the fifthteenth century until the recent 'digital turn', a 'truism' that suggests that architecture can be reduced to an endless reproduction of identical forms.[46] This limitation, marking the separation of design and building by means of the drawing as a definitive prescriptive tool, he traces to the Albertian notion of the *disegno*, fostering an inevitably allographic practice of architecture. For Carpo, the opportunity that then emerges from the parametric digital is this: the possibility of the infinitely non-standard that is produced from an open-ended design process, freed from the fixity of representation.[47] Carpo's discussion of the digital, and specifically the parametric, as a process capable of producing difference by escaping the mediation of representation for the participatory 'subjectivity' of the digital, points out the historically anthropocentric character of architecture. Nevertheless, it contradicts the ethos of productivity and the cumulative subjectivity emerging in the deconstructivist cartographic strategies examined, as well as in more recent paradigms such as Metis' representational 'excursions' (Figs. 1 and 3) or Perry Kulper's relational drawings (Figs. 2 and 4), which

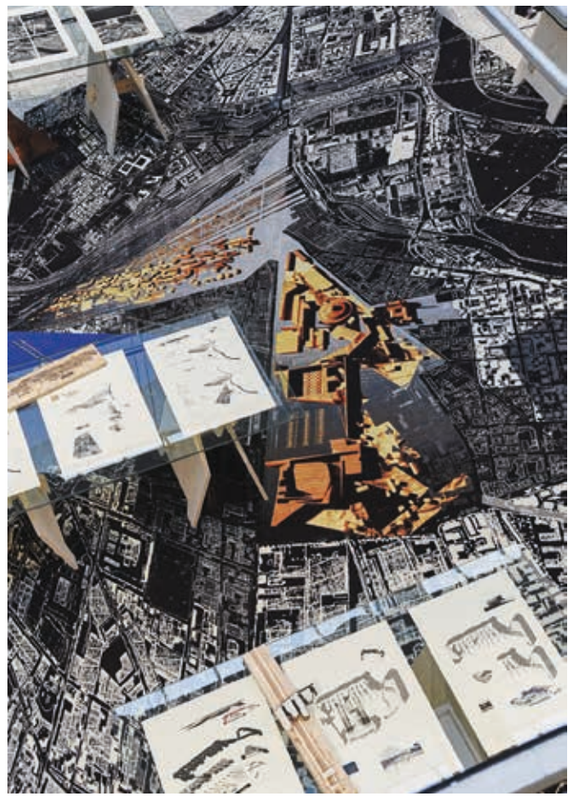

Fig. 3: Metis, *On the Surface*, 2014, digital-print textile floor drawing. Arkitektskolen Aarhus, Denmark: 10 October–14 November 2014. The *Mimetic Urbanism* drawing is resited and transcribed into the immersive installation of the 'On the Surface' exhibition in Aarhus.

eventually find their way into digital fields of production. Carpo's understanding of variation as difference, as well as the association of the parametric with the Deleuzian notion of the *fold*,[48] tie these forms of architectural production to the postmodern concept of deconstruction. Yet, this suggests a deconstruction more akin to Mark Wigley's early definition,[49] regarding an ungrounding of structure as form, as opposed to the one found in his later writings. There, drawing from Derrida's use of the term, he approaches deconstruction as a 'non-method' of semiotic inquiry within architecture as a form of representational thinking.[50] Derrida's idea of deconstruction reveals the instability of representation and consequently the question of language within architectural practice. The point of departure, for Derrida, is not form as figure but as sign: an inherently unstable writing whose reading reveals the slippage between form and content, rendering the opposition between the two – as the signifier and the signified – unsustainable.[51]

The fallacy, then, in these skeuomorphic digital resemblances of drawings is not a fault of the technology but rather of the misconception of the act of drawing itself as a tool of prescription as opposed to a field of architectural invention. Seen through the cartographic, drawing emerges out of the cinematic as a 'cybernetic' event: taking advantage of new media and available perceptions of spaces to expand both its scope and its codes by grafting its intentional mutability onto the media, as opposed to merely succumbing to their own practical efficiencies. This suggests what Catherine Ingraham describes as the 'domesticating' capability of both architecture and its linear drawing convention: the ability to import and appropriate materials from other discourses and disciplines.[52] Unlike Carpo's suggestion, drawing seen as such does not constitute an alienation from the craft; rather, as Libeskind illustrates, it is drawing itself that is revealed as craft.

In what can be considered, then, the digital challenge – and I would like to argue not-yet-turn – of architectural drawing, the pressing matter is not drawing's relevance (inevitably tied to architecture's representational operations). Rather, what is at stake is the understanding of the possibilities offered by the digital as a new field of performance, in which expanded forms of drawing are defined neither by the resemblance to the process nor to the result (building or impression) of architectural representation, but instead by their capabilities of invention. How drawing 'under' the digital may look, then, as object and process, should be as unpredictable as the result of any design process. Yet what would maintain its operation as 'drawing' should be its function as an act of 'writing': of constituting a hypertextual space where both architectural convention and the architect can perform, produce and reproduce within the computational, immersive, visual and material capabilities offered (Fig. 5). The discovery of the interiority of architectural drawing, as a distinct space of performance within which new meaning is produced, anticipates drawing as itself an immersive spatial practice: a 'real' experience within the

representational virtual. Considering drawing in this way, rather than constituting its redundancy, this crisis of drawing within the digital may entail its proliferation through the informing of a longstanding but mutable convention and the expansion of the practice into the conquering of new experiences of representational spaces, both material (fabrication) and immaterial (visualisation and augmentation). What we can expect from the combining of architectural drawing with digital media should be drawing, but with a difference – as opposed to 'variations' of drawing.

Fig. 4: Perry Kulper, *Spatial Blooms: Test Tube Berm*, 2009, exhibition digital print. Even when working strictly within the digital realm, Kulper's 'architectural language', found both in his use of forms and framing, maintains the abstraction of architectural drawing while taking advantage of the precise formative capabilities of digital tools.

Fig. 5: Sophia Banou, *Draw of a Drawing: Unfolded view detail*, 2014, laser-engraved wooden box with gold leaf, acrylic and brass details. CAD-drawn elements are laser-engraved onto the surface, prompting further 'drawing' decisions as a response to the material transformations of the box and the behaviour of the laser-cutting machine.

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4 Ibid., 83.
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6 Ibid., ix.
7 Gilles Deleuze, *Cinema 2: The Time-Image* (1985), trans. Hugh Tomlinson and Robert Galeta (London and New York: Continuum, 2005), 27.
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32 Dorrian, "Architecture's Cartographic Turn", 62.
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Fictions: A Speculative Account of Design Mediums

Damjan Jovanovic

The Albertian paradigm of architecture as an allographic[1] practice implies that architectural design comprises forms of notation and representation. It would seem that mediums[2] are all that architects engage with. Architecture is primarily a cultural, visual practice that operates through design, understood as composition and the arrangement of relations. While architects work with drawings and models, they primarily produce images. With the advent of the digital, according to media scholar Lev Manovich, other media (print, photography, radio, film, etc) have been collapsed and integrated into *software* as a meta-medium; in almost all areas of contemporary life, software takes command.[3] According to Marshall McLuhan, when a new medium appears, it does its best to simulate the preceding one before it inevitably supercedes it. Hence, when cinema emerged in the late nineteenth century, its formal vocabulary was that of the theatre until it discovered its own medium specificity – montage and movable camera.[4] Importantly, a change comes to the old medium as well. After cinema took over some of the classical representational and, in that sense, political responsibilities of theatre, the focus of theatrical production shifted more and more towards the participatory and the situational elements, retaining and honing the literary component while moving away from the visual. Eventually, these developments gave rise to modernist theatre and other complex forms. The specificity of theatre was rediscovered in focusing on the living presence of an actor's body and voice. In another example, with the introduction of photography, painting was introduced to a new specificity in the form of abstraction.

What happens when a medium contains all other mediums? Everything changes, yet the issue of software's specificity is rarely addressed. In response, Clement Greenberg's notion of medium specificity can be reintroduced with regard to the problem of architectural design understood as a software practice. The question becomes: what is it that software can do that no other medium can?

Firstly, it is important to make a distinction between the conditions *for* and the effects *of* mediums. In the case of cinema, the technical conditions of the medium involve employing a number of discrete units (images) to create an illusion of movement as an effect. The fact that film operates with discrete units does not prevent its effect from being perceived as continuous. The same goes for software. Its dependence on hardware that currently operates in binary states (since we still do not have quantum computers), tells us nothing of the vast field of sensorial effects that it engenders. Similarly, abstract data, infinities and random values may be at the core of computation, but computation only becomes available as a problem in design methodology once its conditions and effects are coded in such a way as to be readable. This is where questions of code and its relation to language in general come to the fore. Yet coding as a practice (and code in general, its apparent similarity to writing notwithstanding) does not immediately lend itself to any kind of aesthetic analysis. Coding depends on the axiomatic, mathematical model and belongs to a different semiology. Only when the outcomes of code become visible as something other than code does software (and computation) become interesting for design. The crucial question is *how* these outcomes become visible, and under what circumstances this visibility operates.

ALGORITHMS AND INTERFACES

Algorithms form the core of software's medium specificity, and they produce crucial effects, like interactivity. The discussion on the nature of algorithms in relation to architecture becomes possible only when algorithms become visible – that is, only when an *interface* is involved. This is precisely why the computational question in architecture should never be equated with its numerical basis, i.e. the *quantities*, but with how these quantities firstly become manifest optically and then as visual and semiotic *qualities*. Code is the basic interface, and yet architectural design is a visual, cultural practice defined by its focus on compositional issues. Design procedures in the digital age are computational inasmuch as they depend on functions of language as code and code as a representation of space in the forms of design software. In other words, the conditions of a medium become important only when a question of composition comes to the fore, and only if the conditions themselves can be shown as being composed and composing.

For instance, there is no point in looking into the chemical processes of film in order to understand the film's meaning, yet the film stock properties leave a definitive imprint on the composition of an image, already working towards an image composition long prior to the film's treatment in post-production. To avoid the pitfalls and

Fig. 1: A screenshot from the author's game-like design software called *The Other Method*, which utilizes the first person view as the only view available for design.

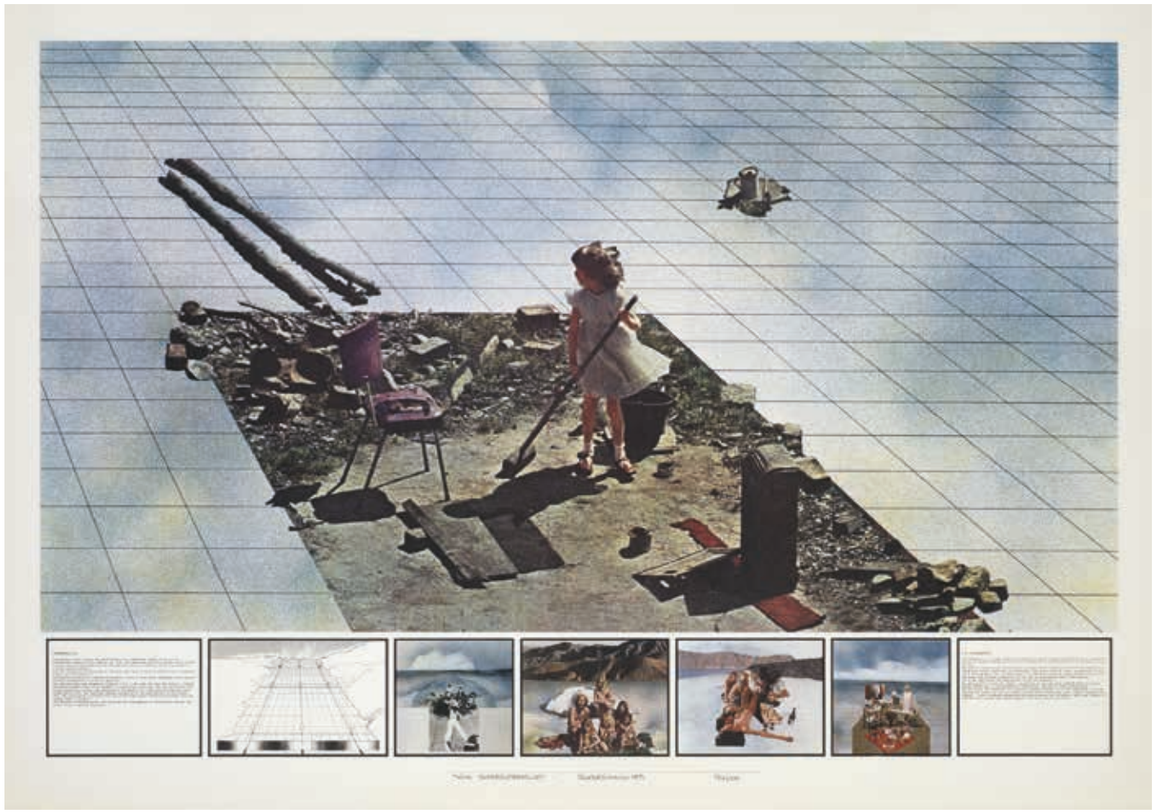

Fig. 2: Superstudio's *Supersurface* project (1971) posits the inhabitation of the flat ground grid as the ultimate architecture of our lives. "MAXXI Museo nazionale delle arti del XXI secolo, Roma". Collections MAXXI Architecture Archive Superstudio.

obfuscation stemming from confusing a visual, cultural practice such as architecture with a scientific practice such as chemistry, a simple rule can be applied: if a procedure is not available for forms of reading in relation to composition (here understood in the broadest sense as the act of combining parts to form a whole), it is not relevant. As with any medium, in the case of design software there exist conditions that operate as composers of space well before any input from the user. Hence, what does software, understood in these terms, mean for architecture?

Architecture relies on its traditional modes of representation for design, which mostly comprise various projection-based imagery, either orthographic or perspectival. As a concept, projection lies at the core of architectural design and continues to do so with software as well. Yet software introduces other modes of projection, of which active projection is by far the most important, since it enables interactivity. Every projection is coupled with a *gaze,* and every projection operates on *grids,* which are the primary design objects. More importantly, the algorithmic nature of software enables these projections to be populated with new and unforeseen *grids*. Principally, a grid is any digital object that has become visible as an interface. In this sense, any projection is always already compositional, and in turn always already political. Hence, the true value of software in architecture is that it constructs new modes of projection and new modes of vision, as well as that it enables new models of grids.

Of all the sub-mediums architects usually work with, only renderings convey a degree of complexity in terms of ambience, mood and atmosphere. Architects are content in making only the necessary documents that their discipline demands, thus leaving the whole world of new, virtual and interactive spatiality to others. The enormous size, complexity, richness and attention to detail of some contemporary computer game worlds exemplify what this new spatiality can be. The overwhelming feeling of immersion and saturation within these worlds is the result of spatial design. Hence, as far as design methodology is concerned, architects may have as much to learn from computer game and software designers as from the histories of architecture or the vast majority of contemporary practices. Yet it is not only that the architectural discipline will find itself in an era where humanity will inhabit and experience artificial worlds in a way not at all different to how it experiences 'real life', but that the very conditions in which the new architectural additions to 'real life' are being produced, organised and disseminated are already completely set in the virtuality of digital and algorithmic worlds.

The dominance of design software packages that come out of the legacy of Computer Aided Design maintains traditional architectural design methodology and ensures the endless reproduction of traditional design notations and their elements, some of which have already become almost obsolete (scale, for example). The latest iteration of the CAD paradigm is BIM, which may yet prove to be the greatest threat to the discipline as a design practice – since the BIM paradigm is principally about project management rather than design. It is no wonder, then, that the most interesting design work today comes from the use of exotic and custom-made software or software whose original area of application is not architecture – Maya, ZBrush, Softimage, Houdini, Unity – or directly from programming languages like Processing.

Hence, the role of software in architecture has been largely misunderstood: firstly, by disregarding software specificity and focusing on simulations of the traditional design medium in software in an attempt to preserve the discipline as it was historically, and out of necessity, defined; secondly, by amplifying the incidental and non-disciplinary effects of software, through using it as a tool for simulation of natural processes. What is needed is a radical embrace of software specificity understood as a new *visuality* – that is, a radically new *vision system* for architecture – and as a new ground for *architectural fictions*.[5]

A SPECULATIVE HISTORY OF DESIGN MEDIA

Historically, the medium specificity of paper was given by its flatness and expendable nature, which provided the perfect conditions for the rise of very specific architectural sub-mediums: orthographic projection-based plans, sections, elevations, perspectives and iso- and axonometric drawings. Since Alberti, architects have dealt with forms of representation without having to worry whether or not representations will take command and trounce 'reality'. Architects use software principally as a simulation tool, which is particularly apparent in the practice of rendering. Rendering is simply perspectival drawing made on a computer. Insofar as Alberti was right in saying that architects do not build but make representations of buildings, renders can be seen as the key product of an architectural practice. Renders are images that trace their lineage to the rules of perspective and come out of the long tradition of mimetic representation that characterised pre-modern painting. They are the perfect example of a purely software-based phenomenon used and regarded as if it has nothing to do with software.

Contemporary layer-based digital image making (which is the basis of software like Photoshop) forms the basis of architectural representation today, and yet even when it draws lessons from twentieth-century cinematography, by design it remains locked firmly in the tradition of passive representation, that of a photo collage. Renders are expected to be nothing more than idealised images of a new architectural reality; they come with their own

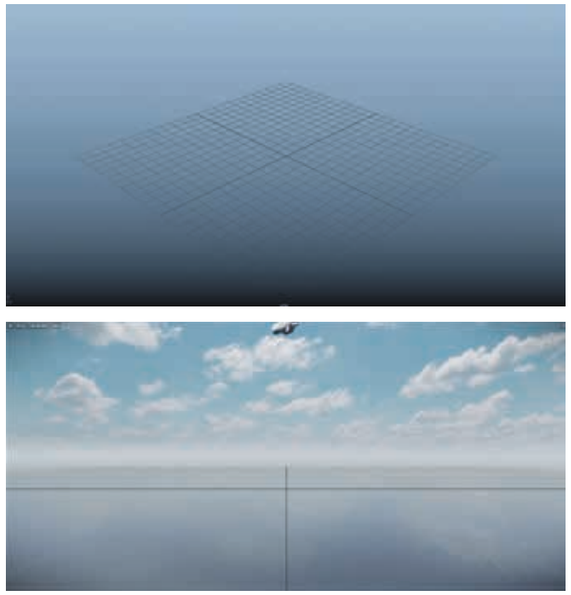

Fig. 3: A comparison between the default interfaces of Maya, one of the most common design software packages, and Stingray, a new game engine made by Autodesk. In Maya, the largest part of the interface is devoted to the model space, represented with a flat grid observed from above, whereas in Stingray, the gaze is changed and the flat ground grid becomes inhabitable.

vocabulary and tropes (balloons, children, vegetation on roofs, cherry blossom trees...). When, in rare cases, an office uses a video presentation of its architecture, this still retains the passivity of an image. The use of a VR platform[6] allows the clients the joy of inhabitation where the 'body' of a possible architecture participates through telepresence. Although virtual reality might eventually replace renders as the primary means of representation of an architectural space, it will change architecture as a discipline only if a similar environment becomes available as a *design* medium as well.

The chronic delay of fabrication and building technologies in comparison to design technologies presents an incredible bottleneck for the discipline. This paradox is shown by the fact that architects do not build yet are obsessed with the imperative of buildability. The Albertian ideal of an architect as a pure maker of spatial ideas will be fully actuated when this paradox is resolved through the flattening of design space with the real space, either by 3D printing or the *utility fog*[7] or a similar idea.

THE GAZE AND THE GRID

Spatial visual media can be analysed based on two concepts which both have to do with projections: the *gaze* and the *grid*. The gaze is our visual access to the model space, which in turn depends on projection. The gaze is never objective, far from disinterested and always intentional.

Traditionally, the need for notating the space for the purpose of preserving the design intention as well as

information for building construction has ensured that orthographic projections rule the architectural design process. This implies that there is such a thing as an *orthographic gaze* as well as a *perspectival gaze.* As with any other tool, orthographic projections are not devoid of aesthetic and political implications. They produce very specific spatial outcomes, as they depend on a very specific set of presumptions. Historically, the architectural discipline has been identified with a special skill set that relies heavily on planar thinking. The word *plan* testifies to this; it has both the meaning of a plan and planning. To plan in architecture is to partake in a political practice enabled by the medium of a plan. More specifically, this political practice is engendered by the gaze that this medium affords. This gaze can generically be identified as a top view in the case of plans, and as a side view in cases of sections and elevations. A top view implies the idea of total control of the model space and is particularly good at enabling any idea that has to do with a central hierarchy and centralised political authority, as exemplified by Roman city planning (Cardo and Decumanus); centrally planned temples; the ideal villa of Palladio; the nine square and the four square grids. Here, symmetry is particularly important since it is producible exclusively in the planar mode. The *ground* is another important notion: in the planar top view, the ground becomes abstracted into a background (which is the original meaning of 'ground' in a figure-ground problem in perception), and this becomes clear with the introduction of the Nolli map. In sections and elevations, another kind of relationship becomes apparent: the hierarchical dependence on the ground datum. In other words, the disciplinary problem of the figure-ground relationship is twofold since it originates both in the top and side views but has different implications in each.

The role of orthographic representations is to ensure the preservation of dimensions, but an unseen consequence is that they impose the flat organisational and compositional principles on the model space, thus saturating the outcomes with abstraction.

Perspectives are a different concept, as they are usually made after the fact of design to add atmosphere and an illusion of life. Perspectival projection hints at the idea of subjective space where the vanishing point is inverted into the eye of the observer. One of its effects is that it enables a specific reading of a picture plane. It not only organises the space but reorganises the observer as well and engenders a specific form of relationship between the two that can be conceptualised as *entanglement*. The notion of gaze arises in the form of a mutual gaze facilitated through an abstract *grid* diagram. There is evidence that perspectival projection has been used as a design tool as well, for example, in the Renaissance,[8] but perspectives have historically been understood as 'too subjective' and, more importantly, imprecise to be used as design tools. Modernism introduced parallel projection-based representations as an assumed *objective* mode of looking at the model space. The gaze embedded in parallel projection promoted another variant of the totalising 'god mode' look that preserved the dimensions of the plan while simulating three-dimensionality.

It follows that the compositional problems in architecture are inescapably governed by the mediums: planar and volumetric representations. These are not merely representations in the usual sense of the words; they are themselves projective systems, systems that generate a spatial outcome instead of just recording one.

Fig. 4: A collection of screenshots of the author's custom-made, game logic-based design software, *Platform Sandbox*, as customised by the student Yara Feghali. This software was used as a design tool, and as a means of design speculation for the first year students at Staedelshule Architecture Class in 2016.

This relationship is an interesting inversion of the Renaissance invention of drawing as ray casting; it could be said that any act of design is ray casting in reverse. If so, Alberti's and Dürer's 'prince of rays' has been conflated with a reverse-direction 'god ray' of the designer's gaze.

Interactivity in software starts with the gaze – in other words, with a specific visual access to the model. Unlike traditional perspective or axonometry, the software 'perspective view' imposes a fully actuated, fully accessible model space. Though still restricted to the two-dimensional plane of a screen, it is an interactive projection that liberates spatial outcomes from the constraints of fixed projection systems. The user can move and orbit around, zoom in and out of the model space and thus gain access to every aspect of its spatiality. Plans and sections are restrictive because they do not afford this access. The move to software is a move from the flat organisational diagram into a volumetric diagram. This implies a more fluid relationship with the underlying organisation and a less rigid set of rules.

In contemporary practice and due to the use of software, plans and sections are increasingly made after the design, and practically no design is ever done only from a plan. The model space enabled by software collapses the different projection spaces into a volumetric diagram. This engenders very specific spatial outcomes; for example, the traditional relationship between the plan and the façade becomes obscured and the façade becomes either an intentional cut through the volume or is literally a three-dimensional envelope. This unification of model space enables a different outcome than what was possible in a time when space was modelled in separate orthographic views. For one thing, it does away with the idea that unidirectionality is a compositional and organisational default. The traditional, orthographic space can thus be described as a disassociated, fragmented space that had to be *stitched* together, and it is precisely in this stitching that the traditional practice found its modus operandi. The modernist grid is a perfect example: an endless, equal potential space that only actually functions in two dimensions and makes stacking a solution to every height problem. The Fondation Louis Vuitton in Paris by Frank Gehry is a building that has been designed solely on the basis of a volumetric diagram. The plan is no longer a generator; it is merely generated. Hence, orthographic mediums are exposed as ultimate abstractions of living space that have become misidentified as guarantors for disciplinary specificity.

Still, when the traditional and contemporary mediums do not share the same type of gaze any more, they have a common base for their spatial models: the grid. The base of every modelling software is the grid, just as it has always been for any graphic procedure based on projection. If software is still dependent on projection, its grid is now separated from the gaze. In other words, the projection is interactive and does not restrict the model space to a two-dimensional space but engenders a fully actuated, interactive projection of total immersion. This means that, for the first time in the history of architecture, there is the possibility of visually inhabiting a design space.

Historically, the grid has undergone a series of transformations, and this history can be found in software in a compressed and accelerated version. The orthographic, perspectival and isometric grids have been replaced by the active and volumetric grids of software. From the traditional grids of early 2D CAD packages to the contemporary high-resolution (aka high-poly) grids of various sculpting and procedural-based software, design is not the design of objects, but of grids, in grids and on grids. Any model designed in software is a grid: a mesh- or NURBS-based, low- or high-resolution, uniform or deformed grid. And every model is instantiated on another grid, the ubiquitous *ground grid*.

THE GROUND GRID

Perhaps the history of ground grids is the most interesting, as they have been present since at least the Renaissance. This ground as flat grid is first found in the so-called *Prevedari* engraving of 1481, made by Bernandino Prevedari after Donato Bramante and named *Interior of a Temple with Figures*. It, or its variations, are always found in the depictions of ideal places, such as in Raphael's *The Marriage of The Virgin*. These places are never simple landscapes; they are the originators of urbanity, yet they always have an atmosphere of an ideal nature. A flat grid indicates a perfect balance between tamed, lived-in nature and enlightened city dwelling – a negotiation between opposites and a sign of harmony. It is a utopian sign *par excellence*, and it is no wonder that it comes back in modernity with such force. It is this inescapability of the grid that has haunted architecture in the late twentieth century. In this sense, deconstruction was primarily a move against the isotropic grid, featuring instead fractured, broken grids supposed to engender new, non-privileged subjectivities.

The flat grid has since become ubiquitous, its latest iterations being equated with popular depictions of the digital realm, such as the one found in the *Tron* films of 1982 and 2010. However, it is precisely in 3D design

Fig.5: A screenshot from the author's upcoming game software called *Supersurface* that recreates the Superstudio project, thus finally enabling the inhabitation.

software that the grid finally takes over. Ultimately, the image of the digital is the image of an endless grid accommodating other grids, manipulated by an omniscient and omnipresent designer. In recent years, another metaphor, that of a *cloud*, has come to represent the *digital regime*, almost as an attempted escape from this perceived artificiality. Yet maybe it is the case that these two ideal images are collapsed: it is as if somehow, in a perfect union between the natural and artificial, the world has become an endless, reflective grid mirroring the clouded sky above. In this sense, and seeing the rise of planetary-scale computation in hindsight, Superstudio's *Supersurface* of 1972, a project that has been understood as a conceptual, ironic utopia which projects an endless, isotropic grid taking over the world, can now be actually read as *the* realist project for the twenty-first century.

GAMES

Software flattens the field of visual effects and enables messy encounters between drawing, painting, video and games. As a direct descendant of traditional design mediums, design software prescribes a very specific role to the user: that of a disinterested, disembodied subject that has full access to any projection space that operates on a spectrum of full visibility and full zoom-in. This approach continues and vastly expands a specific subjectivity of an architect operating in the 'god mode' of the traditional discipline. An architect is now an omnipresent and omniscient entity with full control over the design space, which supposedly ensures that his authorship is visibly imprinted. This notion of total visual empowerment is a heritage of the military roots of the digital regime,[9] and leads ultimately to very problematic and unexamined political outcomes of design processes, best witnessed in totalising fictions like Parametricism.

Unlike other software, computer games tend to problematise the notion of subjective agency either through exposing and putting into question the ability of a player or by disturbing the mere notion of a goal. Because of their full spectrum deployment of interactivity, games could be thought of as the most medium-specific type of software. Play does not have to be always goal-oriented, and although most games do have a goal (the 'win' state), more and more the inherent specificity of experience leads to the player being content with merely 'existing' within a game. Immersion does not depend on, and is more likely even disturbed by, direct calls for action towards reaching a goal. The notions of agency and authorship are thus perceived in a different manner, which enables loosening up the idea of control. It is precisely the notion of loose control that can be postulated as a new authorial model. Rather than depending on guaranteed outcomes that come either out of total control of the medium or out of a system-based logic of computation, this notion puts the possibility of a new subject first. A subject that is aware of his own entanglement with other, non-human forms of agency and is willing to explore new configurations coming out of this flat, non-hierarchical relationship.

This notion of obstructing prevalent, established, rational and positivistic methods through employing game-like scenarios and practices is not new. It was used extensively by the Surrealists as a means of disestablishing the aesthetic and political implications of well-known models. In surrealist games such as the Exquisite Corpse,[10] any notion of systematic, rational form-making is erased. The games were derived as a means of freeing the creative process of conscious control.

In August 2015, Autodesk presented a new software package that will allow architects to finally inhabit the spaces before they are actually built. Named Stingray, the software is actually a game engine, in the tradition of Unity 3D and Unreal. Exactly like those 3D applications as well as others, Stingray employs a grid as a ground and affords a gaze, yet this time a very specific one. Its default view is that of an endless, walkable grid, observed from first person, enclosed by an endless, clouded sky.

1 Mario Carpo, in *The Alphabet and the Algorithm*, (Cambridge, MA: MIT Press, 2011).
2 'Media' and 'mediums' are optional terms. Here 'mediums' is used to ensure difference from broadcasting.
3 Lev Manovich, *Software Takes Command*, (London: Bloomsbury, 2013).
4 "A new medium is never an addition to an old one, nor does it leave the old one in peace. It never ceases to oppress the older media until it finds new shapes and positions for them", in *Essential McLuhan*, Edited by Eric McLuhan & Frank Zingrone (London: Routledge, 1997), 278.
5 The notion of *formats* – a project or a building becomes just one format in a flat ontology of formats, where software is the medium. See David Joselit, *After Art*, (Princeton University Press, 2013), 55.
6 For example, Oculus Rift and HTC Vive offer unparalleled possibilities of immersion.
7 The utility fog (coined by Dr. John Storrs Hall in 1993) is a hypothetical collection of tiny robots that can replicate a physical structure. As such, it is a form of self-reconfiguring modular robotics. Source: https://en.wikipedia.org/wiki/Utility_fog
8 Erwin Panofsky, *Perspective as Symbolic Form*, (MIT Press, Zone Books, 1996).
9 Friedrich Kittler, "Computer Graphics: A Semi-Technical Introduction", *Grey Room* (2001), 31.
10 Alastair Brotchie and Mel Gooding, *The Book of Surrealist Games* (Shambhala, 1995), 25.

Augmented Maritime Histories: Text, Point, Line

Elizabeth Shotton

The coastline of Ireland has been embellished through the accretion of piers, jetties, quays and breakwaters to facilitate the ever-evolving nature of the shipping and fishing industries in the past millennium. These structures represent a significant infrastructural system that has shaped local and national Irish culture for centuries. While Ireland's major ports have been carefully documented and researched, much of this infrastructure, though once intrinsic to the economic wealth and the welfare of local communities, has fallen into disrepair as the industries that once generated their development have been centralised to the major ports. With damage from the seas ever increasing, it has become critical to document these minor harbour structures to describe and elaborate on the entwined nature of their development with the communities they once served.

The current project was conceived and funded as a pilot project to establish protocols for the capture and management of LiDAR-based surveys of these coastal structures in tandem with historic research on their development. Many of these structures have long, complex histories tied to shifting patterns of governance, land tenure, material resources, technology and trade. Unravelling and visualising these histories involves a complex negotiation between text-based archival documents, historic surveys and maps and other forms of pictorial representation such as topographical illustrations, all used in tandem with LiDAR-based surveys (Fig. 1) to articulate their evolution.

METHODOLOGY

Initial scoping of potential harbours was undertaken with reference to the UAU *Ports, Piers and Harbours*[1] in tandem with a review of historic and current Ordnance Survey maps to identify suitably sized and historically relevant harbours for the pilot study. Based on this review, a subset of harbours for further research was identified for this initial research stage:

- Port Oriel (Clogherhead), Co. Louth
- Ballbriggan, Co. Fingal
- Bullock, Co. Dublin
- Fethard, Co. Wexford
- Slade, Co. Wexford
- Dunbrattan (Boat Strand), Co. Waterford

These harbours were chosen based on the variation in geomorphological situation, harbour form and dates of development. This was intended to achieve two purposes; firstly, to ensure that sufficient variation in scanning procedures was trialled to identify critical issues; and secondly, to enable a comparative analysis between differently situated harbours, making use of the very coherent template for analysis developed by Graham in his study of Scottish vernacular harbours.[2]

The research has five phases of interrelated work: review of secondary published research to develop bibliographic data for each harbour; archival research; on-site scanning and inspection; modelling, documentation and record development; and historical comparative analysis. Of interest here is the manipulation of LiDAR point cloud data post-scan, to interrogate the findings from the archival and desk-based research. The original intention had been to translate the point cloud data acquired from the LiDAR scans into digital 3D models using NURBS-based

Fig. 1: Bullock Harbour, Co. Dublin, Ireland. LiDAR scan data, Semar, 2016.

CAD software, which can better account for the irregularity of the surfaces encountered, retain the complexity of the construction detail and ensure that the data could be viewed and manipulated by standard CAD programmes to enable greater access. Coupled with this is the need to link the results of the archival research and other source data, such as photographs or bibliographic notes, to the 3D computer model. There is considerable momentum among international researchers in this field at the moment, including the work of Stephen Fai, director of the Carleton Immersive Media Studio (CIMS) at Carleton University in Canada, and Anthony Caldwell at the UCLA Digital Humanities Group. In particular, Caldwell's use of Building Information Modelling (BIM) software to link this paradata to the digital image[3] is a useful model to deploy in this context, as archival, bibliographic, photographic and management data can be keyed into the digital model for future reference.

BULLOCK HARBOUR

Of the seven harbours surveyed to date (including the earlier study of Coliemore), a considerable number of pictorial representations have been sourced for Bullock harbour in County Dublin, including a seventeenth-century topographical ink wash by Francis Place[4] and a painting by John Thomas Serres almost one hundred years later (Figs. 2 and 3),[5] making Bullock a useful vehicle for initial trials for analysis and visualisation. These images can be used as baselines to articulate the original geomorphological characteristics of the site prior to its embellishment, with several layers of eighteenth- to twentieth-century additions to form the harbour in its current condition.

Bullock Harbour also has a usefully complex and lengthy history, much of which has only been identified by virtue of the archival research interrogated in tandem with the information contained in the LiDAR scans. Although concise histories of Bullock have been published in the past by De Courcey[6] and Gilligan,[7] in addition to an earlier work by D'Alton[8] and a more recent, lengthier work by local historian Smyth[9] in *Bulloch Harbour: Past and Present*, the history of the building of the harbour is underrepresented, being simplified to a recounting of the 'medieval pier' on the west bank below the castle, variously described as either fourteenth or fifteenth century in origin, followed by a complete building of the harbour circa 1820 by the Dublin Port and Docks Board (now Dublin Port Corporation) with quay walls, slip and piers to both east and west. Aside from the improbability of a fourteenth-century pier withstanding the ravages of time and the battering of the seas for five hundred years before it was rebuilt, these histories overlook the more complex evolution of this harbour, failing to account for the range of pictorial history available and formal government documents which expose a more elaborate history.

D'Alton is the only published author who recounts the remains of an eastern pier, in addition to the 'medieval pier' on the west bank, both of which are plainly recorded

Fig. 2: Bullock Harbour, Place, 1699.
Courtesy of the National Gallery of Ireland.

in the 1699 ink wash drawing by Place. D'Alton's description is taken verbatim from a report of 1800 by Captain William Bligh on the state of Dublin Harbour,[10] who provides in his survey the precise dimensions of the ruinous east pier in addition to the length and breadth of the harbour, the latter of which agrees quite well with Place's representation when interrogated using the 'Vanishing Grid' command in Adobe Photoshop. Even more troubling is the lack of attention given to physical evidence on the ground, which is exposed in the high resolution LiDAR data (Fig. 4) in which the physical remains of a hewn stone pier(s) is visible within the larger ashlar granite construction of the early nineteenth century.

The hewn stone construction highlighted in the LiDAR scan appears to consist of two independently constructed piers, which could serve to articulate the constructed history of the harbour. The lengthier section matches precisely the dimensions quoted by Bligh for the ruinous pier in his report of 1800, and, given the irregularity of its edge condition to the north (bottom of image), while the south edge is continuous, it appears likely that its seaward edge had collapsed. This would account for the rubble of stone illustrated in the Serres image made shortly before Bligh's survey. This pier extension was likely funded by the Irish Parliament and built shortly after a petition made by the Merchants and Traders of Dublin in November of 1765 to make "a strong jette from the points of the rocks adjoining the continent, to the rocks of Old Bullock."[11] The jette can be understood as the pier, though it was clearly not built as strongly as the Merchants had hoped, as it lay in ruin less than forty years later, with the rocks of Old Bullock referring to a string of rocky outcrops on the east side of the inlet. The earlier original pier on which it extends was no doubt ruinous at this time, but was likely the remnant of the east pier illustrated in Place's drawing, as its position correlates substantially.

In addition to the petition for a jette, the Merchants and Traders also requested the *continuation* of "...the new quay, opposite the rocks of Old Bullock, which would include space large enough to contain several vessels in ten or twelve feet of water at the lowest spring tides." That this work was undertaken is verified in 1770, five years following this petition, when Wilson writes of Bullock,

Fig. 3: Bullock Harbour, Serres, 1788. Courtesy of the National Gallery of Ireland.

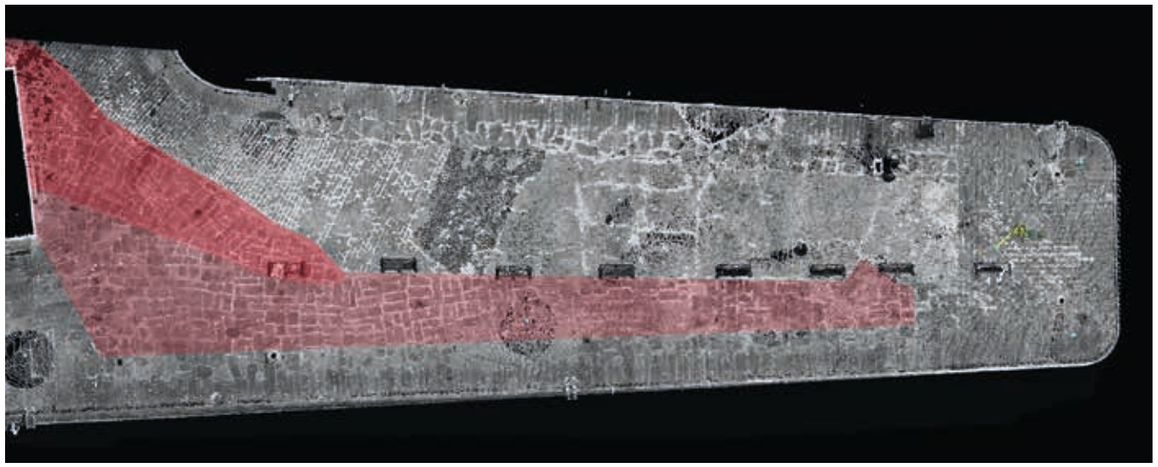

Fig. 4: LiDAR image of east pier with hewn stone construction highlighted, Shotton, 2016.

"A new quay faced with hewn stone hath been lately built, for the convenience of conveying stones to the light-house-works."[12] There are two critical terms used in these documents that allow the pictorial works of Place and Serres to be better understood relative to each other, as well as to the later nineteenth-century construction. When interrogated relative to the LiDAR scan data in tandem with the perspective grid analysis, the western pier in these two illustrations are located differently, with the Serres' pier located south of the pier in Place's drawing. Topographical artists built their reputation on the accuracy of their representations, and while there is cause to doubt Serres' image, in that he has collapsed the perspective in an effort to include the eastern rocks for picturesque effect, Place's reputation is considerable and holds up well to scrutiny. It appears probable that a new quay or pier was built on the western shore prior to the petition of the Merchants and Traders of Dublin, as they petition for the *continuation* of the *new* quay. This suggests that the western pier in Place's drawing had collapsed by this time, which may account for the loose rubble illustrated north of the pier in Serres' drawing, and was rebuilt southward of the original site. This new location correlates closely to the position shown by Duncan in his 1804 survey of the *Coast from Blackrock to Bray Head.*[13] The later *continuation* of the quay adjoining this pier by the Merchants and Traders, by an unknown length, would help to resolve a discrepancy between the known dimensions of the nineteenth-century works which fall short of joining this pier.

The nineteenth-century works are equally complex rather than singular as generally discussed, and again

are revealed in the LiDAR scans. There is considerable diversity of construction techniques used in the visible surfaces of the harbour, including ashlar horizontally coursed stone work on both piers and part of the western quay, ashlar vertical partially coursed stone work on the eastern quay and rough-hewn, uncoursed stone work on the south end of the western quay and the original slipway. Although built by the same contractor, George Smith, rather than being built at a single period, the earliest date of the nineteenth-century work was 1807–8, when the western quay wall was extended by 231 feet in rough-hewn, uncoursed stone work, and later extended by an additional 80 feet, including a slipway, in 1815 using the same technique.[14] The later ashlar work, undertaken between 1818–20 by Dublin Port,[15] introduces a curious angle in the western quay wall where it ties into the hewn stone wall of 1807. While this may reflect a preference to achieve a right angle with the new western pier on the part of the engineer George Halpin, because there appears less effort to ensure this geometric purity on the eastern quay, it is also possible that this shift in geometry was necessitated by the still extant eighteenth-century western pier illustrated in Serres' painting, suggesting the pier may still exist under the roadway adjacent to the quay constructed after this date.

PARTITIONING, IMAGING AND ANALYSIS

A primary underlying ambition of the research has been to develop a more coherent history of the evolution of maritime construction technology in Ireland, which influenced the choice of LiDAR as a survey tool, as it is possible to capture and preserve significant detail using this methodology. The information gathered on the scans has proven remarkable but the choice to retain this detail has lead to significant file sizes, in excess of 9GB for the complete Bullock Harbour (in excess of 298 million points). Though the original intention had been to import the data to RhinoCAD, where the point clouds could be surfaced to create smaller files in more commonly accessible formats, RhinoCAD has insufficient capacity to accommodate such file sizes, thus the work has taken a different trajectory.

To enable the surfacing of the point clouds (as yet incomplete), the dataset for Bullock, once interrogated relative to archival information, has been partitioned by date of construction, a method that will also be used on the other harbour datasets. The subsets developed for Bullock include: rocks and castle (409MB); early east pier (119MB); west quay wall of 1807 (312MB); west quay wall and slip of 1815 (94MB); west quay and pier of 1820 (1.2GB); east quay and pier of 1820 (940MB); road wall (132MB); concrete slip and buttresses (242MB) – which, though large, are sufficiently smaller to enable manipulation in RhinoCAD. Each partition retains the castle as a reference point for further analysis. The partitioning of the scan data in this manner requires a certain amount of interpretation and interpolation to articulate how each phase was constructed and later embellished. To date, the point cloud data has been used in RhinoCAD to develop extruded 3D forms of the subsets that lack construction detail, which have then been merged into a single file and used to confirm or dispel hypotheses regarding the information gleaned from historic sources, including text and images, and from which a series of three-dimensional models of subsequent building phases will be visualised and ultimately linked to the main point cloud data as a web-based record.

The use of perspectival grid analysis using the 'Vanishing Point' feature in Adobe Photoshop, verified against textual evidence from early coasting pilots and/or marine surveys for dimensional integrity, was trialled in an effort to correlate the information in the historic images with the scan data and confirm locations of built features. These vanishing point grids can be exported as .dxf (or .3ds) files and transferred to RhinoCAD to be reconciled with point cloud data from the LiDAR surveys (Fig. 5). In addition, it was hoped that from this data the original

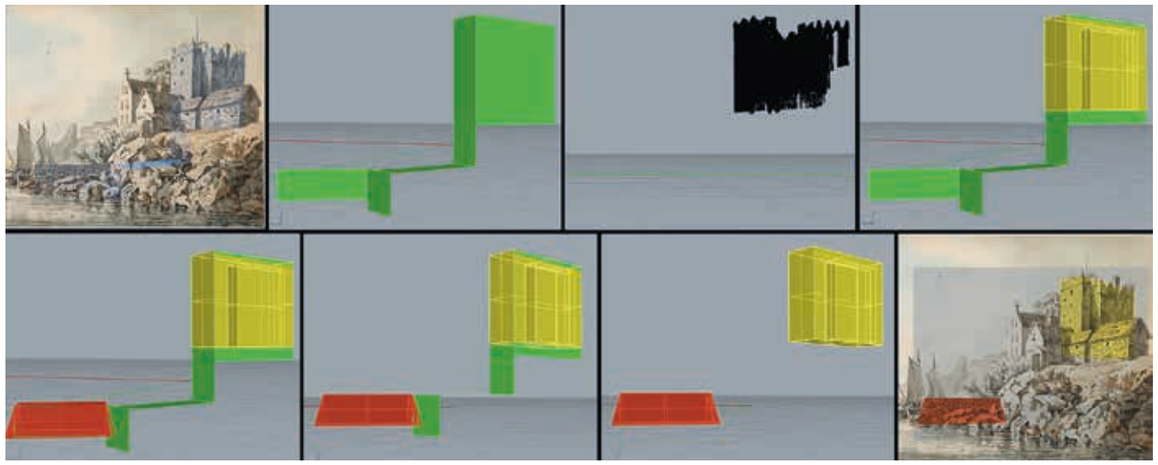

Fig. 5: Analysis of Serres' painting using Adobe Photoshop, RhinoCAD and LiDAR point cloud data, Shotton, Semar, 2016.

Fig. 6: Bullock Harbour, Co. Dublin, Ireland, LiDAR scan data 2016 overlaid on Frances Place 1699, Shotton, Semar and Place, 2016.

geomorphological condition could be hypothetically modelled as a three-dimensional representation to act as a base for further modelling within RhinoCAD of the construction timeline for each harbour.

Through the use of the 'Vanishing Point' tool, the pier in relation to the castle (still extant) was modelled and dimensioned successfully in Photoshop and translated to RhinoCAD as a set of three-dimensional surfaces (green in image) which contained dimensional information on the castle, the distance (horizontal and vertical) from the castle to the pier and the dimensions of the elevation of the pier as represented in the Serres drawing. The transfer of the Photoshop data was not without its problems, as the imported data requires rescaling and reorientation. The dimensions used to properly rescale the imported model were taken from the 'Vanishing Point' tool in Photoshop. Within the RhinoCAD environment, the partitioned point cloud sub-model of the 1807 pier (including castle) was loaded (black) and the castle modelled as a three-dimensional form (yellow) where it was correlated with the model from the Photoshop tool. Based on the elevation surface for the pier in the imported Photoshop model, a three-dimensional pier was modelled (red), though its breadth remains unverified, as Serres' drawing does not contain this information. With this data modelled, the image was rotated to simulate the view of the castle and pier represented in Serres' painting, stripped of the Photoshop data and re-exported as an image file to be overlaid on the Serres image in Photoshop to verify the model. This sequence of operations allowed us to successfully pinpoint the location of this pier in plan view in the RhinoCAD model.

While the Serres painting proved amenable to the use of 'Vanishing Point' analysis in Photoshop, the Place drawing, due to the irregularity of the rock surfaces and the limitations of the grid analysis tool, which only allows for rectangular grids, proved impenetrable. An alternative methodology was employed in this case and later used on the Serres image as well, in which the images were imported to Cyclone, the native point cloud software for Leica scan data, and overlaid on the scan data in perspective view (Fig. 6). The scan data could then be rotated until sufficient correlation with the castle view was obtained. In the Place drawing, this allowed us to ascertain that the location of these early piers correlated quite closely to the current piers built in the nineteenth century, as well as clarifying the location of the current west quay wall immediately forward of the rocky foreshore drawn by Place. This insight was used to model and position hypothetical 'medieval' piers in the RhinoCAD model and test the accuracy of their location against the Place drawing in the same manner as with the Serres painting. It was through this methodology that we could confirm the piers drawn by Place aligned very closely to the fragments of the ruined east pier visible in the LiDAR scan data.

PRELIMINARY CONCLUSIONS

The pilot project is not yet complete, thus results are currently provisional. We have been extremely fortunate in the study of Bullock to have the expansive range of historical images to work with in the analysis, all of which reference the still extant castle. It was likely the existence of this castle, in close proximity to Dublin, that incited such a degree of interest from artists. We are equally fortunate that the castle survives relatively intact, allowing it to be scanned and used as a reference point in the interrogation of the historical images. This is certainly not the case for the majority of small harbours in the survey, which have less imagery available (though often more archival information) and very few with a castle for a reference point. Thus, the analysis of each harbour will present its own challenges and demand modified procedures for interrogation and reconciliation of the information sources.

The limitations of the 'Vanishing Point' tool in Photoshop were disappointing and have obliged us to experiment with alternative forms of visual analysis. The super-imposition of images on the LiDAR point cloud is useful, but depends heavily on the judgment of the viewer and lacks any form of verifiable, mathematically derived dimensions. An alternative we intend to test on the Place drawing is a more conventional perspectival analysis, using a reverse two-point perspective analysis to derive a plan and elevation from the image. This plan and elevation will then be modelled in the RhinoCAD environment and exported as an image file to test its correlation with the original image.

We were also fortunate at Bullock that the harbour, including the seabed exterior to the piers, runs dry at low spring tides, which enabled a full scan of the built infrastructure and seabed using LiDAR. For the rest of the harbours, underwater sonar scanning will be necessary to capture both the seabed and the portions of infrastructure under the waterline, which will be merged with the terrestrial LiDAR point clouds to create comprehensive three-dimensional forms. Fortunately, for a selection of harbours (Port Oriel, Balbriggan, Fethard) this seabed data has been made available to us from Hydrographic Surveys Ltd. The remainder will be surveyed later this summer.

Future plans for enabling more accurate interpretations of the historic data will also involve the use of ground-penetrating radar to obtain profiles of the internal construction of the built elements, which in the case of Bullock may confirm the presence of the eighteenth-century western pier visualised in Serres' painting.

The extraordinary level of detail present in the LiDAR scan files is imperative to retain, though difficult to manage due to the file sizes. Options for web-based point cloud viewers, which can scale the data to the appropriate resolution as one orbits and zooms to particular parts of the cloud, are currently being investigated by the University's Digital Library team to facilitate placing the original scans on the library site for public access. The ambition to create a fully linked information database with the model, as described in Caldwell's work, may be difficult to achieve in tandem with a scalable point cloud interface, and thus may require an additional form of visualisation to be included in the digital record, such as a three-dimensional timeline model. Thus, the appropriate form of digital record configuration for the digital library is still in a development phase.

[1] Underwater Archaeology Unit, *Piers, Ports and Harbours* (Dublin: National Monument Archive, 2002).
[2] See Angus Graham, "Archaeological Notes on some Harbours in Eastern Scotland" *Proceedings of the Society of Antiquaries of Scotland* Vol. 101. 1968–69. 200–285. and Graham, Angus. 'Old Harbours and landing-places on the east coast of Scotland.' *Proceedings of the Society of Antiquaries of Scotland.* Vol. 108, 332–65.
[3] Anthony Caldwell, "Pharos Lighthouse: An Experimental Archaeological Digital Reconstruction", *5th International Conference on Construction History* (Chicago, USA, 2015).
[4] Frances Place, *Bullock Castle and Harbour,* National Gallery of Ireland [NGI 7532]. 1699. Ink wash.
[5] John Thomas Serres, *Bullock Castle,* National Gallery of Ireland [NGI 19216]. 1788. Painting.
[6] J.W. De Courcy, *The Liffey in Dublin* (Dublin: Gill and Macmillan, 1996).
[7] H.A. Gilligan, *A History of the Port of Dublin* (Dublin: Gill and Macmillan, 1988).
[8] John D'Alton, *The History of County Dublin* (Dublin: Published by Author, 1838), 53–54.
[9] Donal Smyth, *Bulloch Harbour: Past and Present* (Dublin: Published by the Author, 1999).
[10] 'Accounts, &C. Presented to the House of Commons, Relating to the Inland Navigations of Ireland, and to the Port of Dublin.' (London: House of Commons Papers; Accounts And Papers, 1806), 55.
[11] Anon, *The Journals of the House of Commons of the Kingdom of Ireland* Vol. 8, (Dublin: George Grierson, 1765).
[12] Peter Wilson, "A Topographical Description of Dalkey and the Environs" in a Letter to John Lodge, Esquire; Deputy Keeper of the Rolls, Dalkey Lodge, 28 March, *The Gentleman's Magazine,* ed. Sylvanus Urban (London: D. Henry, St. Johns Gate, 1770), 208.
[13] William Duncan, *A Sketch of the Coast from Blackrock to Bray Head with Adjoining Roads and Villages, Surveyed 1804 for Major Alexander Taylor*, Manuscript No. BL G70126-58 (London: British Library, 1804).
[14] Dublin Port and Docks Board, *Journal of the Proceedings of the Corporation for Preserving & Improving the Port of Dublin* Vol. 8 to 11, Manuscript Numbers: BR/DPDB 1/11; 1/10; 1/9; 1/8 (Dublin: National Archive of Ireland. 1811–23).
[15] Anon. *The Journals of the House of Commons of the Kingdom of Ireland.* Vol. 12. (Dublin: George Grierson), 1787.

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The Irish Research Council has graciously funded this pilot study. Donal Lennon of UCD Earth Institute has undertaken scans and post-processing of the data with assistance from Aoife Semar, Research Assistant on the funded project. Work on archival research and drawings has been undertaken by Aoife Semar with the author. Bathymetric sonar scan data of the seabeds for Port Oriel, Balbriggan and Fethard harbours has been kindly donated by Hydrographic Surveys Ltd. of Ireland.

Undo

Thomas Balaban
Jennifer Thorogood

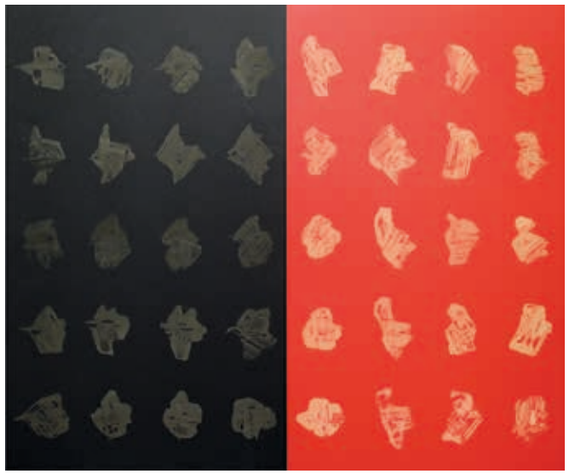


Fig. 1: Thomas Balaban and Jennifer Thorogood, *Engram Suite*, 2010, laser-cut etching matboard, 92 × 46 in. Etching performed by a laser cutter from digital crosshatching.

Absorbed into the lexicon of the computer, 'undo' – once a condition of change – has been freed from consequence. In its contemporary interpretation, undo no longer serves to dismantle but is merely an action deployed to negate the previous action. What is being undone becomes insignificant; the ultimate value lies in the freedom to toggle between the states of undo/redo.

The virtual reality of undoing no longer reflects the physical act of doing, bringing into question the possibility of cleanly unmarking gesture, unrecording sound and unmaking architecture. It sidesteps the dirtier consequences of taking something apart as witnessed in building demolition. In truth, however, Humpty Dumpty could not be put back together again.

This project places at odds the ease of undoing digital representation with the impossible act of physically unmaking. The experiments of Undo are performed in tandem by a software modeller which exposes states of instability and a laser cutter which materialises and shifts them into acts of permanence. The 'machineness' of the laser cutter is undermined by the delicate and artistic nature of its output. Using etching as a primary source of mark-making, the computer-driven machine attempts to erase, rewrite and create architectural drawings, images and sounds in an exploration of the tectonic potential of a physical undo/redo cycle.

HOW TO DRAW

One can examine the image of a drawing and surmise the series of steps required to create the final visual effect. This is particularly true when the image is representational. If asked to reverse engineer the final image into a sequence of instructions aiming to facilitate reproduction and mitigate error, how would you go about undoing the image? Do you start from a general form and move into specific detail or group together similar gestures? Regardless of approach, the process deployed in the undoing and redoing of the image will not reflect its original construction (Fig. 2).[1] in other words, the act of undoing does not directly reflect the act of doing. Moreover, the rigour of the former negates the uncertainty of the latter, as 'happy accidents' held dear in the drawing process become rigidly built-in.

Likewise, descriptive drawings in architecture increasingly separate the abstract geometry of a building from its material realisation.[2] Buildings are expressed through a set of instructional sheets laying out the components necessary to construct the preconceived form. The 2D to 3D instructions focus on specific moments made general through a series of geometrical cuts, projections and close-ups that are pieced together to make a whole. This ordered fragmented set is used to make the transition from concept to reality.

Digital drawing and subsequent digital modelling have made the transition much more fluid, given computational production and precision. However, this precision is now excessively beyond human manipulation and arguably beyond a material reality.[3] Yet the objective, however complicated, remains the same – how to mitigate error and systemise construction of this ideal form; how to recreate this hyperperfected image. We turn again to a meticulous dissection that stagnates the original expression of making.

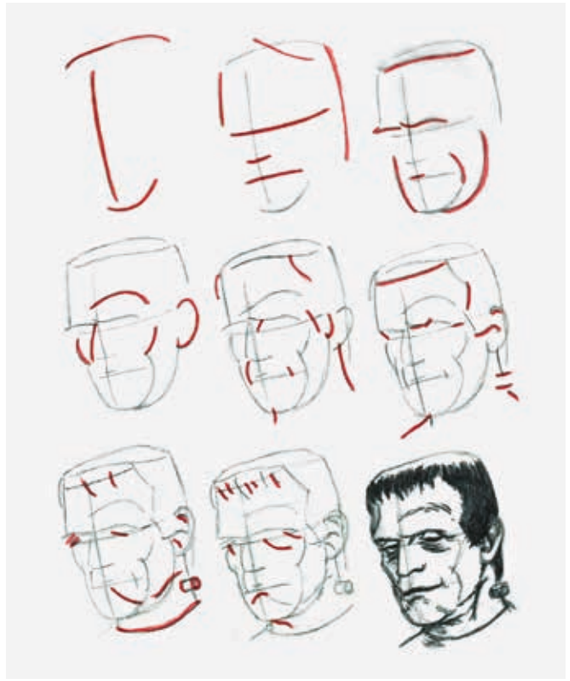
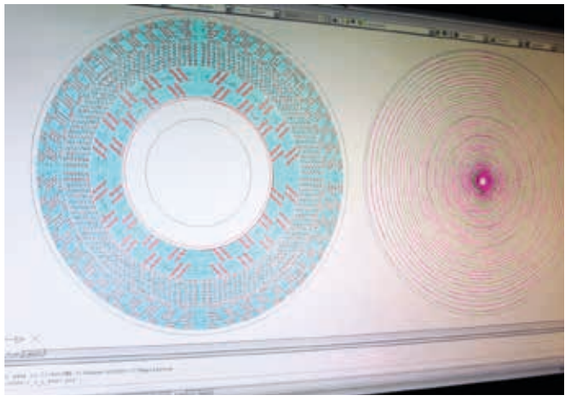
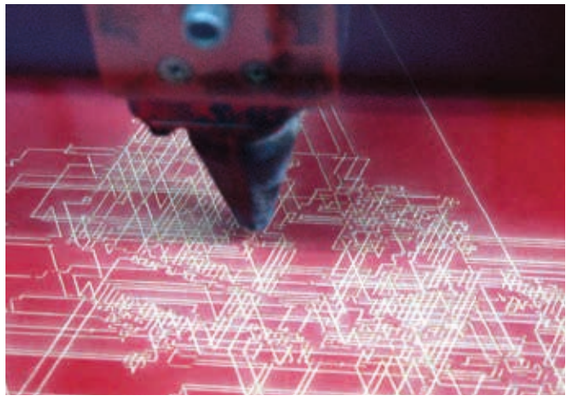


Fig. 2: Balaban and Thorogood, *Following the steps of Frankenstein's monster*, 2016, pencil on paper, 21 × 28 cm. The process deployed in undoing and redoing an image does not reflect its original construction.





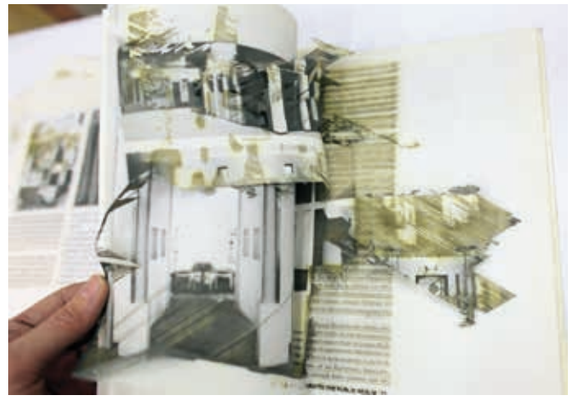


Fig. 3: Balaban and Thorogood, *The Undo Process*, 2010, CAD, laser cutter, vinyl, paper. Experiments involving the digital scanning of books and vinyl grooves, converting the data into tool paths that burn and erase the information on the source material itself.

Undo looks at reversing this rigorous process. It asks: what if we start with the completed form and proceed towards the original blank canvas with a clear 'backwards' roadmap in hand? Virtually, the ease of undoing affords the luxury of digital unmaking as an iterative process capable of removing action before action, essentially removing the hand of the author. Unlike the building cuts performed by Gordon Matta-Clark that "collapse instruction and operation", a virtual undoing is dependent on the making of the completed form.[4] The resulting experiments are to be read as fragments of fragments of the original form, not through a lens of a perceived incompleteness but through one of virtual decomposition.

PROCESS: REDO/UNDO

The project evolved through three stages. The first experiments were directly physical. They involved digitally scanning books and vinyl grooves and converting the data into tool paths that would burn and erase the information on the source material itself (Fig. 3). As expected, the unrecording of sound erased the existing record groove but also unexpectedly created a new rhythm heard when amplified through a speaker. The unmarking of gesture on the page amalgamates the back-to-back images into a single form and often fragments the pages.

The second series of experiments of Undo were conducted virtually as the performative unbuilding of 3D models, including buildings and biological systems. After modelling each structure, the operations and scripts deployed were then reconfigured to play out in reverse. In order to mitigate software lock-up and computer crashes, the complex three-dimensional modelling required a systematic simplification of its operations. As the approach to modelling was not reverse-engineered for efficiency, compound actions necessitated being broken down into simpler object-plane-vector-point operations that lend themselves more easily to being inverted. In a similar way, each function's required inputs and parameters were appended to a series of lists, inverted and fed back into the unbuilding sequence. The process was supplemented by a healthy diet of optimisation and rebuilding. Regardless, discrepancies between the making and unmaking processes were highlighted by unpredictable and unstable results. Invariably, at its completion the procedure never attained the empty point of departure, leaving behind instead a series of convoluted and manifold traces and structures to be mined and described by a series of two-dimensional explorations (Fig. 4). It is important to note that curatorial decisions were withheld until the surviving processes had run their course.

Fig. 4: Balaban and Thorogood, *Engram suite*, 2010, 3D models. Unpredictable and unstable results of undoing 3D models to be mined and described by a series of two-dimensional explorations.

Fig. 5: Balaban and Thorogood, *Snitch*, 2010, laser-cut etching on grey matboard, 261 × 138 cm. Etching performed by a laser cutter emphasising versatility of line.

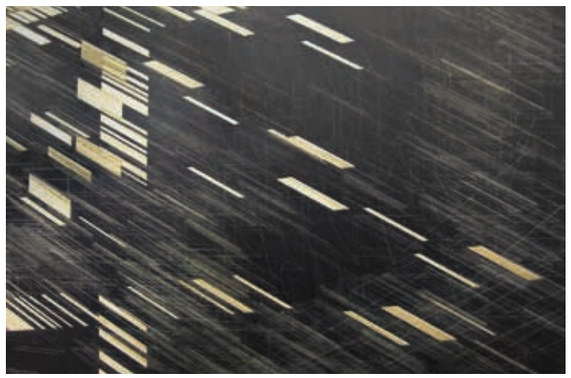


Fig. 6: Balaban and Thorogood, *Woods*, 2010, laser-cut etching on black matboard, 138 × 92 cm. Etching performed by a laser cutter emphasising the delicate layering.

In its third (ongoing) phase, research is now focused on the cross-pollination of digital undoing processes wherein a building script of one model is used to dismantle a second, different model, either the same building modelled independently by two authors or two completely different buildings. However, the material of this paper focuses mainly on the second stage of the project. The result of the first phase was simply a direct expression of the act of undoing inscribed onto the vinyl or paper medium itself. It is in the second stage of the project that things became interesting, where the drawings of the digital artefacts of the undo process acquired a life of their own.

ETCHING AS MARK-MAKING

In direct "resistance to data-driven compositional algorithms, which focus on producing hyperaccurate representational spaces",[5] we sought instead, using traditional line drawing techniques, to materialise the structure of moments of flux within the architectural models. Given the project's origins, we naturally turned to etching, in particular stippling and cross-hatching, as a transparent way to mechanically shift these recorded processes into acts of permanence.[6] An initial imprimature was laid down through basic sectioning of the digital artefacts. Next, exploiting both co-planar and closest point relationships, a series of compressed two-dimensional drawing planes were extracted by weaving point cloud elements into a series of cross-hatch layers (Fig. 7). The results were projected onto a series of parallel picture planes, organised and converted to tool paths.

Drawing technique and expression materialised within the depth of the etching process itself. The laser cutter was chosen for its versatility. Through iterative testing of beam focus, pulse spacing, etching depth, power intensity and speed, all working in tandem with material grain and mechanical vibration, we were able to coax a wide range of output from a standard machine. Compressing virtual space by delicately etching layer upon layer provided an unexpected range of mark-making. Additional texture was provided internally by occasional computer glitches and externally through the transmission of the vibrations of the lab itself. The process ultimately subverted both the hyperprecision of the virtual drawing and the 'machineness' of the laser cutter through the depth and delicate nature of the mechanism's own artistic output (Figs. 5 and 6).

Fig. 7: Balaban and Thorogood, *Digital Etching*, 2010, digital. A compressed two-dimensional drawing plane extracted by weaving point cloud elements into a series of cross-hatch layers.

1 Lee J. Ames, *Draw 50 Monsters: The Step-by-Step Way to Draw Creeps, Superheroes, Demons, Dragons, Nerds, Ghouls, Giants, Vampires, Zombies, and Other Scary Creatures* (New York: Watson-Guptill, 2012), Frankenstein's monster.
2 Dalibor Vesely, *Architecture in the Age of Divided Representation* (Cambridge, MA: MIT Press, 2006), 3.
3 Francesca Hughes, "The Architecture of Error" (Lecture, Canadian Centre for Architecture, Montreal, Quebec, May 5 2015).
4 Ibid.
5 Jason S Johnson and Matthew Parker, "This is Not a Glitch: Algorithms and Anomalies in Google Architecture", in *Acadia 2014 Design Agency*, eds. David Gerber, Alvin Huang and Jose Sanchez (Toronto: ACADIA and Riverside Architectural Press, 2014), 391.
6 Arthur M. Hind, *A History of Engraving and Etching* (New York: Dover Publications, 1963), 10.

KOBUTO: About a Long House and Drive-by Pencil Strokes

Peter Behrbohm

The 'long house' is probably the best-known building in Berlin's Kreuzberg neighbourhood, creating the most lively, diverse and disputed area of the entire city. It's been almost torn down twice, and for the last thirty years every May Day demonstration has culminated here. In the 1980s, it was even the target of a bomb. Yet this building has a secret: hundreds of strangely delicate drawings that show it as the heart of another city that was envisioned to replace Kreuzberg entirely. These sketches are in search of an architecture that exists as some kind of creature crawling all over the city, groping and altering its surroundings, sitting up, jumping over streets, diving into expressways. This bestial concrete vision lay in wait for an ambitious autobahn plan that, in the end, never saw the light of day.

Johannes Uhl, born in 1935 on the Franco-German border, refers to himself as a draughtsman. I first met the architect four years ago, almost by chance. Weeks after having to write a piece on social housing and trying to find out whether he was still alive, he suddenly called back. "It's Uhl talking. You tried to get in contact. What we were up to was a utopia! We've got to meet!"[1]

An elderly gentleman opens the door the moment I ring, his eyes shining mischievously through Le Corbusier glasses. His private residence, in the south west of Berlin, looks like a miniature tower in the middle of an overgrown garden. I follow him along a long corridor. The inside is almost empty. A small shelf with well-thumbed books and a herd of big desks are sparsely surrounded by Italian furniture from the 1970s. The desks are covered with piles of well-ordered documents. Uhl starts talking about a life full of insider stories; about building, driving and loving. But it turns out that nothing has been more important for him than the stroke of a pencil.

> "In the beginning, the strokes do not know what they want. They may be ugly or self-consciously searching. They are born from the gestures of the hand, influenced by the breath and the pulse. Only when the sheets start to vary on the same theme do the strokes get more precise, as they exclude possibilities and filter out noise. By then, there are only a few strokes left. Those few strokes create a void and this void is vibrating!"[2]

Uhl has been teaching architecture and drawing in Stuttgart all his life, up until his eightieth birthday last year. With his yachting shoes constantly pattering, he talks about the sketch as if it were something almost divine. An abstract painting by one of his former students fills the entire wall behind him, like colours in explosion.

> "It is not about 'pleasingness'. It is about collecting truth. The drawings that are still searching capture the essence and gradually become iconic. Drawings that dissect the structural layers iconically are already close to the truth. By iconic, I'm referring to a stroke that claims to imbibe the very same qualities and thereby can even renounce the familiar contour. It shouldn't be symbolic and it shouldn't need any agreement about how to be understood. The pencil stroke should take over peculiarities with the idea of structural similarity so that a stroke can be more direct and more precise than a word."[3]

For Uhl, everything is in motion, sometimes alive and sometimes functioning, but always sprouting or transforming. This idea, he says, came to him when he was still a student, flicking through a book by the artist Paul Klee. Klee developed his drawings in a way which can be likened to growing plants – first they germinate, then they sprout, then they are in fruit and finally they shrivel. But since Uhl had also just discovered Schinkel's Glienicke project, which references building fragments scattered all over a park, he read Klee differently. He started to look out for certain processes and then arrange them against expectations.

> "I was searching for an architecture that could be read in many ways, and not one that would be overlooked because it was so obvious. An architecture that could be discovered in a new way each time one passed it. I wanted to design buildings that set themselves against expectations in order to create unpredictable situations."[4]

Uhl has never thrown a drawing away. He asks me to follow him to his basement archive. Down there, we are surrounded by shelves full of neatly ordered drawings and plans. Together, we heave down a big folder and as we open it I realise that every single one of these hundreds of drawings is part of Uhl's search for his imagined urban utopia.

Although the 'long house' at Kottbusser Tor is Uhl's biggest project, it appears in none of his publications. He describes the complex, which was completed in 1974, as an unfinished part of a masterplan which originally included all the surrounding blocks. The yellowed plans with bold lines or tenderly set pencil strokes are labeled 'Kobuto', as if it was a faraway island. And yet this project began as a reaction to ambitious transport planning by the federal government, who were about to carve a network of highways into the dense urban fabric of Berlin. Two of these expressways would have met at Oranienplatz, right in the middle of the lively district of Kreuzberg. Uhl grabbed hold of the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05:16 mins


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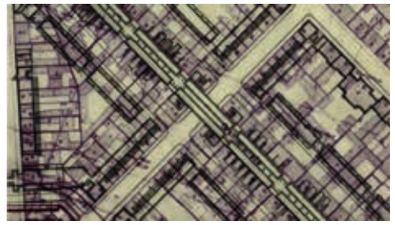
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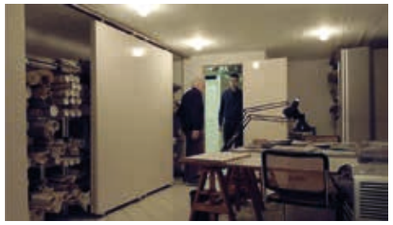
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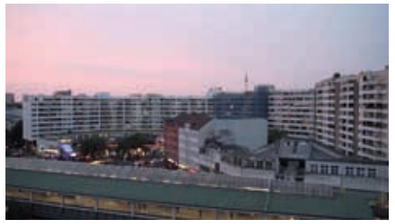
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20:04 mins

Fig. 1: Film stills from *Kobuto*, by Peter Behrbohm and Masen Khattab, 2016.

opportunity to plan a new city that could appear once the old buildings had been demolished.

Even though it soon became clear that neither the autobahn nor his vision would be built, Uhl kept drawing. In Kreuzberg – unlike in all the other districts of West Berlin – citizens took to the street and squatted the buildings that were slated for demolition. In his 'Rauch-Haus-Song', the singer Rio Reiser addressed the investors of Uhl's building by name and kicked them out of Kreuzberg. The song is an anthem for the Kreuzberg postcode SO36 and the counterculture of West Berlin. Uhl kept drawing. He designed another Kreuzberg, a utopia based on the concept of 'zukünftiges Stadtgefühl' – a sense of the future city – at the same time both paying homage to and preserving the compartmentalised 'Kreuzberger Mischung', the social mix that contributed to the area's unique vibe. Uhl's vision for Kreuzberg is of an archipelago of strangely utopian interventions within the fabric of the old city – condensed into a single hand-drawing:

> "The drawing is one by two metres. And in essence, it describes everything I imagined could happen at the time. I analysed every building to decide whether to keep it or replace it; and I drew floor plans, elevations and sections."[5]

But again, opposition grew – at first under the name 'restorational squatting'[6] and later 'gentle urban renewal'.[7] While Uhl tried to continue to realise his vision, others did everything to save every single stone of the old buildings. At the centre of the debate lay the question of whether it was less expensive to renovate a district almost unchanged since the turn of the century house by house, or to demolish some old houses and build better ones instead. In the end, Uhl never got the chance to build in Kreuzberg again, but in the years that followed he silently realised his Kreuzberg drawings all over West Berlin.

Returning from the drawing-stuffed basement feels like emerging from another world. Uhl smiles, as he now has somebody to share his secret with. Although most of Uhl's Berlin is only on paper, it is suddenly all around.

> "It's almost unnecessary to see it built! I am experiencing the building when I am searching for it, and you can't encounter a building more intensely than as a seeker. That's why I don't throw them away. All those sheets – they *are* the project! It's all about seeking! It's like a beloved. As long as you are talking to her, you will constantly discover new thoughts and new images of her. The final house is [...] like a postmortem. What I say sounds tough, but that's the way it is. I'm just describing the process of being alive with a building. That's when it emerges. Like exchanging ideas with a lover."[8]

Our film combines three portraits: of the building, its architect and his Cadillac. The Sedan Deville that Uhl drives is as old as his 'long building' at Kottbusser Tor, and also one of the longest Cadillacs ever made. Driving this car is like sitting in a cinema, with Uhl's city flying past those large bands of windows as he cruises down the expressway to Kreuzberg. With its generous scope, its 360-degree view and its carefree gliding above the street, the Cadillac transforms into an instrument of perception. Talking about his big drawings, we discuss the radical utopian vibe that exists, in fragments, in this particular place. Uhl says it requires a sense of collective spirit and a keen perception of the ways people can live together. His buildings are thought of as a spectacle both to be watched and participated in at the same time. They turn individuals into both actors in and spectators of 'Kobuto'.

Why make a film about an eccentric draughtsman, a far too long car from American movies and a city designed as a stage? Because no other medium could cope with them and nothing seems to be more appropriate than to point the camera at these characters so they can tell their own story. It is hard to reduce a city to a single drawing or a whole pile of plans. Most likely, city is life – city is film.

The drawings, as well as the trailer and a booklet, can be found on the project's website: www.kobuto.de.

1 Johannes Uhl, telephone call with the author, October 2012.
2 Ibid.
3 Ibid.
4 Ibid.
5 Uhl, excerpt from "KOBUTO", 11:17 mins, recorded May 2014.
6 'Instandbesetzung', a movement of squatters that repaired the buildings that were left unoccupied awaiting their destruction.
7 'Behutsame Stadterneuerung', a movement initiated by Hardt-Waltherr Hämer and his office S.T.E.R.N.
8 Uhl, interview with the author, July 2016.

Deep (2016)

Grégory Chatonsky

During the summer of 2015, different image-generating software programmes capable of imagining became widely available. A series of events took place rapidly: in May, a Japanese group managed to generate photorealist textures. On 17 June, Google published the article entitled 'Inceptionism'.[1] On 18 June, researchers from Facebook demonstrated software called Eyescream that generated photographic images taken from images collected online.[2] A month later, they published the source code of this software on Github.[3] On 12 August, Google did the same with Deep Dream.[4] The immediate public response was enthusiastic, with many users fascinated by how the software could magically transform random ordinary pictures like faces, landscapes and pizzas into new ones that looked like dogs and fish. These images were similar to the kind of psychedelic hallucinations one would see under the influence of LSD or psilocybin, as each shape seemed to morph into another. The network of neurons seeks to discover motifs (patterns) within the image, resembling a database of images, and through iteration to emphasise proximities.

The public's interest in the application is echoed in its name, Deep Dream. The dream of this machine consists of hallucinatory images. It finds an image in other images previously memorised, and therefore seemingly haunts the primary image with a fluctuating world of apparitions, where each thing melts into another according to a logic of substitution already present in the most ancient pictorial traces known to humanity. Deep Dream: we plunge into a dream; when we feel that we are falling, we become conscious of being in a dream. The machine, however, does not dream when it dreams. By looking at the dreams of a machine, we only imagine that the machine dreams.

In 1986, Isaac Asimov published a short story, 'Robot Dreams'. The narrative follows the invention of a complex fractal machine that begins to dream and interpret its subconscious, escaping the control of its creator. In its dreams, it sees other robots reduced to slavery by humans. The machine forgets the Three Rules of Robotics and becomes fixated on the phrase 'all robots must protect their existence'.

Why are humans fascinated by the possibility of a machine that dreams? Why do we want to see what a machine would see if it were asleep? What do we imagine when we ponder the dreams of a machine? Isn't there a close relation between a dream within a dream and the field of neuroscience, the brains of scientists interested in the brain? What is this repetition of the imagination, this image of an image? For what strategic reasons does Google, a company on the stock exchange, promote with such enthusiasm the psychedelic imaginary of machine dreams?

Fig. 1: Grégory Chatonsky, *Deep*, 2016, software, variable size.

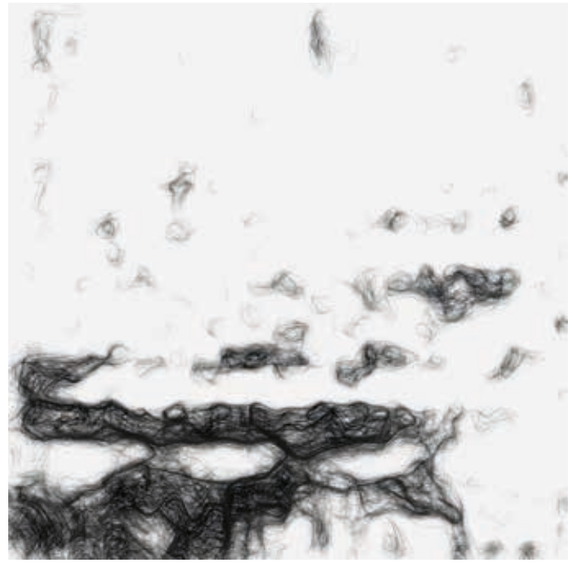

Fig. 2: Grégory Chatonsky, *Deep*, 2016, software, variable size.

I created *Deep* (2016),[5] which connects the organic, the logical and the imitative into a software capable of learning to draw based both on a series of drawings I realised myself between 1992 and 2016 and on sketching textbooks. The software creates a noise from which patterns linked to my former drawing emerge, based on the vectoring of massive visual data stocks. In order to provide a more precise result and to make it more plausible, I then apply a stylistic device automatically produced from the same files[6] as the noise pattern. Lastly, the generated file is reintroduced in the software's learning system, using autophagic feedback, because the software eats itself by learning its own results, which in turn creates a distance from the human-made model for the machine to perfect progressively its own style.

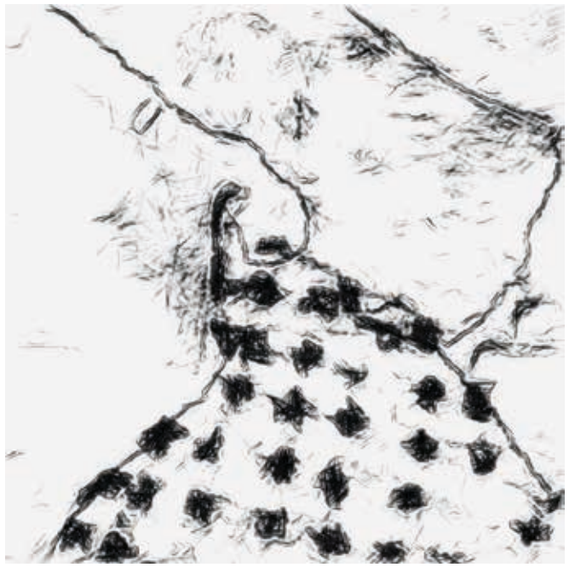

Fig. 3: Grégory Chatonsky, *Deep*, 2016, software, variable size.

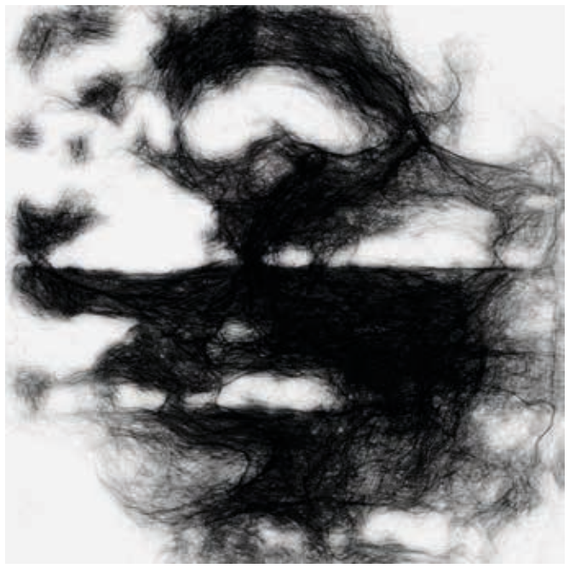

Fig. 4: Grégory Chatonsky, *Deep*, 2016, software, variable size.

Unlike in the industrial paradigm, imitation and individuation are no longer opposed. The individual condition itself becomes imitation, because far from repeating itself, it is subject to a constant self-devouring. Repetition distances itself from imitation, insofar as it is no longer bound to the representative, but to the generative: reproduction of a difference rather than reproduction of the same. The original reference, my drawing, wasn't stable and was already tainted at all times with the possibility of a fracture, which in turn just had to be expanded.

Deep creates an infinite number of drawings. Most ofthe drawings are abstract, as if the machine were dreaming our way of drawing. Perhaps, one day, the machine will manage to create a drawing of great artistic quality, but no one will see this drawing, because nobody will be in front of the screen.

[1] Alexander Mordvintsev, Christopher Olah and Mike Tyka, "Inceptionism: Going Deeper into Neural Networks", https://research.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html, 17 June 2015, accessed 28 March 2016.
[2] Emily Denton, Soumith Chintala, Arthur Szlam, Rob Fergus, "Deep Generative Image Models using a Laplacian Pyramid of Adversarial Networks", https://arxiv.org/abs/1506.05751, 18 June 2015, accessed 28 March 2016.
[3] "Eyescream", last modified 16 December 2015, https://github.com/facebook/eyescream.
[4] "Deepdream", last modified 13 August 2015, https://github.com/google/deepdream.
[5] "Deep", http://chatonsky.net/deep.
[6] Leon A. Gatys, Alexander S. Ecker and Matthias Bethge, "A Neural Algorithm of Artistic Style", http://arxiv.org/abs/1508.06576, 26 August 2015, accessed 30 March 2016.

Polycephalum: A Drawing Apparatus

ecoLogicStudio
Emmanouil Zaroukas

Without questioning the speculative character of analogue drawing within design exploration, and without solely residing with the falsely implied superiority of computational models, this article parts from any distinction between drawing and digital simulation in order to question deeper and more fundamental assumptions. We are suggesting that the anthropocentrism immanent in the explorative mobilisation of drawings limits its operative mode in a dynamic and ongoing world where design problems require a broader and more distributed perspective. In order to argue against the prevalence of the anthropic predicament in design, and more importantly in order to suggest an alternative mode of operation within drawing, we explore the capacities of the polycephalum apparatus.

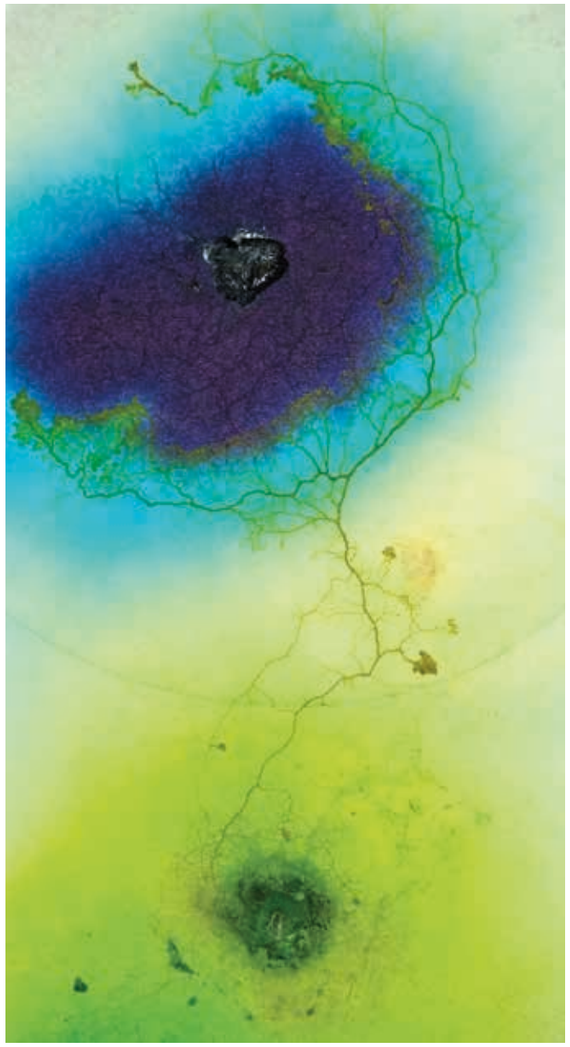

Fig. 1: Polycephalum Apparatus Drawing Experiment 1, 2016, slime.

This article is based on a set of drawing experiments conducted by the authors with the polycephalum apparatus; this consists of a biological organism, a living slime mould, grown by ecoLogicStudio, embedded in a new kind of bio-digital drawing substratum. The experiments are an attempt to harvest a non-human perspective on the world, one that doesn't share our biases and assumptions; and the article therefore explores the speculative capacities of a new type of drawing. We argue that it is necessary to resist substituting living analogue models with their digital algorithmic counterpart; as a consequence, the article explores drawings as a reconstructive force of our all-too-human assumptions. Polycephalism as a mode of drawing. In conclusion, we speculate that this mode of drawing can serve as an analogue for a distributed form of creativity that is needed beyond the all-too-human biases of even the most avant-garde architectural and urban design methodologies.

The first drawing experiment (Fig. 1) uses a homogenous environment, a flat landscape of humid absorbent paper. Two sources of colour food are introduced, one green and one purple; the surface tension of water, combined with the capillarity along the paper fibres, contributes to the spreading of the colour into two gradient zones. The green colour is beneficial to the slime mould, while the purple is poisonous to the creature. The slime mould is then inoculated and starts its search for nutrients, at first by spreading out in scanning mode; the drawing then evolves where the slime mould begins its optimisation routine and generates a minimised detour network; the network begins to transport nutrients to the whole organism and together with it the colour igments – in this case, predominantly the green ones; the colour impregnates the paper and leaves traces.

These traces depict a colour landscape which operates as distributed memory for the organism in the process of optimising its metabolism (minimal surface area of its body for maximum reach of nutrients); the emerging drawing is at the same time a depiction of the slime mould's behaviour and its actual distributed brain, an embedded form of inhuman thinking. The second drawing (Fig. 2) is experimented on a different substratum – a heterogeneous territory that is 3D-printed in ABS plastic and then coated in non-nutritious agar. The coloured food resources are distributed throughout the substratum at specific points such as local maxima (the peaks in the 3D-printed datascape).

The slime mould negotiates the substratum and its articulation; global path systems emerge connecting the food sources, while locally unique detours and bifurcations respond to the emerging gradients of wetness and

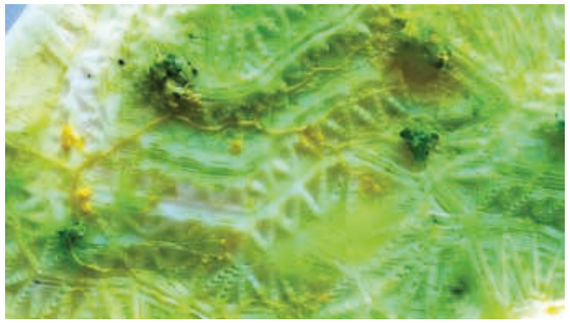

Fig. 2: Polycephalum Apparatus Drawing Experiment 2, 2016, slime mould.

nutrients. Optimisation does not lead to simplification, rather to multiple layers of articulation visible in the micro-branching and gradients of colours.

Following these findings, a new 3D-printed substratum was developed for a third experiment (Fig. 3), this time as part of a bio-digital apparatus manufactured by the Urban Morphogenesis Lab at The Bartlett School of Architecture, UCL. The apparatus grows the slime mould onto a substratum that both morphologically and through light signals embodies information extrapolated from the analysis of a large-scale territory, specifically, a portion of the Copper Corridor in Arizona, US. The slime mould (Fig. 4) avoids light while negotiating the terrain of the substratum to reach for nutrients; the feedback loop leads to continuous reorganisation and adjustment, since both the light field and the available nutrients can change at any moment in time. The slime mould repeatedly scans the terrain and leaves its traces, building a more complex distributed memory; this evolved iteration of the inhuman brain is captured in both the complexity of the drawing and in its colour patterns.

In the final experiment (Fig. 5), the drawing takes a more volumetric and speculative direction as the apparatus depicts a proposal for a bio-power station. Here, the colour gradients represent the distributed renewable energy fields on the site. As the slime mould reaches out for these resources, it depicts a distributed renewable energy network, constantly optimising while increasing its morphological articulation.

These experiments test a hypothesis of thousands of 'pens' that are dragged and controlled by 'minds' that together form a polycephalum drawing apparatus. The slime mould, scientifically named *Physarum polycephalum*, becomes a subject with a thousand heads capable of dragging the colour pigments around in its search for nutrients by grasping and abstracting a variety of landscapes in its own peculiar way. Through its sensorial apparatus, polycephalum perceives the substratum as its object of enquiry and drags the paint in unexpected directions. By seeing the slime mould as a subject in its own terms, it is possible to perceive the images of these processes as speculative drawings. The point here is neither to appropriate and scale up an artefact that has been drawn at the commensurable scale of the *Physarum polycephalum* nor to quickly abstract its behaviour as a minimal path algorithm, i.e. by extracting a solution for a human-oriented problem. The authors propose instead to see the diagrammatic capacity of the polycephalum in the process of drawing. The moment the problem is reconfigured at scales and durations beyond those which the human hand is capable of, a new speculative horizon is constructed. The capacity of the drawing to distribute existing agencies and refract new ones can become a revisionary force; it can reorient human perception towards scales beyond those which are digestible. The polycephalum drawing apparatus therefore communicates what it is impossible to be communicated; it therefore becomes an object for speculation.

In the 2013 edition of *AD* entitled 'Architectural Drawings', edited by Neil Spiller, Mark Garcia interestingly argues that "the key to the architectural drawing lies in the notion of 'acheiropoieta' (made without hands)".[1] He elaborates: "acheiropoieta are images miraculously made by divine (non-human) forces".[2] Garcia dismisses theistic images that bear qualities of lifelike self-production as 'fake'. Instead, he makes the case for the acheiropoieta of contemporary forms of non-human life and intelligences

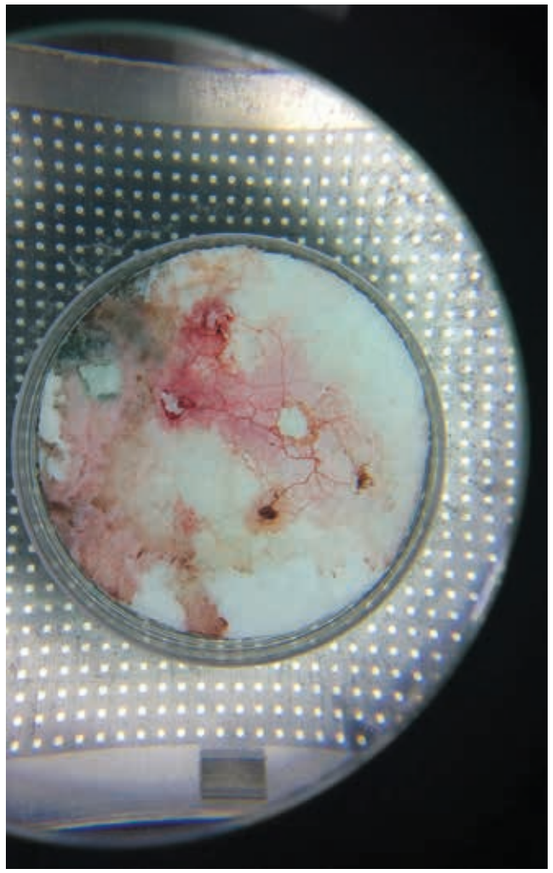

Fig. 3: Urban Morphogenesis Lab, Polycephalum Apparatus Drawing Experiment 3, 2015, slime mould on OBS 3D-printed substratum with pigmented nutrients and LED matrix arduino microprocessor.

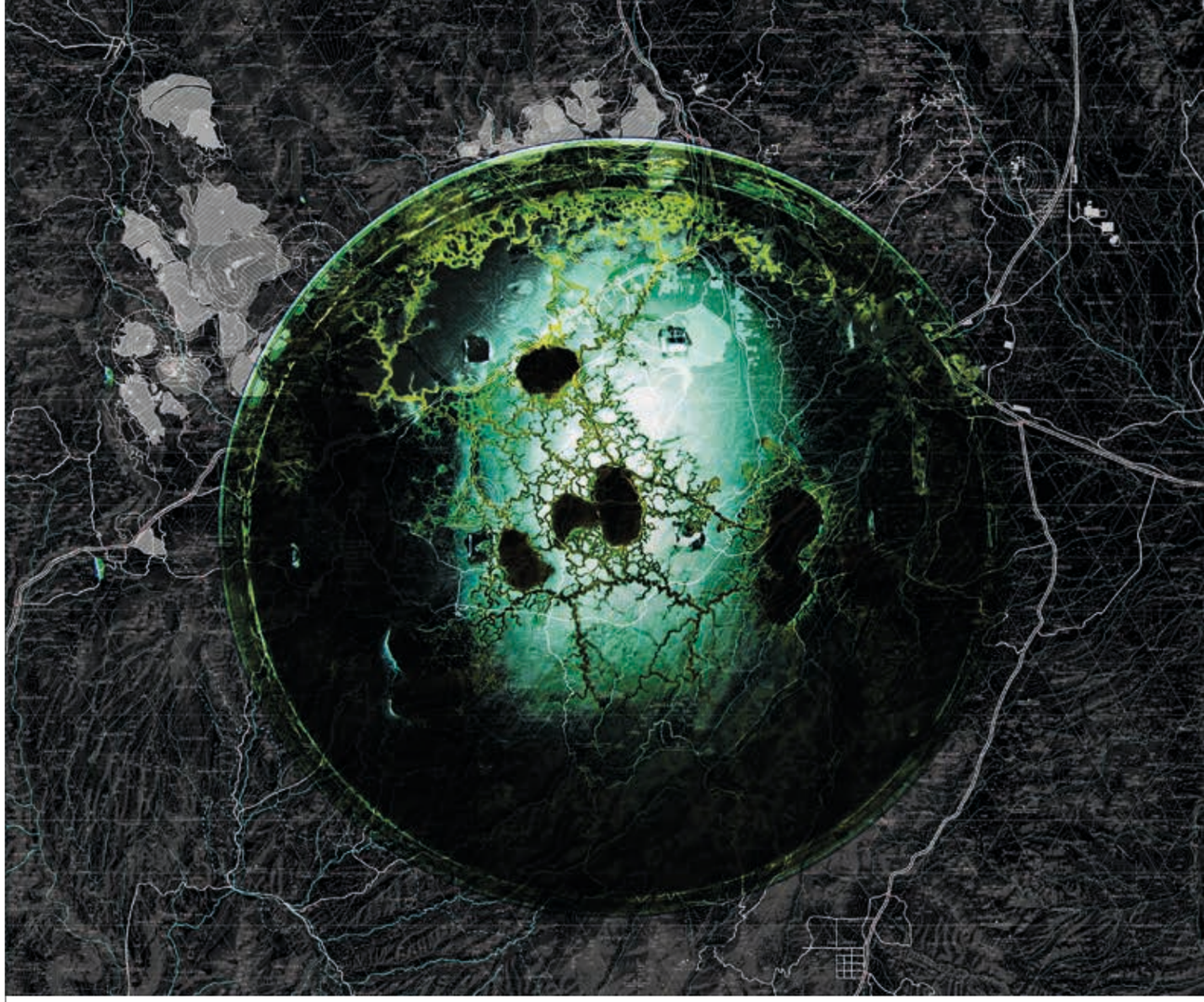

Fig. 4: Urban Morphogenesis Lab, Polycephalum Apparatus Drawing Experiment 4, 2015. Lab_Phyca City Drawing.

Fig. 5: Polycephalum Apparatus Drawing Experiment 5, 2016. Bio-power station proposal.

that can operate as architectural images. What we are intending therefore is to push this updated notion of acheiropoieta – and consequently that of architectural drawing – to its limit.

If acheiropoieta are made in 'divine', non-human ways, then with the polycephalum drawing apparatus we seek to explore a radical version of this. The polycephalum apparatus is radically different precisely because not only does it substitute the human hand with a non-human one but it also simultaneously substitutes the human eye and mind with non-human ones. Thus, the case is not simply to relink the human eye and mind with a non-human drawing apparatus but to radically suspend the traditional and non-traditional modes of drawing that in a variety of degrees are all-too-human. In the polycephalum experiments, the drawing takes place through the slime mould's capacity to drag paint alone; and thus the link between the human mind and the drawing apparatus is suspended. This suspension, however, is quickly reappropriated by the human intellect if a consequent substitution of the living organism by an algorithm is effectuated. This leads us to our second part of the argument. Computing facilitated by algorithms in man-made machines is not the same as computing in the slime mould. The fact that there is a similarity between the slime mould's behaviour and digital simulations should not lead us to the conclusion that the way human and slime mould compute is similar. Our computing capacity and therefore our algorithmic construction is all-too-human, without this being a bad thing per se. It is for this reason that Andrew Adamtzky et al. refer to the computing capacities of the slime mould as 'unconventional'.[3] To assume the opposite, that is, to assume that one type of computation (human/algorithmic computation) is shared between different entities, is to assume that thinking is a privileged human capacity. Thinking takes place in the slime mould through a peculiar perspective on the world that allows it to construct its own algorithms. It is this new form of computation that expands Garcia's already updated concept of acheiropoieta and gives it a deep non-human dimension.

We therefore conclude that if drawings have any future in architecture, it will be their capacity to convey traces of an alien view that will inform, revise, reorient and reconstruct human intellect. In a discipline where design increasingly takes place among bot-to-bot, bot-to-human and bot-to-non-human exchanges of data via protocol, there is still a tendency to restore some kind of humanism, in the form of human-induced algorithms, which serve and accommodate a figure of humanity that still accepts its central place in the world. The deep non-human dimension of the drawings presented in this paper aim to make human reflection impossible but human refraction plausible.

[1] Mark Garcia, "Emerging Technologies and Drawings: The Futures of Images in Architectural Design", in *AD: Drawing Architecture*, ed. Neil Spiller (London: John Wiley and Sons Ltd, 2013), 30.
[2] Garcia, "Emerging Technologies and Drawings", 30.
[3] Andrew Adamtzky et al., "Physarum Chip Project: Growing Computers From Slime Mould", in *Int. Journal of Unconventional Computing* Vol. 8 (Philadelphia: Old City Publishing, Inc., 2012), 319–323.

CAD Blocks for the Present of Drawing

HipoTesis

DRAWINGS AS TEXTS

In 1970, Roland Barthes wrote *S/Z*, a text based on an open and unprejudiced approach to Honoré de Balzac's novella *Sarrasine*, proving that there are ways of reading that can transcend or subvert conventional interpretations of narratives and instead provide multiple meanings, overcoming conventional linear reading. In *S/Z*, Barthes establishes up to five unprecedented and additional 'itineraries' in the book, coming to the conclusion that two types of text are possible: the 'writerly' text and the 'readerly' one. The first is reversible and allows the reader to reinterpret it, requiring an active role. The second requires only a neutral reader who proceeds in a more robotic manner.

Architectural drawings, as vehicles of communication and transfer, inevitably possess a 'readable' nature. They communicate our ideas, stance or theories to others, who almost always read them in a neutral fashion in order to bring them to reality. But, following Barthes in *S/Z*, how could a 'readable' architectural drawing become a 'writerly' one? Or better yet, a 'drawerly' one?

One way to achieve a 'writerly' drawing is by understanding it as a narrative – one which contains the potential to be transformative. While we draw, different worlds that challenge the conventions of everyday life appear. Narrative as a drawing tool allows us to imagine spaces that allow for diversity and inclusion and therefore help our 'readers' to engage and comprehend more widely and deeply.

Narrative is of key importance in the development of empathy in humans. According to Nussbaum (2010, 95–96), "Citizens cannot relate well to the complex world around them by factual knowledge and logic alone. The third ability of the citizen, closely related to the first two, is what we can call the narrative imagination. This means the ability to think what it might be like to be in the shoes of a person different from oneself, to be an intelligent reader of that person's story and to understand the emotions and wishes and desires that someone so placed might have".

CAD BLOCKS AS DESTABILISING AND NARRATING ELEMENTS

Just as Barthes sets in motion a reimagining of Balzac's text, in the architectural field it is commonly held that CAD blocks can destabilise fixed readings, thereby turning the narrative imagination of 'readers' into that of 'writers'.

In November 1982, Version 1.0 of AutoCAD was launched. Only two months later, in update 1.4, the famous 'blocks' were introduced. These were aimed at repeating figures within projects, in order to show the different relations (scale, spatial use, etc) between the architectural objects designed. Thirty years later, architects still recognise blocks as an essential practice tool. They were born under a combination of a certain culture, technology and architecture, but are these circumstances still relevant?

Today, blocks have become inherited drawings, anaesthetised and frozen in time; they represent the vestiges of an outworn information. They have become neutralised in the course of time because we haven't made the effort to update them. They are necessary, but as we have accumulated them in our CAD libraries they have become increasingly unable to contain the multiple readings we require of them. They have become outdated, simple readers stripped of any real transformative power. However, current societies are rather heterogeneous and have acquired new habits, which have outpaced what is available in our antiquated block libraries.

The properties enclosed within blocks exceed those of a group of lines with a recognisable shape under a certain name. They are able to combine the complexity of scale in an architectural drawing. They intensify the usability we supply an object with. They determine the meaning of unnamed lines. The moment a block populates our drawing, a double plane of review is established: both geometric and projective. We grew accustomed to using it only for the former, as a tool for checking geometrical quantities (beds that fit bedrooms, tables, chairs, groups of people, etc); but if we go beyond these 'legible' readings, it can supply us with insightful and 'writerly' – or indeed 'drawerly' – readings.

Buildings are containers of stories, so understanding and making architecture begins with tracing the narratives that are contained inside them. CAD blocks have the ability to work as 'narrative tracers' so as to question behaviours and habits and draw attention to certain situations, objects and subjects commonly excluded from public life.

According to Rancière (2009, 25), "Politics consists of reconfiguring the distribution of the sensible which defines the common of a community, to introduce into it new subjects and objects, to render visible what had not been and to make heard as speakers those who had been perceived as mere noisy animals [...]". In fact:

> "politics occurs when those who 'have no' time take the time necessary to front up as inhabitants of a common space and demonstrate that their mouths really do emit speech capable of making pronouncements on the common"
> Rancière, 2009, 24

Under these considerations, architectural drawings can be seen as 'policymakers' of our commons. Using CAD

Berta, Le Corbusier's blogger

1

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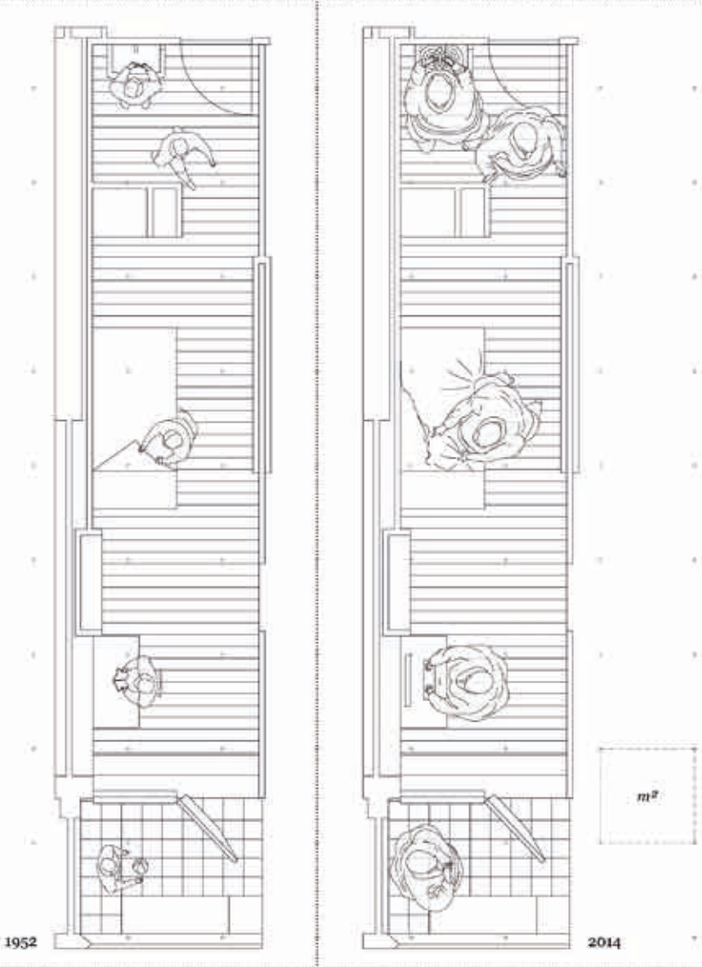

> In 2013 Spain is the European country with the highest rate of obesity, affecting one in four adults. http://goo.gl/pELSHB
> In 2013, 80% of young Spaniards under 30 live with their parents. http://goo.gl/Oex5pk
> Meanwhile, The 'Unité d'habitation' from 1952 designed by Le Corbusier remains a reference in architecture.
> Is this architecture suitable for these new residents?

Fig. 1: Francisco García Triviño. © *HipoTesis* magazine under Creative Commons license.

'Escrache' at a bank branch against the eviction of Carmen

2

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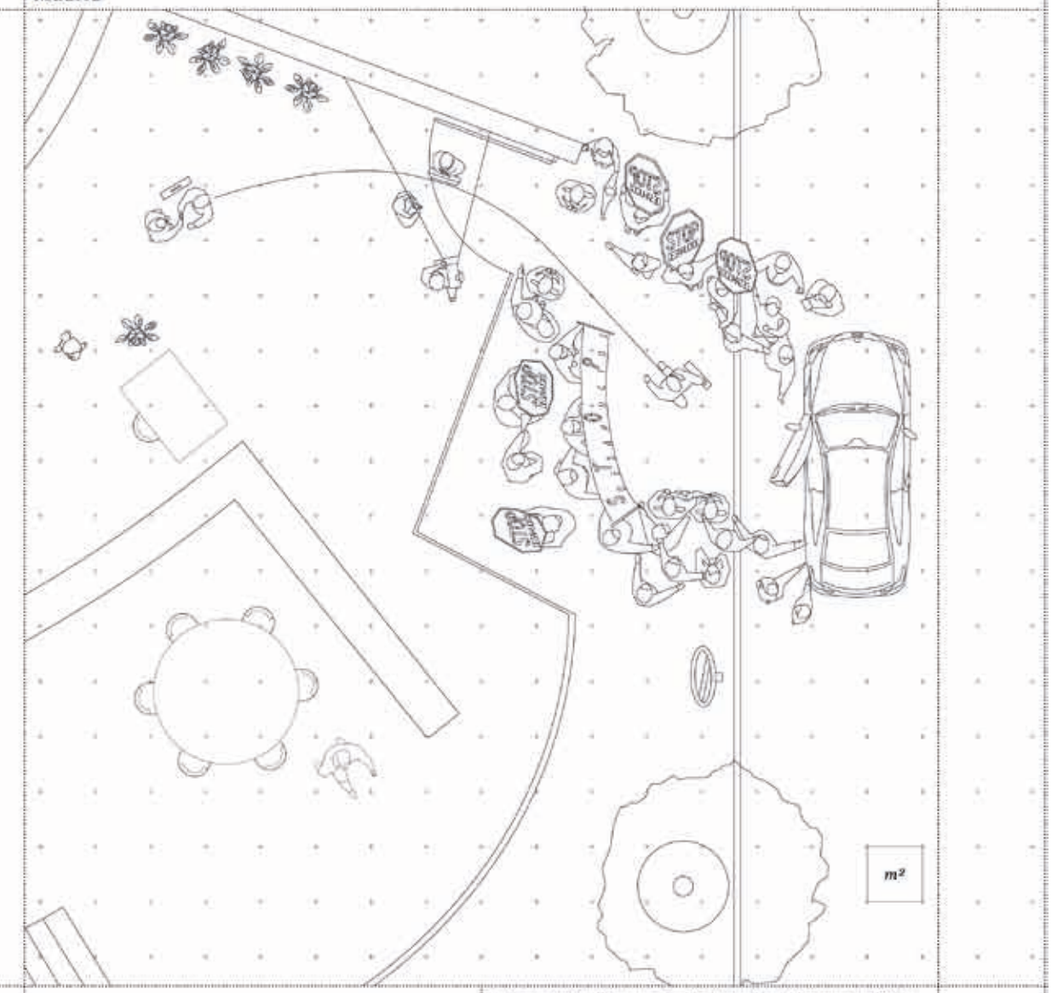

> 'Escrache' is the name given in Argentina, Uruguay and Spain to a type of demonstration where a group of activists move to the home or workplace of someone they want to denounce. It is a slang word that describes a method of protest based on direct action, which aims to give voice to claims and make them known to the public. http://goo.gl/co69tU
> Carmen Ayuso Martínez, 85 years-old, was evicted from her house in 10 Sierra de Palomeras street, Vallecas, Madrid, on the morning of Friday 21 November, 2014. She had lived there for 50 years. She endorsed a loan of €40,000 for her son Luis, an amount she could not cope with. http://goo.gl/F5sWUQ
> According to data published by the Bank of Spain, 19,565 homes were handed over to court as part of eviction procedures in the first six months of 2014. http://goo.gl/87n9Zp

Fig. 2: José Manuel López Ujaque. © *HipoTesis* magazine under Creative Commons license.

blocks to retell the stories of our lives, paying attention to diversity, strangeness, difference, consensus and dissent, will enrich our lives, acts, knowledge, productions and learning.

Blocks also create multiple readings; their critical function is their power to redefine and reimagine the horizons of any project. Isn't a CAD block able to encase and write about experiences, real or utopian societies, complacent or fierce criticism, magical realisms, grammars, normcore tribes or any other person, thing or attribute that haunts our ability to write or draw?

METHODOLOGY

Blocks research has been carried out by the editorial board of *HipoTesis* magazine through an open call.

The aim of the call was to create a visual narrative where objects and people who do not fall within what is generally known as 'standard' were converted into CAD blocks and inhabited critically recognised architectural buildings.

Participants drew objects and people with different stories, sequences of ordinary lives usually excluded from architectural drawings; habits and customs which, through failing to be socially sanctioned, are not represented in architectural culture; stories of lives that pay tribute to diversity, strangeness and the oppressed.

The examples presented in this article describe this situation. The first drawing, called *Berta, Le Corbusier's blogger,* exposes the spatial problems of an overweight female blogger who still lives in the spare bedroom of her parents' house at Le Corbusier's Unité d'Habitation. This architectural reference, still common in the academy, presents many spatial problems when re-imagined in contemporary settings. Berta represents many young people who still live with their parents and may work remotely or spend significant time online.

The second drawing, *Escrache at a bank branch against the eviction of Carmen,* shows certain activities that could now be considered in the design of a bank. Nowadays '*escraches*', public demonstrations outside residencies and protests around banks, are commonplace. We should start accommodating the design of these activities under new scenarios. Can 'Pinto & Sotto Mayor', the famous bank of Alvaro Siza, accommodate an *'escrache'*?

The third drawing, called *Free the NIPL (Nursing In Public Library)*, shows a mother breastfeeding her baby in Seattle Central Library, made by OMA. This practice is increasingly censored in public places, especially in the absence of a law protecting the breastfeeding mother. But even when the law protects the mother, there is still a lot to change in terms of public opinion. Through this CAD block, we invite you to think whether Seattle Library is a space where this scenario can happen or not.

The last drawing is an atlas of CAD blocks which has been created collectively as a result of this call. A digital archive of non-stereotypical blocks has been created and distributed among the architectural community. In this way, each reader and draughtsperson can design the future while considering the real agents of the present.

Fig. 3 (opposite): Alberto Jonás Murias Suárez, Álvaro Martín Fidalgo, Ana Belén López Plazas, Antonio Jesús Palacios Ortíz, Arantza Ozaeta Cortázar, Arantzazu Luzárraga Iturrioz, Aurora Andrea González Garrán, Carlos Álvarez Clemente, Carolina Cabello Sánchez, Clara Dios Díez, Félix De La Fuente González, Franca Alexandra Sonntag, Francisco García Triviño, Gonzalo Pardo Díaz, José Manuel López Ujaque, Lucía Martín De Aguilera Mielgo, Luís Navarro Jover, Mateo Fernández Muro, Pablo Villalonga Munar, Paula Pérez Rodríguez and Ricardo Montoro Coso.

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Repetition and Difference, After William Morris

Adam Marcus

This series of drawings uses the wallpaper pattern designs of William Morris as the basis for an exploration of the production of difference in architectural drawing. Morris, the late nineteenth-century industrialist and polymath, is notable for, among many other things, the collection of iconic wallpaper patterns produced by his decorative arts firm, Morris & Co. These patterns, often associated with the British Arts and Crafts movement, are celebrated for their floral exuberance and exceptional visual richness. But they also represent a remarkable example of an artist successfully reconciling aesthetic intent with limitations of technology and means of production. The printing presses in Morris' factory operated within the paradigm of standardised mass production that defined the Industrial Revolution. The machines maintained a high degree of quality and consistency from one print to the next, but the identical repetition of each print presented an obstacle to Morris' obsessive desire to conceal the edge that is inevitably produced in any tiled system. The response to this tension between constraints of production and design intent was to accept the recursive logic of the printing press, but also to subvert it by developing deliriously layered geometries that produced enough visual complexity to mask the tile's boundary.

Today, we face a very different and almost opposite dilemma with regard to the relationship between technology and variation. Equipped with technologies of mass customisation that enable the production of endless difference, we are no longer bound to the limits of standardisation that so constrained Morris and his contemporaries. But this unfettered variation has become a new kind of deterministic technological constraint – particularly in contemporary architectural production, where boundless, parametric differentiation now represents the de facto status quo. This project looks to the example of William Morris as a way to develop a rigorous, thoughtful and productive approach to designing the relationship between standardisation and variation. It begins with a detailed analysis of a selection of Morris' original patterns: tracing the geometries, diagramming the underlying network of curves and understanding both their logics of repetition and the visual subversion of that repetition. This information – DNA derived from Morris' sophisticated and complex geometries – is then input into a digital parametric framework, which allows for the careful and iterative introduction of subtle difference into the system. The resulting studies maintain the precedent's repetitive logics, but explore how calibrated variation in a single parameter – such as quantity of branches, layering of leaves or colouration of the pattern – can produce new optical effects across the field.

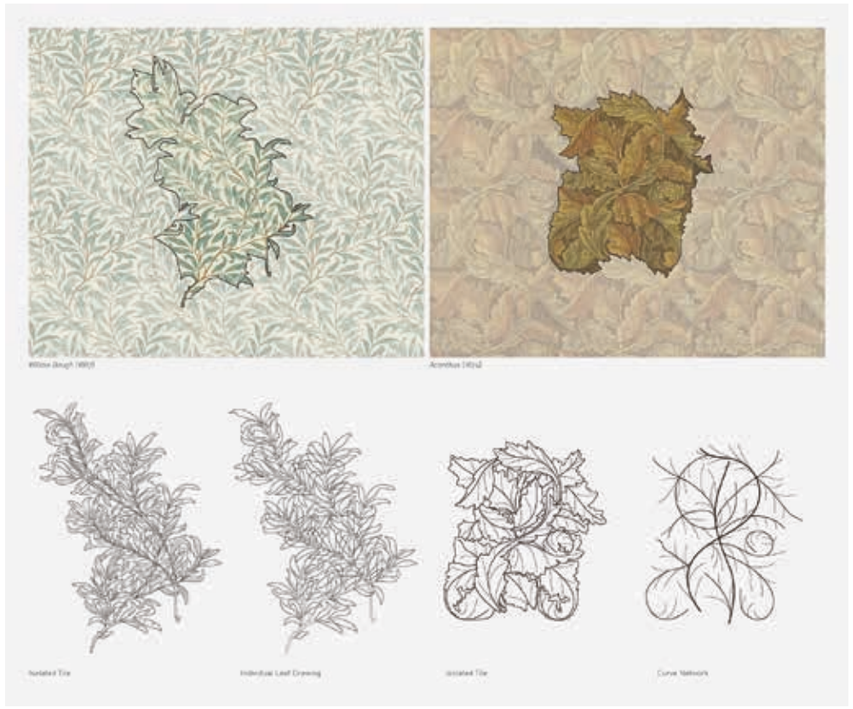


Fig. 1: Diagrams from *After William Morris*, 2016, digital drawing. These analytical diagrams examine two iconic patterns by William Morris: *Willow Bough* from 1877 and *Acanthus* from 1874. They identify the base tile that is repeated in each pattern and, by tracing the intricate floral geometry in each pattern, they extract the underlying network of curves that structures each pattern. These curves become the basis for the transition to the parametric drawing process.

Two examples inspired by wallpaper patterns from the Morris catalogue demonstrate this approach of melding Victorian-era sensibilities with contemporary practices of design computation. The first is based on the *Willow Bough* pattern, designed by Morris in 1877. A series of analytical diagrams identify the base tile that forms the repetitive module for the pattern (Fig. 1). These diagrams – produced manually, by carefully tracing the pattern's intricate floral geometry – unpack the underlying network of curves that structures the pattern. Redrawing the pattern also reveals the organisational logics of the pattern's primary feature: the layered branches of overlapping leaves that through their sheer quantity produce a sense of apparent depth, helping to further obscure the pattern's repetition.

The logic of the overlapping leaves becomes the basis for the transition to the parametric drawing process. The redrawn pattern – which, importantly, includes the full hidden-line outline of each leaf – is input into a parametric model that deploys the tile in the same grid used by Morris. The script allows for the introduction of geometric and representational variation across the field. This particular series identifies two parameters for testing such variation: colour of the leaves and the three-dimensional order in which they overlap. The first drawing recreates the field of overlapping leaves, maintaining Morris' grid and layering configuration but varying the leaf coloration from one tile to the next (Fig. 2). The script uses a randomisation algorithm to assign hues that are sourced from the original wallpaper colour scheme. The second drawing maintains the same leaf colours in each tile, but instead varies the draw order of the overlapping leaves, again using a randomisation algorithm to 'shuffle' the order in each tile (Fig. 3). Through these subtle introductions of variation, the drawings demonstrate one way to simultaneously reinforce and subvert the pattern's original logic of endless repetition.

The second series of drawings uses the 1874 *Acanthus* pattern as a point of departure for exploring the complex, fractal-like curve networks that underscore many of Morris's pattern designs. The process begins with a similar analytical phase of diagrams that identify the base tile and uncover the intricate lattice of lines and arcs that structure the twisting branches and leaves of the pattern. The lines and arcs extracted from these diagrams are categorised into primary, secondary and tertiary sets of curves. This skeletal hierarchy, once input into a parametric model, becomes the basis for generating new branching patterns with algorithms that allow for difference across the field of tiles. The drawings maintain the repetition of the primary curves, but the script uses a random function to vary the quantity, location and subtle coloration of the secondary and tertiary arcs from one tile to the next (Fig. 4). The resulting effect is one of multiple

Fig. 2: Adam Marcus, *Willow Bough Leaves, Randomised (Seed 580)*, 2016, digital drawing. Inspired by Morris's famous *Willow Bough* wallpaper, this drawing recreates the field of overlapping leaves that help to mask the boundary of the repetitive tile. The leaves are deployed in the same configuration as in Morris's pattern, but their coloration varies based on a randomised algorithm that assigns hues sourced from the original wallpaper.

Fig. 3: Adam Marcus, *Willow Bough Leaves, Reshuffled (Seed 812)*, 2016, digital drawing. This drawing complements the previous drawing in its use of the overlapping leaves and colour to articulate the relationship between standardisation and variation across the field. In contrast to the previous drawing, it maintains the same leaf colours from one tile to the next, reinforcing the pattern's logic of repetition. But the three-dimensional order of the overlapping leaves changes from tile to tile, creating a subtle variation that only becomes evident upon closer examination.

Fig. 4: Adam Marcus, *Acanthus Arcs (Seed 252)*, 2016, digital drawing. Inspired by Morris's *Acanthus* wallpaper, this drawing recreates the network of lines and arcs that structure the twisting branches and leaves of the pattern. The repetitive tile of the primary curve network is maintained, but the quantity, location and coloration of secondary arcs varies from one tile to the next.

readings at multiple scales. The repetitive nature of the tile grid is clear when viewing the overall pattern, but as one zooms in, the subtle variation distributed throughout the field becomes legible (Fig. 5).

Although these drawings remain two-dimensional and preserve William Morris' Victorian language, the ideas they explore open up new territory for contemporary architectural design at large. They suggest one possible way to synthesise ornament and performance by deploying visual variety and complexity according to highly quantitative, data-driven logics. They also stake a claim for parametric modes of representation, whereby computational techniques are leveraged not just for formal purposes, but also to carefully calculate conventions of architectural drawing such as line weight, line type, colour and hatch patterns. Finally, they recognise that the contemporary paradigm of mass customisation has become a crutch for architects, and a more rigorous and critical understanding of the relationship between standardisation and variation is long overdue.

Fig. 5: Adam Marcus, *Detail, Acanthus Arcs (Seed 252)*, 2016, digital drawing. A detail view of the drawing demonstrates the subtle variation that has been distributed from one tile to the next.

Erratic

Norell/Rodhe

Robin Evans' famous statement that "architects do not make buildings; they make drawings of buildings" has arguably today become somewhat exhausted.[1] Although intended to target representation as a problem of translation from drawing to building, it can be used to perpetuate the distinction between drawing as a mainly conceptual pursuit that targets idealised geometry and building as a material pursuit that deals with the real world. Drawings tend to define objects by position, dimension and, with the aid of rendering, visual characteristics. With the exception of linking objects to standard products in a CAD environment, these objects lack a specific material referent. *Erratic* challenges these conventions by exploring how material simulation transfers aspects of 'real' materials into drawings. These drawings exhibit a tension between the 'erratic' nature of a 'real' piece of material and the abstracting powers of orthographic projections, grids and section cuts.

Erratic is a recent installation and exhibition designed by Norell/Rodhe.[2] The project borrows its name and its massing from the erratic block – a large boulder that has been tumbled by glacier ice. The *Erratic* installation consisted of a thick, pliable polyurethane surface – essentially a large, spheroid sack – that was constrained in hundreds of points onto a rigid inner armature (Fig. 1). The sack was designed to be considerably larger than the armature, so that plenty of excess material was left between each constraining point. The force exerted by the constraining points made the surface bend, twist and furl in a seemingly random manner. While the location of each point could be designed and placed with precision, the resulting behaviour of the surface was difficult, if not impossible, to predict. The piece was designed by the careful placement of the points – and in between, the material had its way.

Fig. 1: Norell/Rodhe, *Erratic*, 2013, polyurethane cold foam surface pointwise constrained on inner armature, 3 × 3 × 3 m. Installation at the Aalto University Digital Design Laboratory, Helsinki, Finland. Photograph courtesy of Norell/Rodhe.

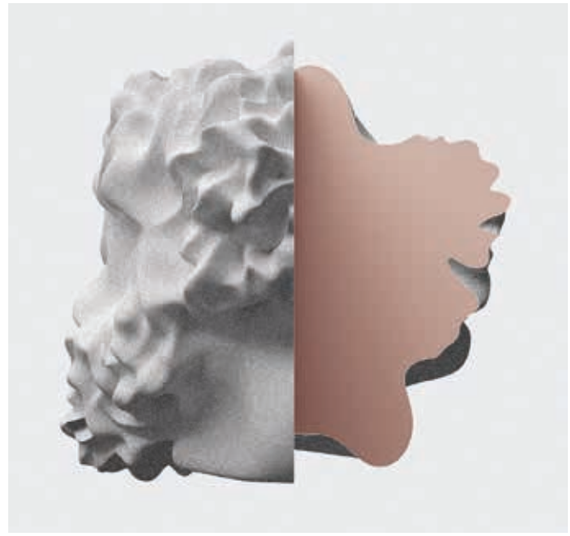


Fig. 2: Norell/Rodhe, *Erratic* #1, 2013, elevation and section drawing showing spheroid constrained in 200+ points with particle spring-based material simulation. The drawing combines the phenomenal qualities of surface texture materiality with the analytic aspects of orthographic projection and section cut.

So far the project seemed to be aligned with a conventional separation between representation and materialised design: some aspects of architecture can be designed, quantified and represented 'before the event' (for instance, through orthographic drawing), while others are dependent on material manipulation and must be tested 'live'. In other words, while pure geometry can easily be described in the Euclidian space of the drawing, a constructed artefact is inevitably affected by the noise of the real world.

The work on *Erratic* took an interesting turn when we started using particle spring-based simulation software to simulate how the material could be manipulated (Fig. 2). This was a necessary step in order to be able to quickly design massing variations of erratic boulders without producing time-consuming mock-ups. These variations were studied in models and drawings. The drawings do not describe curved geometry through the familiar language of radii or control points. Instead they target the discrete nature of the material by annotating the constraining points and the excess material that bunches up between them. They measure geometry as actual redistribution of material, not as deformation of a topological surface.

To a certain extent, we could now predict the erratic behaviour of the material. In the software, the agency of the real world material co-existed with the Euclidian space of the armature drawing (Fig. 3). Material agency could suddenly be designed and quantified as well as represented. This was the first issue that the work

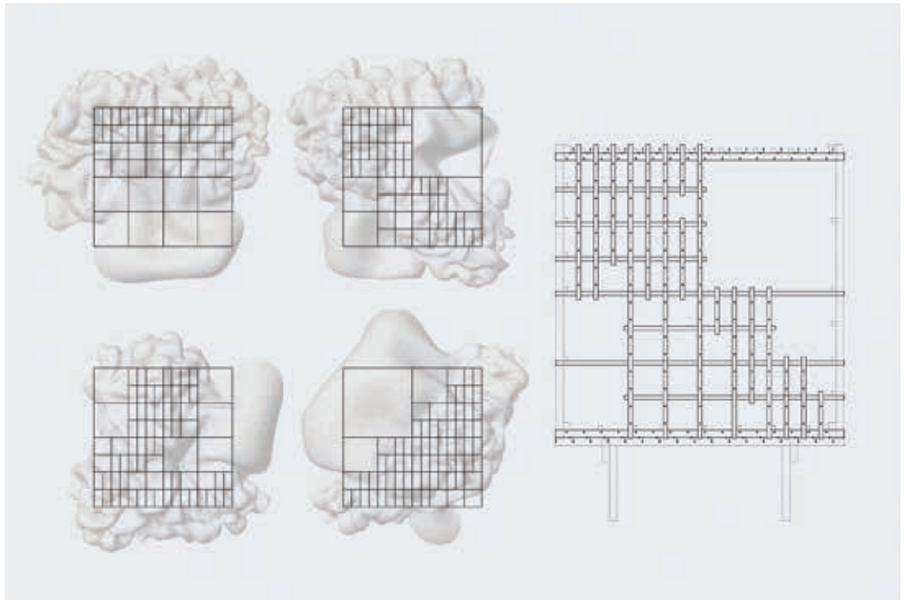


Fig. 3: Norell/Rodhe, *Erratic* #1, 2013, elevation and plan drawings showing relation between digitally simulated geometry and armature (top) and construction drawing for armature with location of constraining points (bottom).

seemed to prompt: simulation in architecture challenges the typical separation between representation and materialised design, between Euclidian space and the real world.

As the work progressed, it became increasingly important to fine-tune the relation between analogue scale models and full-scale mock-ups on one hand and simulated models on the other. Parameters in the simulation software, such as bend and compression resistance, were tweaked to achieve conformity with the analogue tests. But tuning also worked the other way. The material that the installation surface was built from, polyurethane cold foam (i.e. foam rubber), is isotropic and comes in a variety of thicknesses and densities. This meant that the properties of the material could be tweaked in parallel to achieve a better conformity with the simulation. The second issue that the work on the project prompted thus had to do with process and method and the creation of feedback loops between simulated geometry and real material.

On the drawing board or in 3D modelling software, virtual lines and surfaces can be conjured and extended indefinitely. The act of drawing, whether by analogue or digital means, is projective and virtual in its logic. It may involve orthographic projection, it can happen at scale and it is subject to little or no material resistance. In contrast, a chunk of material, whether real or simulated, is inherently discrete and unique in its nature. In this case, design is not a product of imposing will onto formless and featureless matter, since matter is real and discrete. Like the *objet trouvé* in art – the found object – a chunk of material derives its identity from the designation placed upon it by the designer, as well as from its genesis in the real world. It has a certain amount of resistance to the agency of the designer. The designer may react to this genesis by amplifying or subverting it, but cannot ignore it.

As a design medium, material simulation combines features from both abstract geometry and the material experiment. It grants the designer the projective and descriptive powers of orthographic projection and quantification that are native to drawing, while simultaneously introducing some of the resistance native to a real and discrete piece of material. In fact, design by means of material simulation is closer to the 'live' material experiment, where the designer sets something up in order to 'see what happens', than it is to typical modes of drawing and digital design.

[1] Robin Evans, "Architectural Projection", in *Architecture and its Image: Four Centuries of Architectural Representation: Works from the Collection of the Canadian Centre for Architecture*, ed. Eve Blau et al. (Montreal: Canadian Centre for Architecture, 1989), 21.

[2] *Erratic* was exhibited at The Aalto University Digital Design Laboratory (ADD) in Helsinki between 19 September and 17 October 2013. Project design: Norell/Rodhe. Team: Daniel Norell, Einar Rodhe, Hseng Tai Lintner, Stefan Svedberg, Axel Wolgers. Fabrication: Emballageteknik AB. The project was supported by the research environment Architecture in the Making at Chalmers University of Technology in Gothenburg.

Edges of Misperception: Drawing Indeterminacy

Andrew Walker

AN ANTHOLOGY OF ALEATORIC DRAWING EXPERIMENTS

This journey into the sketchy world of hacked perception, scotopic labyrinths and performative architectures evolved out of a philosophical 'itch' regarding the notion of intent in the creative act of drawing, a curiosity about whether this act – most often the prelude to any form of design realisation, imbued as it is with imaginative potency – may hold the key to synthesising new modes of occupation. We live in an age where a majority of the spaces we encounter prioritise clarity over ambiguity, passivity over interaction, stillness over dynamism and most certainly control over indeterminacy; combined with the growing exhaustion of formalism (or as Maxim Gorky described it, "varied bored"), vision is edging ever closer to a perceptual event horizon, risking regression from active perception to passive reception – potentially resulting in a culture of mass distraction and spatial disconnection.[1] What role could drawing, a vital part of architectural production, play in addressing these issues?

The following research asks: what if the drawings we create were less predictable, less deterministic and less stable? Could the act of drawing be elevated to something occupiable, emergent and participatory – existing with a temporal as well as a spatial flesh? Can a drawing, through indeterminacy and orchestrated chance, trigger a more engaged form of perception and, as a result, provoke a more active occupation?

These questions were (and continue to be) explored kinaesthetically through an experimental toolkit of lumino-kinetic robots and interactive drawing machines that probe the notion of spatial authorship and question where drawing ends and architecture begins. The following text and images highlight but a small selection of early devices that initiated the investigation.

Fig. 1: Drawing instrument – Species 1 – calibrating parts at laboratory.

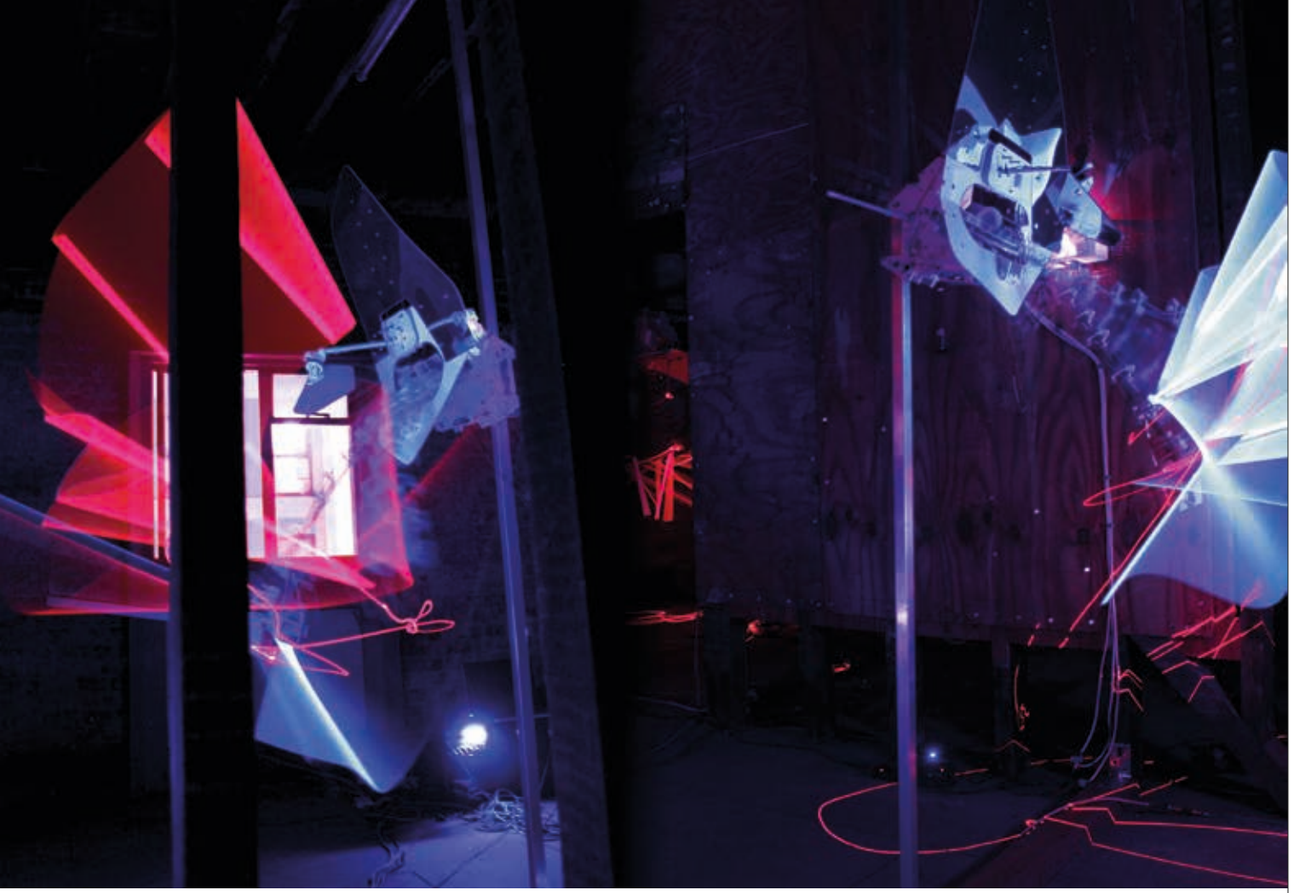
FIAT NIGRUM: RETINAL PAINTING

Taking cues from both the generative drawing techniques of Cy Twombly (painting in the dark) and Samuel Beckett's 'Lessness' (a short story of reconfigurable fragments), a plan was hatched. A moderately sized room of 200 sq ft was chosen as the stage. The aim: to create a series of architectural experiments where occupancy and presence would be translated into live and emergent drawing events. Equally inspired by John Cage's 'prepared instruments', the room was compromised by a series of randomly situated light-painting mechanisms, parasitically hung in the space to unexpectedly distort their context. Each unit was equipped with discrete motion sensors that worked in tandem with each other to detect and calculate an occupant's proximity within and movement through the space. Anatomically, each device consisted of a series of reflective synthetic muscles, luminous proboscises, powerful LEDs and phosphorescent tape, capable of producing a broad taxonomy of light gestures (Fig. 1).

Before each drawing began, the room was emptied of all references and blanketed in darkness – removing any possible visual cues that might distract the viewer. Once the installation was activated participants were free to roam the void cautiously, all the while being sensed and tracked. As they moved across the numerous invisible proscenia, a series of light events were triggered. Dynamic flashing contours and spotlights would rapidly appear and disappear in response to how the occupants navigated the space. The sequence and type of these gestures was entirely unplanned and unscripted – their reception equally uncontrolled (Figs. 2 and 3).

Treating the retina as a drawing board, composite after-images were randomly bleached onto the back of the eye. These schizographic fragments, through their superimposition and assemblage, would begin to allude to more defined spaces through cognitive error (illusory conjunction and subconscious inference).[2] Here, the retina was treated as painters like Francis Bacon treated their canvases; by making initially arbitrary marks on the surface until "suddenly the lines drawn suggested something totally different".[3] Through this illusionistic and gestalt layering of balletic light gestures, sub-architectures of potential but impossible occupation appear and disappear, briefly existing in the interstitial space between the real and the imagined. An ambiguous territory somewhere between memory, synaptic impulse and illusion (Fig. 4).

For participants in these drawing experiments, their *Raumgerfühl* (sense of space) and *Raumphantasie* (spatial imagination) overlap, resulting in an active *Raumgestaltung* (spatial creation), where reality and interpretation are fused. These temporal collapses were also an attempt to build on Nam June Paik's experiments with 'tenses'



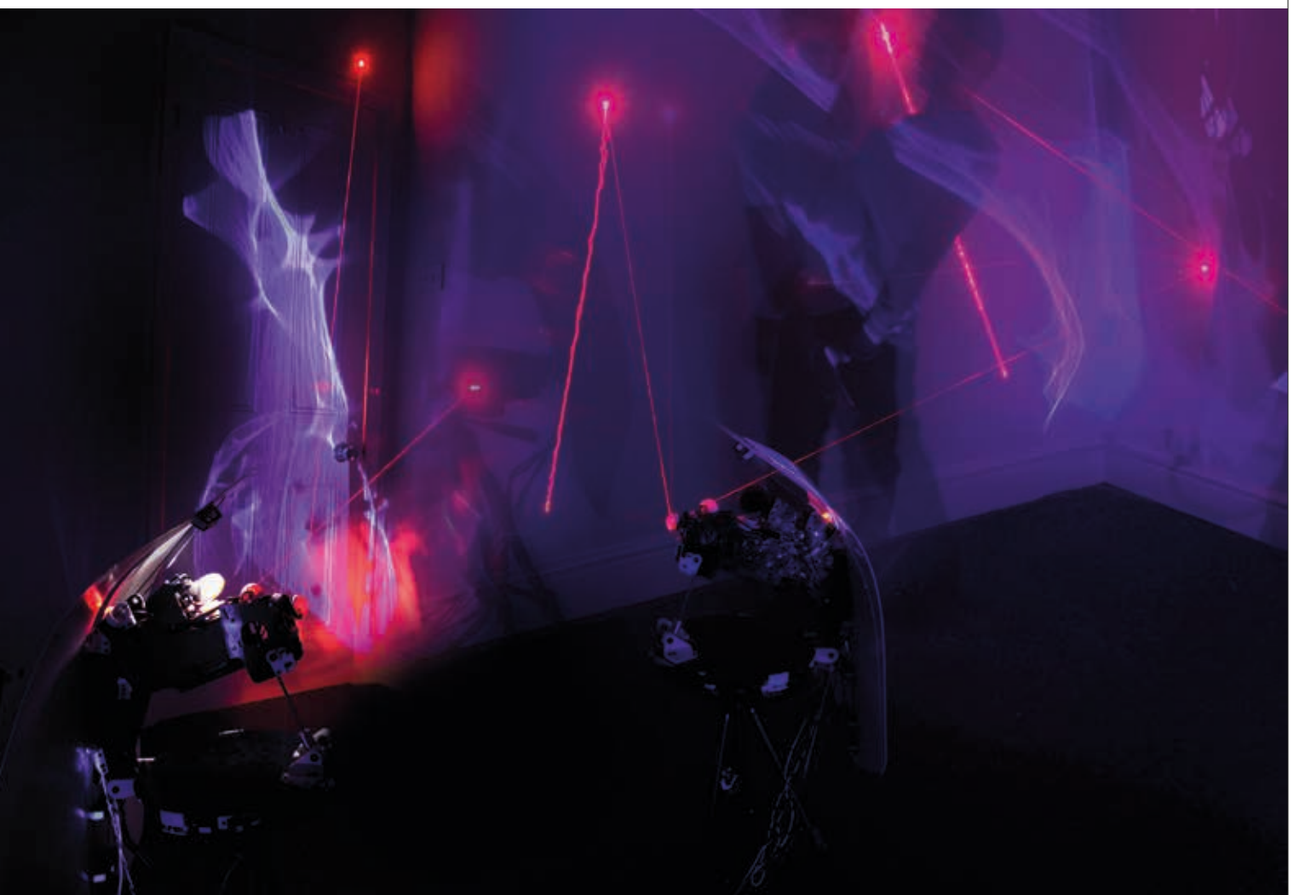


Fig. 4: Retinal paintings

in his mediated spaces works. By overlapping zones of production, transmission and reception (as in pieces like *Video Fish*, 1975), where the real is recorded and played back over itself, the viewer's perception of a unified time is fractured.[4] These adjacent drawing experiments rely on similar multiplicities of time (created through the ambiguity of layered after-images) to help the participant reconceive the 'space' surrounding them as an inhabitable working drawing (*Werknetz*) rather than a passive sensorial zone (*Mertznetz*).[5]

This temporal compression also echoes Bob Sheil's observations about the ever-decreasing gap between design information (usually in the form of a drawing) and fabrication.[6] This collapsing of inputs and outputs, of information and production, could hold emancipatory potential for the contemporary designer. Yet equally, as space is continuously redrawn and reconditioned, it could reinforce an increasingly individualistic approach to design. We tread carefully.

That being said, these early experiments aim less at radically subverting the conventional role of drawing in the design process, and are instead explorations of new ways that 'drawing' can be used as a design tool to re-engage occupants with their environments. These lumino-kinetic follies rely on 'hacking perception' through light gestures to do just that.

For example, according to the philosopher Vischer, there are two modes of seeing: '*sehen*' (quiet imprint) and '*schauen*' (the gaze). The latter, a state of heightened awareness, Vischer subcategorised into linear (tracing contours) and painterly (the laying out of masses).[7] This notion implies that the more attentive the viewer, the more they compose while examining their context. What these drawings demonstrate is the power of ambiguity and chance in the creation of a drawing to simultaneously stimulate and open the mind to new spatial concepts, away from passive observation to active participation.

Fig. 2 (opposite, top): Installation in progress – a participant navigates the space as the edges are constantly recreated around them.

Fig. 3 (opposite, bottom): Installation in progress – acrobatic light gestures are being executed as participants wander across their sensory thresholds.

1 Henri Bergson, *Matter and Memory*, trans. Yeoryia Manolopoulou, *Architectures of Chance* (Farnham: Ashgate, 2013), 29.
2 Richard Gregory, *Eye and Brain: The Psychology of Seeing* (World University Library, 1978), 21.
3 Luigi Fiacacci, *Bacon* (Cologne: Taschen, 2003), 24.
4 Nick Kaye, *Multi-media: Video, Installation, Performance* (Routledge: London, 2007).
5 Shaun Murray, "*ENIAtype*" in *Design Ecologies* Vol. 1 (Intellect Books: Bristol), 26–27.
6 Bob Sheil, "Design Through Production" (lecture presented as part of Bartlett International Lecture Series, 3 October 2012).
7 Moshe Barasch, *Modern Theories of Art: From Impressionism to Kandinsky* Vol. 3 (New York: NYU Press, 1998), 101–103.

Illustrating the Cellular Mesoscale

David S. Goodsell

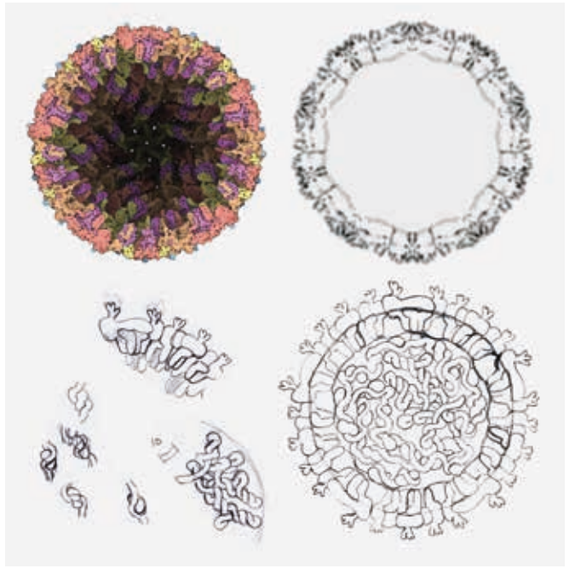


Fig. 1: Preliminary sketches. Two experimental representations of the virus are shown at the top: the atomic structure at top left and a slice from electron microscopy at top right. Preliminary sketches of the proteins and RNA are shown at bottom left – the number "10" is the number of nucleotides in the small piece of RNA next to it. A full sketch of the viral cross-section is at bottom right.

Drawing is an essential, and enjoyable, part of my scientific work. For the past 25 years or so, I've been creating illustrations of the cellular mesoscale – the scale range between the nanometre world of individual molecules and the micron world of a whole cell.[1,2] These illustrations depict a portion of a living cell, magnified to a level where we can see individual molecules. This is a challenging scale level to visualise, however, since there aren't currently any experimental ways to observe it directly. Instead, information must be integrated from many different experimental techniques in order to build up a consistent model. Our task is then to create a comprehensible picture of this complex model.

The process of drawing has several advantages when creating illustrations of cellular environments. These environments are highly complex, comprised of thousands or millions of individual molecules, each with its own unique shape and interactions. Computational methods have only recently advanced to the level where three-dimensional models of this type are feasible.[3] So instead, I went to the drawing board to create illustrations of these scenes. Drawing allows exceptional freedom to explore the ways that these molecules are distributed and the ways that they interact. In particular, long fibrous molecules are difficult to simulate but quite easy to draw, as they twist and turn around one another.

Second, we can build on centuries of experience in scientific drawing to help make dynamic and comprehensible visuals. For instance, a healthy dose of artistic license goes a long way toward making these complex spaces comprehensible. [4] The process of drawing allows me to arrange and group the individual players in ways that highlight their functions and minimise distractions, while keeping as true to the science as possible. This is far more difficult to do with algorithmic construction of computation models, when the freedom allowed by drawing to nudge and craft is lost.

These advantages are exemplified in the illustrations of Zika virus infection included here, which were created as part of outreach efforts at the RCSB Protein Data Bank (pdb101.rcsb.org/motm/197).[5] Fig. 2 shows a typical computer graphics rendering of the virus, created from atomic coordinates. The non-photorealistic style of this rendering is designed to complement the hand-drawn style of the cellular landscapes, allowing viewers to compare and contrast the molecules depicted in each.

Fig. 1 show steps through the process of data collection and integration that create the cellular landscape. Drawing is essential throughout, to simplify complex subjects such as the subunit structure of the virus and to create acceptable representations for molecules that have less scientific support, such as the long proteoglycan strands extending from the cell surface. Drawing is a straightforward way of exploring many approaches to depicting these players.

All this preliminary sketching is synthesised into a coherent scene. Some storytelling may be layered in at this time – in this case, by showing two states of the virus during the process of attachment and using a cross-section on one to show more details of the inner structure. Finally, after the full sketch is developed, a rendered painting, Fig. 3, is created. At this point, the friendly feel of hand-drawn illustration helps to make the daunting subject more accessible, inviting viewers to explore.

1 David S Goodsell, "Inside a living cell", *Trends in Biochemical Sciences* 16, (1991): 203–206.
2 David S Goodsell, "Making the step from chemistry to biology and back", *Nature Chemical Biology* 3, (2007): 681–684.
3 Johnson GT, Autin L, Al-Alusi M, Goodsell DS, Sanner MF & Olson AJ "CellPACK: a virtual mesoscope to model and visualize structural systems biology", *Nature Methods* 12, (2015): 85–91.
4 David S Goodsell and GT Johnson, "Filling the gaps: Artistic license in education and outreach", *PLOS Biology* 5, (2007): e308.
5 David S Goodsell, Dutta S, C Zardecki, M Voigt, HM Berman and SK Burley, The RCSB PDB "Molecule of the Month: Inspiring a molecular view of biology", *PLOS Biology* 13, (2015): e1002140.

ACKNOWLEDGEMENTS

This work is supported in part by an NSF award (DBI1338415) to the RCSB Protein Data Bank.

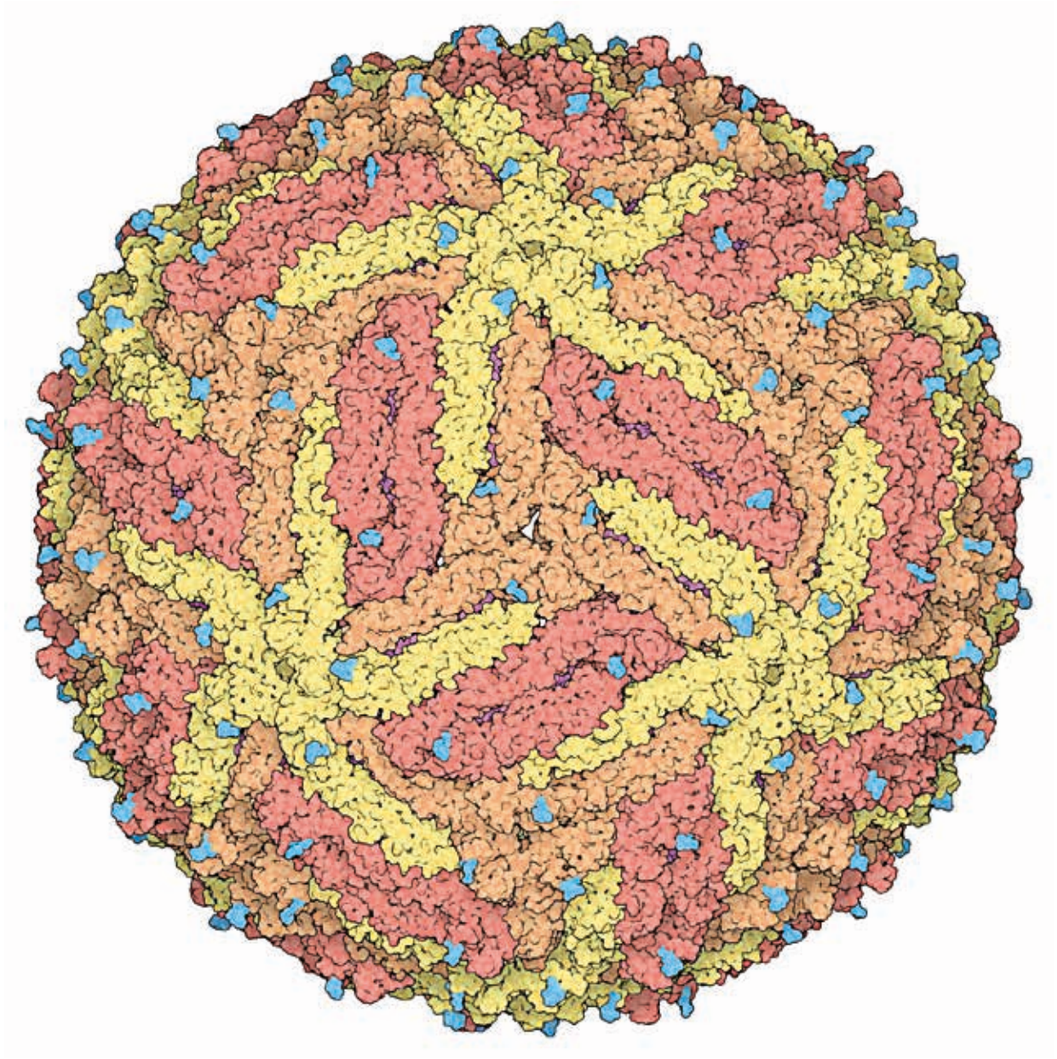


Fig. 2: Zika virus. This computer graphics rendering was created using atomic coordinates from entry 5ire from the Protein Data Bank (www.pdb.org).

Fig. 3: Completed painting *Zika Virus 2,000,000 X*. Two viruses are shown, with the lower one in cross-section to reveal the RNA genome (yellow) inside. The cell membrane is in green, with long proteoglycan chains extending upwards. Molecules in the blood plasma include Y-shaped antibodies, UFO-shaped low density lipoprotein and a long fibrinogen molecule (involved in blood clotting).

Deviated Histories

What is the history of drawing? Can a conclusive account be constructed or would we find too many outliers and perversions to detect one definitive trail? With such an amount of material and precedent to build upon, it is tempting to question what contemporary drawing can achieve on top of all the seminal projects and concepts developed on the page across history. Of course, we only need watch a Hollywood film set in the past to realise how fluid and mutable history can become. The drawing can become a site for deviating and challenging the historical, whether through imaginary flights away from the past or the methodological re-analysis of it. Drawing can serve as an analytical tool to reveal the real history of spaces, its inherent subjectivity offering a different means of inquiry to the photograph or text. Salon.com's work on Mohamed Bashmilah's detention at a CIA black site included drawings made directly from his recollection of the space, a historical record impossible via other documentary means. To deviate history through drawing might not be only fantastical, but also political.

In this chapter, we will see projects that use history as a site for speculation and proposition, whether physical or metaphorical. *Deviated Histories* leads us through Pablo Bronstein's eighteenth-century brothels to a 'ghostpainting' of contemporary Beijing, from readings of controversially demolished buildings to bubblegum pop and the exploratory act of trying to draw an active volcano. Within these works, we see the breaking and reframing of history through drawing as a critical act – going back in time to redraw the future.

An Introduction to the Eighteenth Century

Pablo Bronstein

DESIGN AND CONSTRUCTION OF A MAGNIFICENT BALDACHIN ERECTED IN CELEBRATION OVER STONE AGE RUINS ERRONEOUSLY THOUGHT TO BE THE REMAINS OF THE HOUSE OF ADAM, OR THE 'FIRST BUILDING ON EARTH', 2013

The cross-section of this giant reliquary reveals its modern internal iron skeleton. This daring technological innovation is put to use in a large apparatus that displays a group of stones thought to be the remains of the house of Adam (the first man on Earth), built for himself in the desert upon his expulsion from Paradise. Around the time this baldachin was designed, the possibility began to dawn within some intellectual circles that the world was not as new as the Bible claimed; and indeed that humans weren't descended from Adam and Eve. In the drawing, these stones are still interpreted according to a religious framework, and have been incorporated into an architectural language which continues to be dominated by the need for ornamentation. Complementary though the religious and the technological might be here, as the eighteenth century progressed they became deeply at odds with one other. This increasingly fragile relationship and ultimate conflict between science and religion is alluded to with the title, making it clear that despite the optimism of the design for the baldachin, the ruin is in actual and incontestable fact not the house that Adam built in the wilderness.

Fig. 1: *Design and construction of a magnificent baldachin erected in celebration over Stone Age ruins erroneously thought to be the remains of the house of Adam, or the 'First Building on Earth'*, 2013.

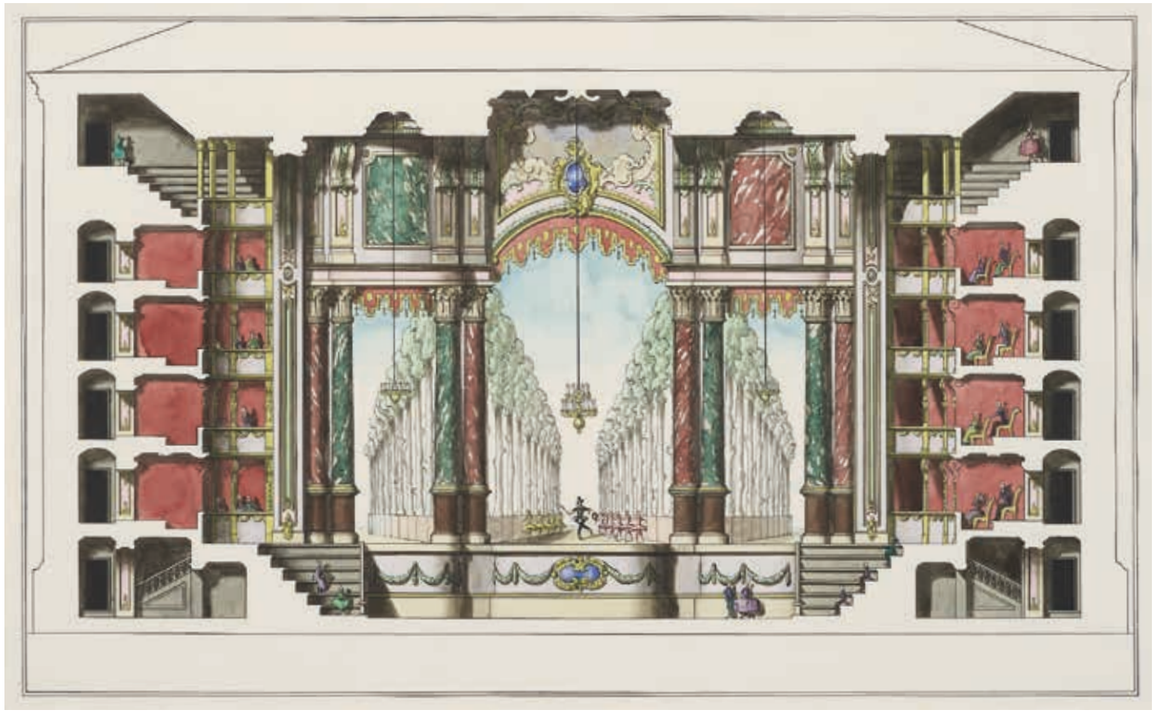


Fig. 2: *Theatre Section with Stage Design for an Oliver Cromwell Ballet*, 2014.

THEATRE SECTION WITH STAGE DESIGN FOR AN OLIVER CROMWELL BALLET, 2014

I have a book that describes a late seventeenth-century Italian ballet/opera called 'La Imprudenza di Cromweglio'. It is clumsily illustrated with images of an imp-like Lord Protector centre stage going about his business performing wicked tricks, aided and abetted by a band of furies (differentiated from the other dancers by monstrous faces embroidered on their bellies). The proscenium suggests one that might be found in a provincial theatre in a second-rate town, with a badly-carved group of lethargic angels holding aloft an unimpressive coat of arms, while a row of local grandees are seen from the back, hot and sweating into their wigs. What drew me to this charming image of bathos is that it is a response to the panic that spread through Europe's courts following Charles I's execution. This crap evening of schlock, ham and crap costumes constitutes an attempt to translate the shocking situation in England into a recognisable moral argument. Cromwell is the Devil in disguise. He sings a song on a stage, commits evil and then is dragged to hell by the very imps that helped him on his rounds. Though *Cromweglio* creates a distancing effect with the aid of the architectural and entertainment structure of an opposing political ideology – that of absolute monarchy, we should remember that proscenium stages were an architectural invention from that very century, Italian opera being barely fifty years old and unknown in England at the time. As theatre was, for the most part, banned by Cromwell, it is with a good deal of unintentional irony that he takes to the boards here.

My drawing takes place in London about eighty years after the 1660 opera. A new bourgeois audience has continued the aestheticisation of the Cromwell era. This new ballet shows Cromwell bearing the decapitated head of Charles I, with a phalanx of ballerinas arranged symmetrically on either side of him. The scene is the central motif housed within a cross-section of a theatre. Not an old-fashioned court theatre – tight, stuffy and geared towards intimate social interaction – but a large new city theatre, resplendent with all the cheap *scagliola* required for a successful cultural venture. This new class of audience with its commercial system and the demands it makes on cultural and architectural production are perhaps a legacy of the Cromwellian revolution, but its decorative programme evokes the recherché glamour of the noble and absolutist courts of Europe.

Fig. 3: *Mother Clap's Molly House, Holborn 1720*, 2014.

MOTHER CLAP'S MOLLY HOUSE, HOLBORN 1720, 2014

For two years, Mother Clap ran a gay brothel at her house in Holborn before it was raided by the authorities in 1724. The most famous gay venue of the eighteenth century, it is particularly endearing because of the kindheartedness of Mother Clap, who frequently provided false testimony for her clients, who risked the death penalty for sodomy if caught. This story of a semi-private and very small-scale enterprise has always jarred with my vision of the eighteenth century as being homosexualesque to its core in respect to display, self-promotion and decorative ostentation.

It is all the more intriguing because the houses in Holborn that existed then, excluding those around Lincoln's Inn Fields, were as conventional as the eighteenth century produced (which may explain their survival into the present). The idea of a community of gay men performing illegal acts behind a dull facade makes sense from the point of view of avoiding the law, but does not, however, make for an interesting picture.

My drawing presents a building that expresses its subversive interior function on the exterior. This structure loudly declares that on its inside there unquestionably must be bewigged High Court judges with semen up their arses and rent-boys wiping their cocks on the curtains. Whereas the surrounding buildings are speculative and standardised, this building is handmade, retouched, altered and humane. The form of the building is that of a large, continually adapted seventeenth-century inn. The owner, Mother Clap, is represented anthropomorphically via the large head sitting on top of Dutch gabled shoulders, with two bawdy protruding breast extensions at the front. The clapboard siding is a deliberate allusion both to her name and to the disease. The building also suggests a history of cheap, fun, pleasurable diversions. More importantly, rather than a mere two-year lifespan, this house of pleasure has already been going for fifty years and will survive well into the Victorian period.

INCENSE BURNER IN THE REGENCY TASTE, 2015

In the late eighteenth century, the cartoonist James Gillray produced a popular print depicting the uncomfortable exchange which ensued when George III sent an ambassador to China to pursue a treaty allowing for trade privileges and the import of British manufacturing. The ambassador took a selection of royal and entertaining gifts with him, but when in the magnificent and humbling audience chamber he asked the Emperor if there was anything else in particular he might want. The Qianlong Emperor replied, mystified, that as Celestial Ruler of all of Heaven and Earth he was in any case already the possessor of all things. This incense burner is a vulgar manufactured commodity from the late eighteenth century, of little appeal to the refined Qianlong court but destined as the joyous centrepiece to a Chinese-mad Islington parlour. It is drawn in the style of Gillray, who would satirise stylistic fads and consumer excess and parody the buying public's obsession with the exotic. It is also an object I would very much like to own.

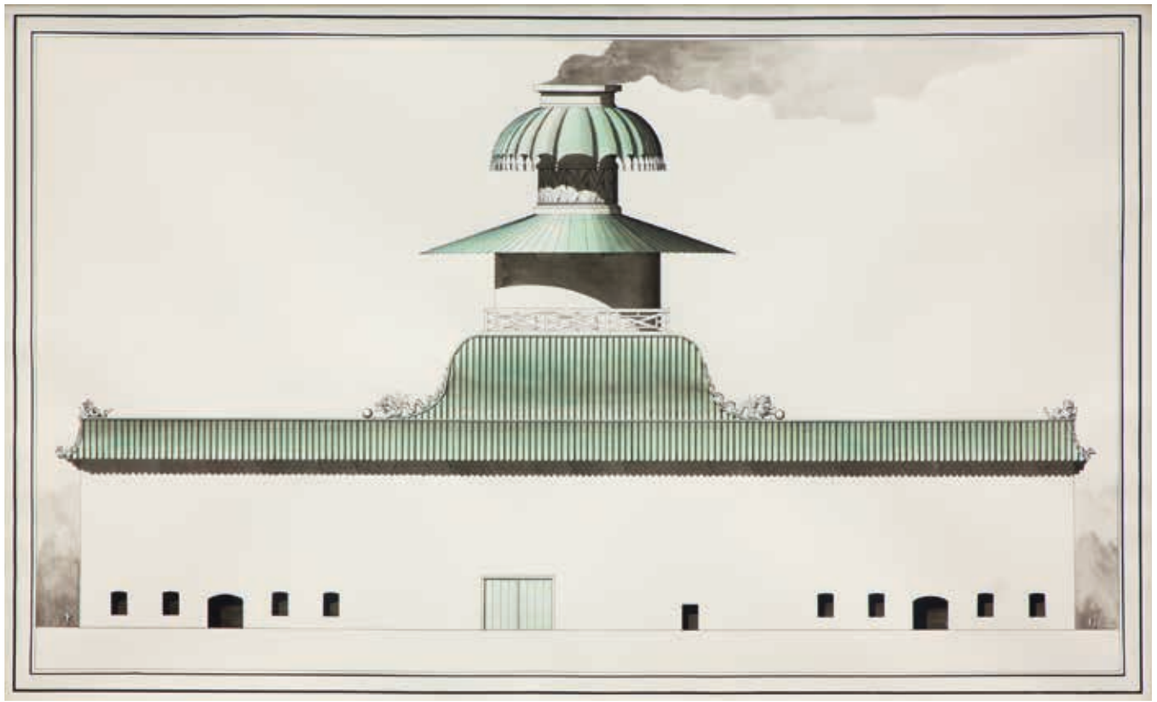


Fig. 4: *Incense Burner in the Regency Taste*, 2015.

MINTON CHINA FACTORY, 2015

The design for this factory attempts to demonstrate the importance that pottery assumed in British manufacturing during the eighteenth and early nineteenth centuries. The development of industry goes hand in hand with the desire to produce porcelain in quantities greater than those imported from the Far East. Minton china, aimed squarely at the middle class, produced a very hard-wearing white substance which was then decorated in a variety of exotic patterns. Factories were built more or less plainly in the eighteenth century, and the potteries in Staffordshire in particular were very pragmatic and unaestheticised. However, this building attempts to evoke China directly, with the roof serving as a billboard for its goods. Its walls are 'china' (porcelain) white and it has a chimney disguised as a pagoda. Its size indicates not only how big the market for Minton had become, but also the extent of the general population increase. The crematory quality to the building and chimney place it proudly in the modern era.

Fig. 5: *Minton China Factory*, 2015.

A Flat Tale: The Picture Book as an Architectural Project

Jana Čulek

Since their seventeenth-century golden age, the Dutch have steadily formed recognisable visual codes and conventions through the numerous depictions of their urban, rural and natural landscapes. Images were the predominant way of knowing and understanding the world. "In Holland, the visual culture was central to the life of the society [...] If we look beyond what is normally considered to be art, we find that images proliferate everywhere. They are printed in books, woven into the cloth of tapestries or table linens, painted onto tiles, and of course framed on walls."[1] The visual culture of the Netherlands and the knowledge inscribed and disseminated through images is consistent throughout the country's history. The importance placed on images and their narratives remains a recognisable attribute even in contemporary Dutch architecture.

As architects, we often create more stories than buildings: "Since the inception of Western architecture in classical Greece, the architect has not 'made' buildings; rather, he or she has made the mediating artefacts that make significant buildings possible. These artefacts – from words, to many kinds of inscriptions and drawings, to full scale mock-ups – and their relation to buildings, however, have not remained constant throughout history."[2]

Architecture has come to a point where the main focus in creating a project is placed on the formation of the concept. An attractive and innovative conceptual narrative is what differentiates a successful project from an unsuccessful one. 'A Flat Tale' is an architectural project that examines the relationships between images and texts in creating architectural narratives. Dutch architecture and visual culture are used as a lens for studying architectural stories through their textual and visual narrative structures and methods. In order to gain a clearer understanding of the complex relationships of lexical and visual forms of storytelling and their capacity for disseminating knowledge, the project uses known didactic literary genres as heuristic devices. Approaching the topic of architectural representation through both its visual and lexical qualities has allowed for the elucidation of three main categories depending on the complexity, presence and correlation of drawings and text. These three categories are presented through three books, each transposing one category of architectural representation to a literary and didactic genre. *A Good Life ABC* pairs the architectural diagram with the alphabet book, *A Flat Tale* conveys the architectural design project through the picture book and *Pitch* examines the architectural essay through the format of an academic journal. The method questions the storytelling capacity of architecture as well as the ability an architectural project has in transferring and conveying knowledge and information that lie beyond the brief.

Fig. 1: Jana Čulek, *A Good Life ABC*, "A is for Architecture", The Berlage, 2016. Stereotypical Dutch canal house.

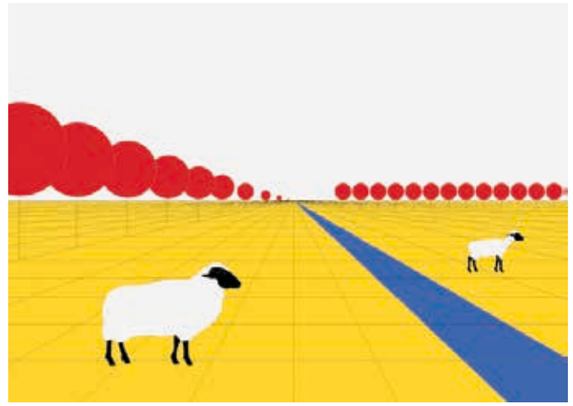


Fig. 2: Jana Čulek, *A Good Life ABC*, "L is for Landscape", The Berlage, 2016. The curated Dutch landscape, complete with orthogonal grid, row of trees and field decorated with livestock.

A Good Life ABC, set in the format of an alphabet book, defines the basic grammar of Dutch architecture and the built environment. Each spread contains a letter of the alphabet and a word that represents one of many stereotypical, recognisable Dutch objects, landscapes, elements of the built environment or a drawing – a recognisable visual representation of that object or landscape. Since the project is based on the Netherlands, *A Good Life ABC* defines the specific vocabulary of spatial, architectural and cultural conditions. The images define the intended meanings and visual conventions of the words, allowing the viewer to acquire basic knowledge and information about the spatial and cultural context of the project. The method of combining words with referential images can be traced back to Comenius's *Orbis Pictus* (1658), where pictures were used as "a visual aid, a means of transmitting information to inexperienced listeners and readers that could not be conveyed by the words alone."[3] The reader

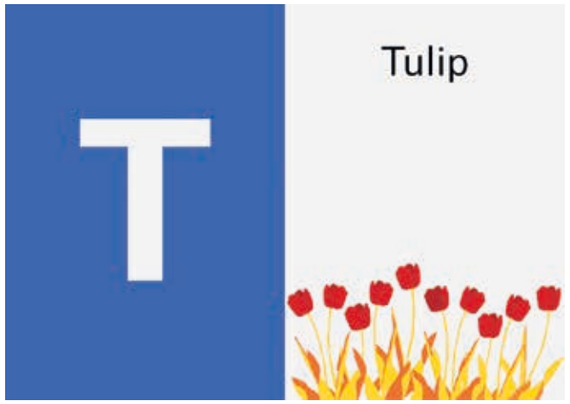


Fig. 3: Jana Čulek, *A Good Life ABC*, "T is for Tulip", The Berlage, 2016. Row of tulip flowers as one of the most recognisable Dutch emblems.

Fig. 4: Jana Čulek, *A Flat Tale*, "Polder Life", The Berlage, 2016. "The housing was first built in a ring, to make polder life a wonderful thing. Later they changed it back to a grid, and tried to correct the mistake that they did."

of *A Good Life ABC* gains context-specific information, such as the fact that the word 'landscape' signifies an endless view of gridded fields flanked by canals or straight rows of trees, sporadically inhabited with livestock, or that the most recognisable and widespread image of 'architecture' is the brick canal house with large windows and topped with a pitched roof.

In order not to provide the viewer with specific examples of the Dutch objects and landscapes, but with stereotypical and emblematic ones, a limited colour palette is used. Because of their visual properties, and as an *homage* to the Dutch De Stijl group, the three primary colours – red, blue and yellow – are used to depict everything. In the words of Piet Mondrian, "the primary colour [...] is non-individualistic and free of individual sensation and expresses only silent emotion of the universal. Primary colours in the afore described art of painting form a conception of the primary colour in such a manner that they no longer depict the natural and yet remain realistic."[4] The lack of realistic colouring removes any specificity from the depicted objects. They become emblematic representations of only themselves and their Dutchness.

This seemingly simple way of transferring knowledge through the use of reductive imagery can be related to architectural diagrams. In the same way that the alphabet book forms the knowledge basis for reading and understanding a language, the set of architectural diagrams can form the basis for reading and understanding the architectural project. Architectural diagrams, whose origins can also be found in the works of Dutch architects such as Herman Hertzberger, are meant to be an "abstract pattern of physical relationships which resolve a small system of interacting and conflicting forces"[5] in order to help the process of developing an architectural project. But today they have become a way of communicating the complex process of architectural design to those less familiar with it. The diagram has become a representational method for the architectural concept and idea. Instead of being used as a tool to communicate the basic grammar of a project, it becomes its language as well as its entire narrative.

After acquiring the basic knowledge and visual conventions through the alphabet book, the reader is able to transition to a more complex narrative through the format of a picture book. The second part, *A Flat Tale*, now forms the syntax. It consists of fifteen spreads containing drawings of specific locations or occurrences in the Dutch landscape. The story follows the historical development of the Flevoland polder and the city of Almere in order to convey important events of Dutch land reclamation, urban planning and architecture. The 'text' – in this case the development of Almere – was created prior to the drawings. The drawings interpret the text through various scales. Starting with a map depicting the Netherlands and ending with detailed fictional and realistic architectural and interior depictions, *A Flat Tale* provides the reader with all the visual and textual information necessary for one to form an idea and interpretation of Dutch landscape and architecture. The elements from the alphabet book are used as building blocks for the larger scenes, reminding the reader of the visual conventions already learned.

Following the tradition of seventeenth-century Dutch art, the drawings collect and convey knowledge and information about the world. As explained by Svetlana Alpers in *The Art of Describing*, "no other culture assembled knowledge through images as did the Dutch".[6] One would know the world through seeing rather than through reading and to draw something would be to know it. Consistent with the tradition of Dutch artwork from the seventeenth century, there is an "absence of a prior frame [...] so that the image spread out on the pictorial surface appears to be an unbounded fragment of a world that continues beyond the canvas".[7] All drawings were created in an axonometric view, allowing for an objective overview of the depicted situation. This enables the readers to interpret and discover the details by themselves. The use of axonometric drawings, the absence of a prior frame, the landscape theme, variations in scale, depictions of maps and text captions as parts of the drawings are all elements and approaches found

Fig. 5: Jana Čulek, *A Flat Tale*, "Idea Factory", The Berlage, 2016. "They pitched their ideas, or so it would seem, and presented their perfect architectural dream. No buildings were necessary to stand out from the rest. You just needed to pass a conceptual test."

throughout Dutch visual culture. Whether created by the Dutch masters or found in more recent architectural drawings like the ones of Rietveld, Hertzberger or the early drawings of OMA, these visual codes form a specific representational language that amounts to a visual style of the Netherlands. "Because styles do act as signifiers that express values of those who first produced them, an illustrator can use a particular pre-existing style to evoke and thus illustrate a particular set of values."[8] Using a combination of specific Dutch styles, a mood is set for the picture book that allows for a better understanding of the context.

A Flat Tale is an architectural picture book that can be viewed as an analogy for the architectural design project. Both consist of images carrying the spatial narrative and texts carrying the temporal one. An existing text is also a prerequisite for both the picture book and the project. While for the picture book the text is usually a short fictional or non-fictional story, the text for the architectural project can be interpreted as both the programme given by an external entity and as a concept created by the architects themselves. The latter, where the architect is the author of both the narrative and the imagery, is a situation that also occurs in the creation of picture books when the author of the text is also an illustrator. In both cases, the most successful examples are the result of the same author(s) working on both the narrative and the imagery. As with good picture books, perhaps the criterion for a successful relationship of an architectural narrative and its imagery is in understanding that it is "not that words and pictures are quite separate from each other but, rather, placing them into relationship with each other inevitably changes the meaning of both, so that good picture books as a whole", and perhaps architectural projects as well, "are a richer experience than just the simple sum of their parts."[9]

A Flat Tale also establishes abstract ideas such as concept, export, identity, welfare and subsidies, which are conveyed through the use of the drawings. The words appear as part of the text accompanying the drawing, while the drawing acts as a visual explanation of the concept through a familiar visual example. "Since language is a codification of what we already know – we would not have learned words to describe experiences we have not encountered yet – the information in pictures that we cannot yet verbalize is the information that is new to us, the information that transcends our pre-existing categories or class names. Seen in this way, pictures can teach us about unfamiliar objects, but only if we use the words of an accompanying text as cognitive maps, schemata to apply them in order to understand exactly what is new, left over beyond the schemata."[10]

The project set is completed with the third part, *Pitch*, which takes the format of an academic journal. Through the use of polemic, it represents the mature method of conveying thought, knowledge and ideas. *Pitch* is a collection of stories of significant Dutch projects presented through historical and theoretical narratives. *Pitch* puts the visual and narrative elements established in the first two books into a spatial and historical context. The majority of the pages are covered with a body of text

Fig. 6: Jana Čulek, *A Flat Tale*, "Identity Crisis", The Berlage, 2016. "The houses won't have their identities lost, even with the low final building cost. So what if not all were made out of brick! You just needed to pick a façade that would stick."

Fig. 7: Jana Čulek, *A Flat Tale*, "Exporting Architecture", The Berlage, 2016. "Now to survive and compete on the scene, they have to export the grand Dutch dream. The buildings will surely bring them fame, even though behind the facades they're all the same."

accompanied by reductive black and white drawings used as an additional visual explanation. Since we "commonly associate black and white with uncompromising truth",[11] *Pitch* uses colourless drawings in order to convey seriousness and maturity. The pattern of the text on the pages becomes denser and more attractive to the viewer, switching their focus from the image to the word.

Architects mostly create two types of text: the narrative of the architectural project – which is commonly an elaborate project description created for the client or used as a promotional tool – and the theoretical and abstract texts created for architectural journals. The former uses simple, relatable language but results in mostly uninspired and dry descriptions, while the latter tends to use an obscure and complex language in order to project mature architectural thought and complex spatial relationships. However, the most interesting architectural texts are the ones that combine descriptive elements of project descriptions with the intelligent thoughts of a theoretical text. By examining the early projects of OMA, we find that their appeal "lies in the quality of presenting the reader with opposing positions – both at the same time. OMA's observations on metropolitanism contain simultaneously the extremes of an architecture which is both visionary and implementable, surreal and commonsensical, revolutionary and evolutionary, and puritanical and luxurious [...] Rarely in the work are these oppositions satisfactorily resolved – they are extremes which do not, as yet, mesh, but rather touch."[12]

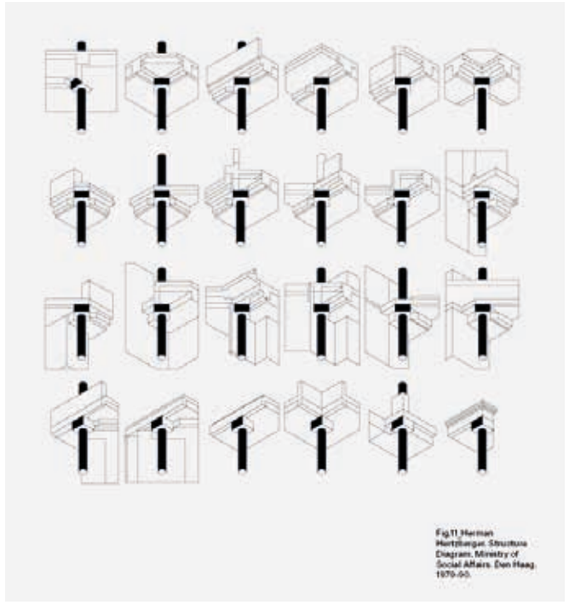


Fig. 8: Jana Čulek, *Pitch*, "Grid, Module, Structuralism", The Berlage, 2016. Redrawing of Herman Hertzberger's diagram for the Ministry of Social Affairs in Den Haag.

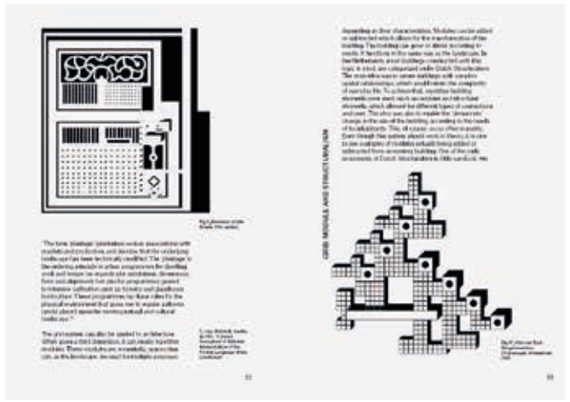


Fig. 9: Jana Čulek, *Pitch*, "Grid, Module, Structuralism", The Berlage, 2016. Text and drawings of modular elements and structures: the Beemster estate and Aldo van Eyck's Amsterdam orphanage.

As a way of testing the capacity of text as the dominant conveyor of an architectural idea, *Pitch* ends with a narrative of a project. The project is formed as an interpretation and culmination of the information found within all three books. It tells a fictional story of the construction of a mountain in the Netherlands. Combining different scales in which the Dutch have altered and developed their environment, the narrative of the Mountain mixes elements, spaces and processes that are plausible and realistic in this context, but work together in order to create a purely fictional utopian project. It urges the readers to recall the visual codes and conventions established throughout the previous books in order to be able to create their own visual interpretations of the project, based on the Dutch context. But since the text only implies visual information, one still needs images in order to understand the specificity and focus of the textual narrative. Due to this, images that help the reader understand and visualise the Mountain project have been placed throughout all three books. From allusions to the Dutch idea of a mountain in *A Good Life ABC* to various pieces of the structure travelling through the pages of *A Flat Tale* to the black and white bird's-eye views of Dutch landscapes as seen from the Mountain itself in *Pitch*, these images work together in order to form a visual basis for the readers even before they reach the narrative of the project itself.

By viewing the representational methods and thought-forming processes of architectural projects through the lens of didactic literary genres, a different set of rules can be applied to forming, conveying, viewing and interpreting architectural thought.

As separate elements, *A Good Life ABC*, *A Flat Tale* and *Pitch* do not present three separate methods of creating and representing an architectural project, but rather they each represent a specific step in creating a more complex, intricate whole. They are used to build up the necessary elements of what is considered to be an architectural project. Each of the books addresses one way of combining visual and textual narratives in architecture with the aim of conveying knowledge and information. Reading the books in sequence allows for a gradual building up of knowledge and understanding of the context, its related visual codes and conventions and its complex architectural thought. Through multiple re-readings and re-viewings, one gains additional information due to the insight into the totality of the architectural story.

Picture books and architectural projects both use two separate mediums – picture and text – in order to convey narratives. These two mediums, however, are never fully related and interdependent. They create a continuous dialectic relationship that allows for information, critique, irony and humour to be transferred to the viewers, due to the need of their constant awareness to both the image and the text. The combination of familiar and unfamiliar information and the co-existence of fictional and non-fictional objects and events creates the opportunity for different interpretations that allows for the transfer of new knowledge and information.

1 Svetlana Alpers, *The Art of Describing; Dutch Art in the Seventeenth Century* (Chicago: The University of Chicago Press, 1983), xxv.
2 Alberto Perez-Gomez and Louise Pelletier, *Architectural Representation and the Perspective Hinge* (Cambridge: MIT Press, 2000), 7.
3 Perry Nodelman, *Words About Pictures: The Narrative Art of Children's Picture Books* (Athens, Georgia: University of Georgia Press, 1998), 4.
4 Piet Mondrian, *De Stijl* (Leiden, 1918).
5 Christopher Alexander, *Notes on the Synthesis of Form* (Cambridge: Harvard University Press, 1973), preface.
6 Alpers, *The Art of Describing; Dutch Art in the Seventeenth Century,* 165.
7 Alpers, *The Art of Describing; Dutch Art in the Seventeenth Century,* 27.
8 Nodelman, *Words About Pictures: The Narrative Art of Children's Picture Books,* 83.
9 Nodelman, *Words About Pictures: The Narrative Art of Children's Picture Books,* 199.
10 Nodelman, *Words About Pictures: The Narrative Art of Children's Picture Books,* 208.
11 Nodelman, *Words About Pictures: The Narrative Art of Children's Picture Books,* 67.
12 George Baird, 'Les Extremes Qui se Touchent?' *Architectural Design – AD Profiles 5: OMA*, 5/77 (London: Architectural Design, 1977).

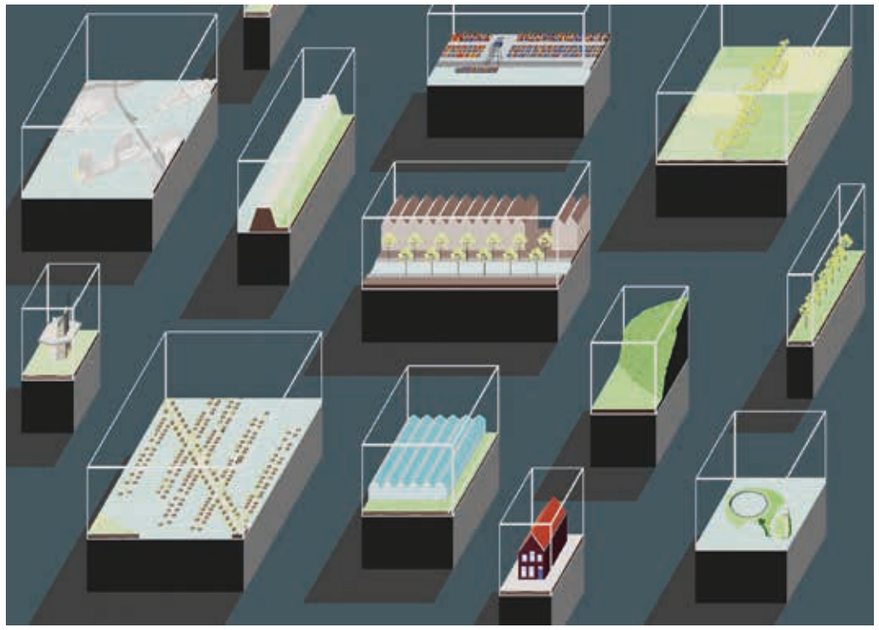


Fig. 10: Jana Čulek, *A Flat Tale*, "Constructed Landscapes", The Berlage, 2016. "They constructed a good life in land under sea, with building regulations that were uncommonly free."

With-drawing Room on Vellum: The Persistent Vanishing of the Architectural Drawing Surface

Penelope Haralambidou

One of the earliest surviving examples of architectural working drawings, dating from 1260, depicts an elegant alternative rendering of the façade of Strasbourg Cathedral and is drawn in fine lines on parchment.[1] In fact, the drawing's durability is due to this extraordinarily resilient surface that pre-dates paper. But what is parchment? Parchment is a thin membrane made of animal hide, prepared for use as a surface for drawing and writing. Vellum is a finer quality parchment made specifically from calf, off-white, soft and semi-translucent: a painting and drawing surface that has been revered by architects and artists throughout history.

Although not directly connected with the process of design and construction, another rich source of information about architectural practice in the Middle Ages is preserved in the form of 'illumination' on vellum pages bound in manuscripts. Here, elegant architectural forms and details frame the narrative of the depicted religious scenes in gold gilding and lapis lazuli. Drawn laboriously by hand on animal skin with pigments made out of ground precious stones and metals, the forgotten past of architectural drawing could not be more visceral. Drawings on vellum remain tethered for more than 750 years to not only inert but also organic animal matter.

Fig. 1: Unknown. *Façade of Strasbourg Cathedral ("Plan A1")*. Strasbourg, France, 1260s, 86 × 59 cm, two joined pieces of parchment. Musée de l'Oeuvre Notre-Dame, Strasbourg, Inv. No. 2.

In sharp contrast, lightning-fast advancements in digital technology have led contemporary architectural drawing to withdraw from the skin of the world. Today, the architect navigates the intricacies of design through clicks of a mouse on a luminous screen, defining with mathematical precision points and lines that she can never touch. Where is the drawing drawn today? What is the materiality of the drawing? Drawing withdraws behind the monitor in the realm of an untouchable digital and remains dormant on hard drives until printed or fleshed out directly in matter. However, the loss of the materiality of mark-making and the tactility and embodiment of the act of drawing is counteracted by an expansion, a blossoming in space and time.

With-drawing Room on Vellum is a two-fold drawing that reflects on the fast-changing nature of the architectural drawing surface, physically and notionally. Drawn on vellum, the piece is informed by historical examples of medieval architectural working drawing, as well as drawn architecture in illuminated manuscripts. Yet the drawing is not complete until matched by a digital counterpart beamed through a projector and using the surface of the skin as a screen, thus expanding the notion of 'illumination' through the contemporary medium of digital back projection. One could say that the true essence of architectural representation is never tethered on a surface, instead residing in the imagination or in the finished building itself. By bringing together vellum – as the forgotten, visceral past – and digital projection – as the uncertain, evanescent future of the architectural drawing surface – *With-drawing Room on Vellum* aims to probe and challenge the current tendency for drawing to withdraw from the skin of the world.

The piece takes as its subject matter an allegorical 'with-drawing room' sited at 22 Gordon Street, as a vehicle to dream up the future life of The Bartlett School of Architecture in its new home, marking our return to the building after a two-year break. The aim of the drawing is not to portray the measured geometry and changing form of the building at 22 Gordon Street, but to capture the complex residue of its remembered past and the intangible promise of its imagined future.

But how can the skin of an animal turn into a surface for drawing?

All fat and sebum is removed and the skin is washed and soaked in lime for several days to soften and loosen the hair, which is then easily removed. Any remaining hair is scraped off and the skin is stretched onto a wooden frame to dry. It is attached on the frame with strings, at points along the circumference of the skin, which are wrapped around small pebbles to prevent tearing. With the help of a crescent-shaped knife, the parchmenter very carefully removes any remaining hairs and more layers of skin to achieve an even, translucent surface.[2] The skin is then bleached and the two sides are barely distinct: the 'inside body side' is the lighter and more refined, while hair follicles, as well as any scarring caused when the animal was alive, may be visible on the outer side. The membrane can also show the pattern of the animal's vein network, known as 'veining'. To prepare for writing and drawing, the vellum is finally smoothed with pumice and whitened with chalk.

Fig. 2: Attributed to the Rohan Master or immediate circle. *Leaf from a Book of Hours*. Paris, France, c. 1410–30, 26 × 18.5 cm (10 1/4 × 7 5/16 in), empera colors, gold, and ink on parchment leaf. JPGM, Ms. 112.

Distinct from leather, because the hide is not tanned but limed, parchment consists mainly of collagen – natural glue – so it can keep its shape well when stretched, obtaining the appearance of a crisp flat sheet. When water in paint media touches the parchment's surface, the collagen melts slightly, forming a raised bed for the paint. This changeability, as well as an uncanny feeling of touching wet skin, makes the material feel alive.[3]

Parchment has been in use since antiquity, but the peak in its popularity as the primary writing and drawing surface was in medieval times, up until the later fifteenth century, when it was replaced by paper.

The contrast between today's withdrawal of the architectural drawing surface and its medieval visceral past is sharp. So it is difficult to imagine that in the Middle Ages drawing architectural form on a membrane was a technological innovation that signified a paradox: it was both the first materialisation of architectural representation as we know it today and also a significant step away from matter.

Before the invention of linear perspective during the Renaissance, architectural drawings, as they are known today, were rare, if not non-existent. Medieval building practice was fundamentally 'constructive', operating through the traditional techniques of stonemasons and inherited typology.[4] According to Lon Shelby, "stereotomic problems were solved by medieval masons primarily through the physical manipulation of geometrical forms by means of the instruments and tools available to them. These were rule-of-thumb procedures, to be followed step by step, and there were virtually no mathematical calculations involved".[5] Architectural knowledge existed in the traditions of making, building was a collaborative process transmitted orally and the responsibility for the form of a building did not belong to a single individual but was spread up the hierarchical ladder of the guild.

Medieval drafting was executed one-to-one in situ by the master builder on a layer of plaster of Paris on the floor of the lodge's 'tracing house'. The lines were transferred into wood or metal templates and passed on to the stonecutters.[6]

Drawing was thus a physical act and a tactile handling of geometry linked with the etymology of the word: *geo*, 'earth', and *metron*, 'measurement', the marking and measuring of ground or terrain. Similar to a choreography of steps and pirouettes revolving around a waist-high compass, the draughtsman performed design with his whole body, full-scale. So before vellum, the equivalent of the drawing surface was a tracing floor; a spatial feature incorporated inside the building that was being built. The use of a standalone flat membrane turned the drawing surface into an abstract projection plane able to hold a measured image of the building in scale.

Although plenty of surviving examples exist – usually on whole skins or larger surfaces constructed by many skins attached together – the purpose of architectural drawings on vellum remains unclear. Art historian Nancy Wu suggests that the prohibitive cost of parchment meant that architects used it only for presentations: "architects scraped drawings off parchment to create clean surfaces for new designs, which resulted, for example, in the so-called Reims palimpsests of the mid-thirteenth century".[7] On the other hand, according to Nicola Coldstream, one significant purpose of architectural drawings on parchment could have been 'transmission'.[8] Drawings incised on floors and models

lack portability, but drawings on parchment, rolled or assembled in folios, could be taken away.

A significant example of architectural sketches on parchment organised in an album, which also exemplifies the confusion about the use of drawings in medieval times, belongs to a travelling draughtsman, Villard de Honnecourt.[9] Dating from c. 1225–35 and drawn on smaller sheets of vellum, the purpose of these sketches is the subject of disagreement. It was first thought that he was an architect, but most current researchers believe the album served as a pattern or model book, containing designs for manuscript illumination. Indeed, it is clear to a contemporary architecture-trained eye that these are not drawings by an architect-trained hand.

Drawing on vellum for transmission, as well as the practice of erasing the surface to use for a new drawing, exemplifies the role of architectural drawing as a repository of information and is uncannily similar to digital practices in drawing today. Finally, Wu suggests that the emergence of masterly draftsmanship and the increasing frequency of the production of ambitious drawings on parchment that started in the late thirteenth century "coincided with the growing status of architects, who worked with designs and supervised construction as distinguished from those who worked with hands and tools".[10] So the advent of architectural drawing on a membrane allowed the architect to link the invisible geometric relationships of the building into a single image through pen on parchment. The architect became someone who "orders matters only by word, rarely or never putting his hand to the task".[11]

Consequently, the use of a membrane gave birth to not only architectural drawing as we know it, but also the contemporary architect.

In parallel with the study of medieval architectural drawing, I was drawn to a different type of graphic representation of architecture on vellum in the Middle Ages: illuminated manuscripts. Prior to the introduction of printing, books were written by hand, so they were all manuscripts. Illumination refers to a text that is illustrated – 'lit' by the way light catches on the burnished gold and silver adorning the dazzling drawings and embellishments accompanying the text.

According to art historian and curator Christine Sciacca in *Building the Medieval World*, the creative ways in which architecture is represented in illuminated manuscripts "offers a unique insight into what these buildings meant for men and women of the medieval era. Buildings were not simply structures to inhabit – they symbolised grandeur, power, even heaven on earth".[12] According to Sciacca, "while many medieval buildings are lost to posterity, a record of their magnificent appearance is often preserved within the pages of illuminated manuscripts".[13] Indeed, representations of castles, churches, cityscapes and the countryside, as well as interiors, offer invaluable details about how architecture framed life in the Middle Ages. Furthermore, the illustrations often contain historically significant details of construction methods and drawing instruments.

Pointedly, architecture was an important protagonist in framing the narrative structure in scriptures and books of hours. Sciacca observes that "open cross-sections of multi-room interior spaces allowed artists to depict different episodes in a story within a single building, in much the same way as the frames of a movie show a progression of events through time".[14]

Another intriguing aspect of illumination in relation to architectural design is that medieval illuminators also excerpted individual building elements and used them as decorative motifs in their illustrations: elegant renditions of columns and archways provided bold frames for important texts as well as images, and splendid architectural frames organise the information in many charts. For instance, curator Melanie Holcomb in the catalogue for the exhibition *Pen and Parchment* suggests the decorative vocabulary that fills in the arches and spandrels of the structures represented in the diagrams of Thorney Computus "is so rich that turning the pages of the book approximates an extraordinary architectural tour".[15]

Fig. 3: Court Workshop of Duke Ludwig I of Liegnitz and Brieg. Silesia, Poland, 1353. *Saint Hedwig and the New Convent; Nuns from Bamberg Settling at the New Convent. The Life of the Blessed Hedwig*, 34.1 × 24.8 cm (13 7/16 × 9 3/4 in), empera colours, coloured washes, and ink on parchment. JPGM, Ms. Ludwig XI 7, fol. 56.

So beyond the accurate delineation of geometric relationships, vellum in the form of cut sheets arranged in very expensive books allowed architectural representation to frame storytelling and structure meaning.

Finally, the arrangement of these drawings in books allowed an unfolding in time, which in combination with the breathtaking 'technicolor' depiction of scenes in ground pigments could be seen as an, admittedly very slow, antecedent of contemporary cinema.

So what about architectural drawing today?

Although drawing on paper by hand is far from dead – one could say that it even enjoys a revival – it would be difficult to argue against the fact that architectural representation in practice, as well as academia, has irrevocably stepped into the digital. BIM, Building Information Modelling, where complex information about the design and performance of a building is linked to a digital three-dimensional model, is becoming ubiquitous: it constitutes a new type of complex DNA defining not only new-built but increasingly historical buildings as well.

The act of drawing is reduced to typing and clicks of a mouse. Points and lines have become datasets, information codified and saved in hard drives or the 'cloud'. But where is the drawing surface? Caught in the whirlwind of new technological advancement, has its extinction gone unnoticed? Representation has withdrawn behind the screen, held on virtual picture planes or illusory full three-dimensional forms. The physical presence of the drawing is delayed, finding matter only when printed or forging itself on the building material directly.

Behind the screen, the tactility of the drawing surface and the infinitesimal materiality of the line and texture have all been lost. What has been gained is a mathematically robust, dynamic, three-dimensional digital simulacrum of the building, which, after losing its ties to a physical membrane or sheet, has come to life.[16]

Undoubtedly, the digital revolution has triggered ground-breaking – if not hasty – changes in the way that architecture is not only drawn but also constructed and, more significantly, in the way it is conceived. In my own work and the work of my students, however, I am primarily interested in new digital time-based media and their capacity to unlock the storytelling, affective, political and philosophical potential of architectural drawing.[17]

I see the relationship between this new digital cinematic drawing vis-a-vis other types of algorithmically driven digital drawing as equivalent to what the illuminated manuscript was to the medieval measured drawing.

Architecture and film belong to traditionally discrete disciplines, but have always shared a mutual attraction. Recent advancements in digital technology have not only deeply transformed the production of film and architecture, but also brought the two disciplines closer than ever before. Drawn architectural form – the domain of the architect – and the camera, together with lighting, scripting and editing – the domain of the film director – have recently merged into compatible digital platforms. Current digital tools allow the creation of an entire new world, a fictional parallel universe, through architectural invention and narrative. Often using exaggeration, visual rhetorical tropes or surreal elements, architectural projects take the form of complex structures, composed in separate episodes and held together by the structural storyline and the framing.

Adding time to drawing departs from the established notion of architectural representation as inert, which was promoted by the static orthographic projections of the plan and the section on a surface, and which has sometimes led architects to conceive space outside time. By losing the single surface and adding the dimension of time, the representation of space becomes 'alive'. Digital animated drawing offers the potential of generating an affective relationship with architecture, a form of empathy, where the architect/filmmaker more closely identifies with the building.[18] Adding time to drawing can unfold the narrative of assembly; predict the architecture's response to weather; calculate future patterns of occupation; introduce sound and relink architectural composition with music; connect with history and imagine the future. Architectural films better convey the impact that our experience of architecture has on the structure of our memory and imagination, and working with film as a design method offers an amplified sense of inhabitation.

But where might the materiality of a cinematic architectural drawing lie? Digital advancements in the film industry have led to the loss of its celluloid origins, forcing film to withdraw behind the screen. Yet film is still also presented through projected light, albeit now deriving from a digital source. American architectural historian and critic Sylvia Lavin also observes a mutual attraction between architecture and projection. In her book *Kissing Architecture*, she uses the word 'kissing' to describe the growing intimacy between buildings and video installations.[19] According to Lavin, "architecture's original sin was that it could not tell stories in the manner of poetry or painting, although it has certainly tried, offering up such gestures of atonement as *architecture parlante* and postmodernism," and she sees this coming together of projection and architecture as a fertile ground where architecture can reassume its storytelling powers.[20]

I am also drawn to the ephemeral immateriality of projection that exemplifies traditional cinema from its celluloid origins to its current digital form.[21] I see projection as an emancipation from the screen, which accentuates the drawing's long historical link with conceptions of light. In my drawing, *With-drawing Room on Vellum*, I suggest a similar cohabitation, or 'kissing', between physical drafting on vellum and drawing in light through projection.

The research presented in this paper is guided by the making of a drawing, which was developed in parallel to the textual analysis. Marrying two unlikely techniques, separated by more than 750 years, my drawing establishes a fecund tension for questioning their hidden assumptions. Using drawing as a research method opens up a series of questions that textual analysis alone cannot reach. This is the value of the use of design as research method, as the often intuitive links that happen through drawing hold ideas that are yet unnameable.

The act of drawing both guides and derives from historical research and the theoretical analysis of medieval and contemporary practices. Additionally, I see the act of drawing as a practice-led historical research method in itself. Emulating medieval drawing practices combined with contemporary digital techniques allows an embodied reflection on architectural representation. Assuming the additional identity of a draughtswoman during the Middle Ages, I question my current research in film and architecture through hybrid role-playing.[22]

The subject matter, 22 Gordon Street, is a physical building in limbo: the drawing attempts to capture a glimpse of the future, which is about to be born inside

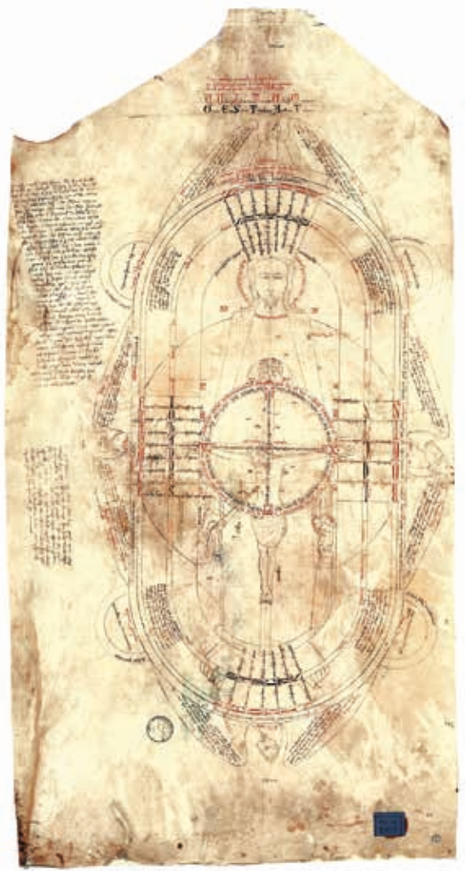


Fig. 4: Opicinus de Canistris. *Diagram with Zodiac Symbols*. Avignon, France, 1335–50, 100 × 65.5 cm (39 3/8 × 25 13/16 in), single leaf. Biblioteca Apostolica Vaticana, Vatican City, Pal. Lat. 1993, folio 24r.

the memory trace of our experience of the past. However, my work is not seeking to accurately represent the physical form of the building. Rather, it attempts to portray the intangible identity of the institution that it houses: The Bartlett School of Architecture.

With-drawing Room on Vellum is a drawing of a drawing. Drawn on a 9"x12" piece of vellum, it takes the form of an illuminated manuscript page, a preface, presenting the design of a larger drawing, that will be drafted on a whole skin of manuscript vellum. The drawing of the whole skin is the central element of the drawing on the smaller sheet. This drawing within a drawing is a synecdoche: the part refers to the whole. The page does not only describe the design of the larger piece, but also acts as a test ground for exploring ideas and techniques that will be applied on it.

To begin work, I acquired two pieces of 'manuscript' vellum, a sheet and an entire skin, from the last remaining manufacturer of parchment in the UK, William Cowley, where vellum is prepared according to the traditional, painstakingly laborious processes followed since 1870.[23] At first glance, the pure whiteness of this membrane has very little to suggest its animal descent. The surface is smooth, with a pleasant 'tooth' to the touch. It displays a translucence and luminance quite unlike paper, which in comparison looks and feels muddy. At closer inspection, however, discernable regular waxy indentations at the lower and top parts of the sheet reveal themselves as traces of the anatomy of the animal: spine, hip and shoulder pressure points. In my rendition of the whole skin in the preface, I chose to represent those in gold. The symmetry of the body of the animal inspired a strong symmetry in the overall composition that also introduces in the foreground the body of the draughtswoman herself, in a way that is not dissimilar to a fascinating medieval drawing by Italian cleric Opicinus de Canistris.[24]

The two sides of the membrane are marginally different, with hair follicles visible on the fur side and a waxier feel on the 'inside body side'. When held up to the light, a network of veins charting the whole surface is detectable.

To draw on the skin, I used shell gold and lapis lazuli, the pigments often adorning illuminated manuscripts, as well as other inks and watercolour. Vellum is one of the most rewarding drawing surfaces I have used, affording a satisfying gliding of the metal nib or brush. The texture of the surface is not consistent, however. It becomes waxier around areas where there is a pressure point on the skin from a bone, for instance.

In the top left corner is an intricate rendition of the letter B, for Bartlett. The general shape follows The Bartlett School of Architecture's logo, which is here embellished with a complex pattern of red and blue lines. The design was improvised after looking at similar examples in illuminated manuscripts, where the first letter, or first word of a text, is decorated and framed by architectural details and structures. For instance, in a gospel lectionary

Fig. 5: Master of James IV of Scotland. *The Feast of Dives*. Spinola Hours. Bruges, Belgium, 1510–20, 23.2 × 16.7 cm (9 1/8 × 6 9/16 in), tempera colors, gold, and ink on parchment leaf. JPGM, Ms. Ludwig IX 18, fol. 21v.

from the late tenth century, 'in', the first word in the Gospel of John, 'In Principio erat verbum' (In the beginning was the Word) is presented as a complex and interlacing monogram in red, gold and blue. A gold and silver arch further monumentalises the letters, recalling the typology of the triumphal arch, which as a built monument was intended to commemorate rulers and was a material expression of prestige and power. The red and blue intertwining lines in my architectural monogram are representations of the central staircase handrails, which at a recent visit to the unfinished refurbishment were the only recognisable remnants of the building.

Flanking the skin in the centre, left and right, is a mirrored constellation of forms inspired by the usually floral but often architecturally inspired decorative patterns framing the text in illuminated manuscripts. Decipherable are the two pico projectors, throwing their projections on the front and on the back of the skin respectively. The projectors are connected with curly cables to two open laptops below.

Caught between the twisting of the cables, peculiar geometric ornaments blossom. Attempting to capture the identity of The Bartlett as a school infamous for its strong drawing culture, the adornments represent familiar graphic tropes found in students' drawings. This part of my drawing touches upon the proliferation of certain persistent motifs that constitute 'a Bartlett drawing', which most students and staff adapt, reinvent and revise, contributing to a potent visual trademark language that few fail to be seduced by. I see this as a significant underlying, invisible identity signalling what The Bartlett represents to insiders and outsiders alike. To choose these forms, I looked no further than The Bartlett Summer Show publication, the *Bartlett Book*, an important repository and perhaps the main culprit in the perseverance of this language that The Bartlett feeds upon through osmosis.[25]

The illusionistic cubic motif represents both a tile floor pattern often found in representations of interiors in medieval illumination and a reference to the world of the pixels and the illusion of space they offer.

Although milky, vellum is surprisingly translucent and captures light unlike any other material.[26] Testing the digital projection from the back and the front of the membrane, I decided to use both. The back projection creates a magical apparition of slightly blurred images that seep into the skin and the front projection catches on the gilding, accentuating the 'illuminated' parts. The arrangement allowed real-time matching of the projection with the vellum, introducing a dialogue between the hand-drawn piece and the digital insertions, with one completing the other. The two become a pair and depend on each other for the completion of the composition.

Finally, the central part of the drawing hosts a film that remembers the past and imagines the future of 22 Gordon Street. The façade of the new building, drawn in shell gold, opens up and frames episodes of its history, here merging in a homogenising blue tint. One of these stories revisits my own past as a student first arriving at The Bartlett in the 1990s for Peter Cook's newly established Masters: my project of a two-fold drawing of a cube sited at The Bartlett. The project comprised two cubes, one painstakingly drawn in string in the old main crit space, the heart of the building, and a short digital animated film showing the cube withdrawing from the building and floating in space. The project shared many of the concerns of this paper and was also a reflection on the changing nature of drawing in the 1990s: a lamentation, but also a celebration and a deliverance from the constraints of matter into a world of animated simulacra.

In April 2016, the majority of MPs voted to continue to print Acts of Parliament on vellum, a tradition that goes back to the drafting of the Magna Carta, as there were concerns about the longevity of archival paper and the long-term security of digital technology.[27] As we have seen, architectural drawing on vellum, a portable flat membrane, was an innovation in the Middle Ages. Today, the use of a drawing surface is also slowly declining, withdrawing from matter. Does this persistent vanishing of the architectural drawing surface signify that this was a blip in the history of architectural representation? Not drawn on vellum, will the architectural drawings that we draw today survive for the next 750 years? And if so, where will they lie?

Fig. 6: Penelope Haralambidou. *With-drawing Room on Vellum*. London, England, 2016, 23.0 × 30.5 cm (9 × 12 in), Red and black ink, watercolour, shell gold, shell lapis lazuli and digital projection on parchment. Private Collection.

[1] Nancy Wu, "Facade of Strasbourg Cathedral (Plan A1)" in *Pen and Parchment: Drawing in the Middle Ages*, ed. Melanie Holcomb (New York: Metropolitan Museum of Art, 2009), 134.
[2] Patricia Lovett, *Illumination: Gold and Colour* (London: L Cornelissen and Son, 2015), 68.
[3] See my analysis of Marcel Duchamp's use of vellum in Penelope Haralambidou, *Marcel Duchamp and the Architecture of Desire* (Farnham: Ashgate, 2003), 161–174.
[4] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge* (Cambridge: MIT, 1997), 8.
[5] Lon R. Shelby, "The Geometrical Knowledge of Mediaeval Master Masons" in *The Engineering of Medieval Cathedrals*, ed. Lynn T. Courtenay (Aldershot: Ashgate, 1997), 41.
[6] An example of a 'tracing floor' survives in York Minster. In a confused mass of intersecting lines engraved into the floor, the full-scale drawing for the Lady Chapel's window can still be distinguished and the walls are also covered with physical wooden templates for drawing other parts of the building. Jan Svanberg, *Master Masons* (Stockholm: Carmina, 1983), 124.
[7] Wu, "Strasbourg Cathedral", 134.
[8] Nicola Coldstream, *Medieval Architecture* (Oxford: OUP, 2003), 80.
[9] The album was discovered in the mid-nineteenth century. See Carl F. Barnes, *Villard de Honnecourt–The Artist and his Drawings: A Critical* Bibliography (Boston: G.K. Hall, 1982) and Nikolaus Pevsner, "Villard de Honnecourt", in *Pevsner on Art and Architecture*, ed. Stephen Games (London: Methuen, 2002/2003), 61–69.
[10] Wu, "Strasbourg Cathedral", 134.
[11] Nicolas de Biard, the Domenican preacher active in Paris in the thirteenth century quoted by Wu. Wu, "Strasbourg Cathedral", 134.
[12] Christine Sciacca, *Building the Medieval World* (Los Angeles: J. Paul Getty Museum and London: British Library, 2010).
[13] Sciacca, *Building,* 2.
[14] Sciacca, *Building,* 2.
[15] Melanie Holcomb, "Strokes of Genius: The Draftsman's Art in the Middle Ages" in *Pen and Parchment: Drawing in the Middle Ages,* ed. Melanie Holcomb (New York: Metropolitan Museum of Art, 2009), 21.
[16] Recent developments on either side of the screen include technologies such LiDAR scanning, which uses a laser beam to accurately record and draw physical three-dimensional objects and environments as point clouds and immersive environments, such as Oculus and Vive. These have spawned a refocus on the human body, re-introducing drawing as a kinaesthetic experience within the space of representation.
[17] I have explored the relationship between film and architectural representation by coining the term 'architectural essay film'. See Penelope Haralambidou, "The Architectural Essay Film", *Architectural Research Quarterly* 19, 03 (2015): 234–248. For more on the architectural film work of the Masters unit 24 students, I teach with Michael Tite and Simon Kennedy, see: 'Unit 24' accessed 12 September, 2016, http://www.unittwentyfour.com.
[18] Haralambidou, "Architectural Essay Film", 247.
[19] Sylvia Lavin, *Kissing Architecture* (Princeton: Princeton University Press, 2011).
[20] Lavin, *Kissing*, 10.
[21] I have used projection in an earlier 'drawing' entitled *Déjà vu: Restaging Alain Resnais's Last Year at Marienbad,* 2009. See Penelope Haralambidou "*Déjà vu*: Restaging Alain Resnais's 'Last Year at Marienbad'", in *Drawing Is/Not Building,* eds. Roland Snooks, Sarah Treadwell and Simon Twose (Wellington: Adam Art Gallery, 2016), 58.
[22] Some of the illuminators were women. See "Repertorium of Manuscripts Illuminated by Womenin Religious Communities of the Middle Ages", accessed 12 September, 2016, http://www.agfem-art.com/introduction.html.
[23] 'William Cowley,' accessed 12 September, 2016, http://www.williamcowley.co.uk.
[24] Opicinus de Canistris (1296–ca. 1354), *Diagram with Zodiac Symbols*, folio 24r, Avignon, France, 1335–50, Biblioteca Apostolica Vaticana, Vatican City, Pal. Lat. 1993. Opicinus's image belongs to a tradition of medieval diagrams that sought to align the cosmic, the earthly and the bodily.
[25] In particular I focused on the years between 2008 and 2010, when a significant change of culture between hand and digital drawing at the school was observed.
[26] Vellum is used as a material for lampshades.
[27] 'Printing Acts of Parliament on Vellum – 20 Apr 2016 at 18:58', The Public Whip,' accessed 12 September, 2016, http://www.publicwhip.org.uk/division.php?date=2016-04-20&number=245.

BOX No. 1: Unpacked (Visions of Ron Herron)

Simon Herron

Fig. 1: Ron Herron portrait by Peter Kent, 1982. © Estate of Ron Herron. All Rights Reserved, 2016. Photos: Susanne Isa.

When Ron Herron died in late September 1994, I collected the contents of his office for safekeeping: 51 archival folders, drawing and negative cabinets, cardboard tubes, portfolios cases, document boxes, a collection of original drawings of many well-known Archigram projects, as well as the legacy of his own practice, professional correspondence, lecture notes, personal papers, image source material and ephemera from the early 1960s to the mid-1990s.

Located in the suburban family home in Essex – the site of much of its production – the sprawling collection forms a unique time capsule, absorbed into the fabric of the house.

Offering a rare view of the profession on the brink of the digital revolution, these works combine orthographic drawing, collage, photography and xerography – lost analogue technologies of the recent past deployed to imagine the ephemeral technologies of a utopian near-future.

A recently successful Graham Foundation small grant award to Simon Herron (University of Greenwich) and Mark Morris (Cornell University) will provide exclusive access and insight into the untouched and complete archive of Archigram co-founder and noted architect Ron Herron (1930–94), creator of the seminal *Cities: Moving, East River, New York* (1964) and gifted draughtsman of a wide array of Archigram and solo projects alike.

This presentation provides a snapshot at the beginning of this complex process. In addition to the familiar, finished or nearly finished works, there are files of collage source material that Ron collected – images of figures, cars, gadgets, toys, lights, plants, clouds and airships – carefully cut from newspapers and magazines of the day. Chosen for subject, aspect and size, these cuttings capture a certain period of time, providing a glimpse of the distinctive method used in creating Archigram's early, iconic architectural images. What this portion of the archive reveals is a special and finite phase of a genre of graphic design aligned to architectural creativity from the *pre-* to the *early Xerographic* period. As context, these early machines produced simple black and white facsimiles and had limited functions – they were, for instance, unable to alter scale. Images were either used as found or, as with the world of advertising and media, re-photographed and adjusted as 'blow-ups' – and the alchemy of the photographic darkroom was central to this practice. Magazines were chosen for the quality of photography and stability of inks and papers. Throughout this pre-digital period, for their pre-electrochemical means of image reproduction Archigram engaged with the tools and practices of professional printers and media alike. As technology advanced, so did Archigram, from static to moving image to complete immersive image-rich, super-saturated sensory environments.

Images seen close up are bold, from the assured line and glistening jet-black liquid stream of the Rapidograph technical drawing pen, air dried by the red hot breath of *Lucky Strike* cigarettes, to the cow gum-fixed, collaged cut-up, with its throwaway aesthetic. Throughout the archive are traces of technological residue – from ruling pen and wash to the tipping point of digital production. All with the simple singular premise in common: produced for reproduction and dissemination – the idea of the magazine at its core.

Box No. 1 – unpacked, a staged photograph, illustrative of the organisational structure of the archive. Among this fragile raw material, there's a rare unpublished account of the drawings of Archigram, written by Ron Herron in December 1979. This paper will introduce this text, seen as a critical cipher that unlocks the unseen workings of the lost analogue world of Archigram. Tracing historical antecedents from the writings of Marshal McLuhan, comic book heroes, artists, cinema, popular magazines, throwaway advertising imagery, a love of plastic, electric light, fluorescent dreams, film-set living – fantasy or reality, all set within the hot-headed, kerosene-fuelled, psychedelic and technicoloured context of youthful rebellion and rejection. Box No. 1 focuses on Ron's writings – project and drawing descriptions, completed and proposed works alike. It's a personalised inventory of ideas – a lexicon and a navigational aid all at once.

THE DRAWING OF ARCHIGRAM BY RON HERRON, DECEMBER 1979

In the early 1960s, for the first time, the architectural world was hit right between the eyes by the speculative projects and accompanying colourful, evocative and 'fantastic' drawings and graphics of the Archigram group.

The group, consisting of Warren Chalk, Peter Cook, Dennis Crompton, David Greene, Ron Herron and Mike Webb, put together project after project with drawings, collages, photomontages and paintings that were published in their own *Archigram* magazine and in the pages of *Architectural Design, Domus, Japan Architect, Design Quarterly, Architectural Forum, L'Architecture D'Aujourd'Hui* and other magazines, as well as being shown on the projection screens at the many slide and multimedia shows that were put on by various members of the group in university lecture halls throughout Europe and America.

The ideas propounded in these projects generated, within the architectural community, a whole range of emotional responses extending from outright rage – and dismissal of the ideas as pure fantasy – to great enthusiasm akin to adulation. The drawings, because they broke with the tradition of architectural drawing, borrowing as they did from the art world, cartoons, advertising art and science fiction imagery, elicited similar outbursts of ridicule or admiration.

The output from the group was enormous and cheerfully enthusiastic, reflecting the general mood of the time. The projects had great, evocative titles, such as: 'Plug-In City', 'Walking City', 'Living City' and 'Computer City'. The catchphrases were 'plug-in', 'clip-on', 'kit of parts', 'capsule', 'movement systems', 'optional extra', 'throwaway', 'metamorphosis' and 'indeterminacy'. The drawings were a surprise. They were brash, boldly drawn, overstated and cheerful, *never* calm, pure, finely drawn, understated or po-faced. They were meant to make you think, to annoy, to stir things up, to open new avenues and, above all, to communicate an architecture that was experimental, or to quote Warren: a "suck it and see" attitude.

Fig. 2: *It's A ... Beach*, Ron Herron, Archigram, January 1971, 610 × 515 mm, photoprint, collage, airbrush, letrafilm and ink on board. © Estate of Ron Herron. All Rights Reserved, 2016.

The drawing style existed collectively within the group, and emerged as we began to work together, with the heavy line drawing style that Warren and I had developed merging with Peter's brashness, Dennis' precision and Mike and David's poetry to emerge as the style of Archigram.

Drawing is a skill that all architects have to acquire, as it is their primary means of communication with both their clients and builders.

The drawings that are made for the client are to enable him to appreciate and understand how the architect intends to manifest, in built form, the client's brief and budget on a given site and within the confines of building and planning regulations.

The drawings produced for the builder enable him to understand, in technical terms, how the built form is to be achieved and to what standard of finish and detail.

Over the course of many years, the means and conventions for making marks on paper, to convey the information to the client and the builder, have been developed to a high degree. All architects learn this means of communication and develop, in the majority of cases, quite sophisticated techniques for imparting this type of information.

The other, less usual, function of drawing to the architect is as a means of describing and discussing 'ideas'. It is this function and the drawings that have been produced by the various members of the Archigram group, from the early 1960s to the present time, that concerns and interests us here.

The prime delight of those who made up the Archigram group is in the exploration, through design, of ideas relating to a broader view of what architecture might be and consequently in the communication of these ideas through graphic means.

Towards this end, we have always been prepared to look outside of architecture in the search for new forms, new technologies and new attitudes, as well as looking for means of communication outside of those which are traditionally available to the architect.

Comics, fashion magazines, sci-fi magazines, the art world, advertising material, graphics, the movies and television were all studied with great care and fascination in this assimilation of other techniques and means of communication.

The group learnt and became confident in these new techniques of presentation and quite skilled at putting complex ideas across in drawings and collages, and subsequently slide programmes, that exuded excitement,

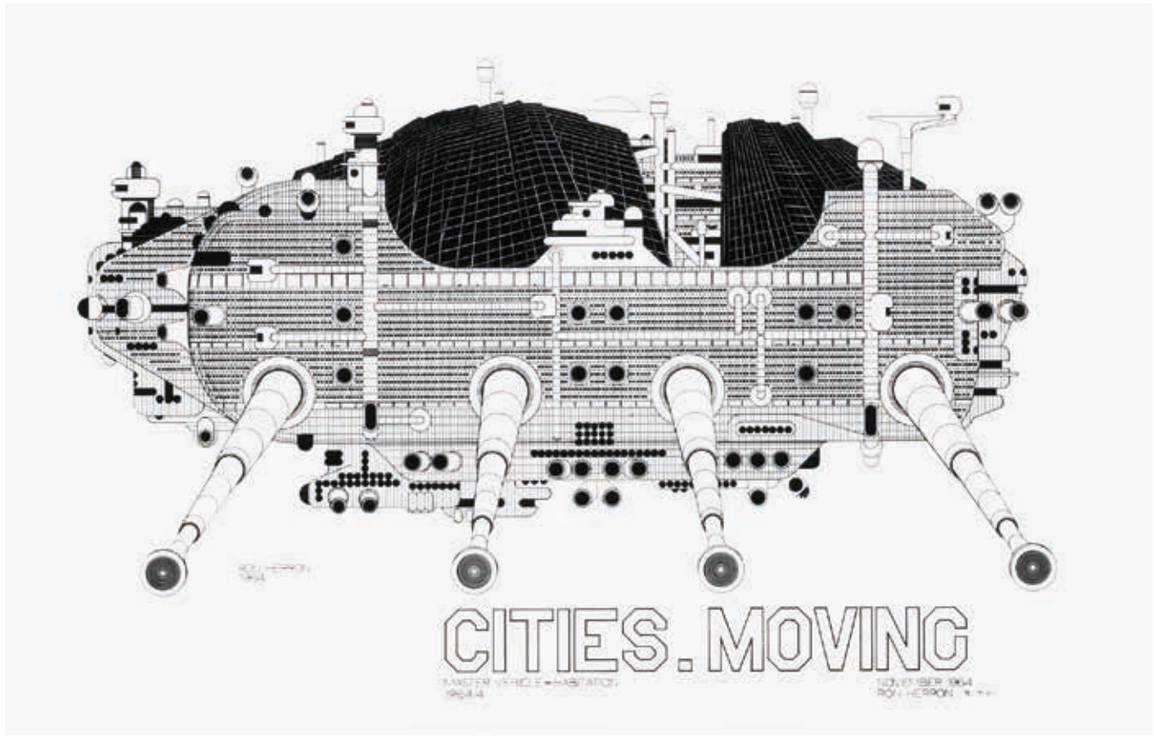


Fig. 3: *Cities. Moving New York*, Ron Herron, Archigram, 1964, 530 × 235 mm, photoprint, collage vehicles, ink, pencil on board. © Estate of Ron Herron. All Rights Reserved, 2016.

Fig. 4: *Cities. Moving Master Vehicle – Habitation*, Ron Herron, Archigram, November 1964, 825 × 550 mm, ink on tracing. © Estate of Ron Herron. All Rights Reserved, 2016.

enthusiasm and belief in what they were doing, and the belief that others would be interested in the manifestation of these ideas. The development of drawing techniques that related to the use of slide and film projection involved the use of colour extensively, initially through the application of colour film, which till then had been used mainly by graphic designers and to some extent by planners, and later through the use of the airbrush, crayon and coloured inks.

Colour became a key component. Exciting and cheerful juxtaposition of colours, which, with the heavy line drawing technique used and the addition of collage material gleaned from the magazines of the day – *Vogue*, *Queen, Nova, Town, Life* and *Paris Match* – related very directly to the mood of London in the so-called Swinging Sixties of the Beatles, Pink Floyd, Pinter, *Blow-Up*, Bailey, Shrimpton, The Stones, Carnaby Street and the miniskirt.

Using multi-screen slide presentation as a demonstration mode and through a consuming fascination with 'change' as a design component, the idea of sequence drawings was developed, that is, drawings that depicted an environment in change through a process of unveiling. This can be seen in the 'Features Monte Carlo' drawings, where plans, sections and perspective of the activity space are shown, using base drawings with a range of events overlaid, to demonstrate change and the responsive environment. The 'Suburbs Strip' also gives a good indication of the use of sequence and the distortion of time to show change.

The prime vehicle for the ideas of the group, between 1960 and 1969, was the magazine *Archigram*, the production of which became possible with the availability of offset litho printing. The magazine first appeared in 1960 and thereafter once a year for a ten-year, ten-issue period, each page a collage of words, drawings and found material, concerning itself with the development of ideas and with design as the mode of experiment.

By the late 1950s, the international style and the international architectural community had stagnated. The dogmas had been formulated and expounded decades before and tested over the years just prior to and immediately after the Second World War, and were found wanting. Hardly any discussion of new concepts and ideas was taking place. The new generation wanted to enter the debate with ideas. They wanted to clear the ground to create a new understanding. This discussion started in various places throughout the world, almost simultaneously in Japan, France, Austria and England. The medium for the propagation and development of the ideas and projects of the Archigram group and their friends would be not in the form of manifestos, as in the past, but in the form of projects, projects to induce radical change within architecture that required radically different graphic means of presentation and communication.

The ideas to some extent, but also the graphic style and imagery to a large degree, have been assimilated by students, the establishment and commercial architects the world over and integrated into the new architectural vernacular over the past years, leading critics to describe such diverse buildings as the Centre Pompidou in Paris and Kurokawa's Nakagin Capsule Tower in Tokyo as being in the style of Archigram.

The impact on and the assimilation by the architectural world of the drawing and graphical style of Archigram is fairly obvious if one takes a liberal view, and can be seen in the drawings of Norman Foster, OMA, Superstudio, Richard Rogers and even Michael Graves. This emphasis on drawing and architecture as a medium for communication has, I believe, led to the current interest in exhibiting, in gallery conditions, architectural drawings and in collecting and framing them as works of art – the Archigram exhibition at the Institute of Contemporary Art in London in 1973 being the forerunner of this. Drawings by various members of the group are now in collections throughout the world, both private and public, including the Gillman Paper Companies Collection, New York, the Victoria and Albert Museum, London and the Museum of Modern Art, New York.

At this point, I believe it will be of interest to discuss antecedents, to trace some of the sources and inspiration for the drawings and graphic style of the group and to show the range of influences and their diversity.

The sources of inspiration were many and varied and included the graphically descriptive collages of John Heartfield, Hannah Höch, El Lissitzky, Moholy Nagy and Rodchenko, the pages of the 1920s and 1930s magazines such as *Lef*, *De Stijl*, *ABC*, *Merz* and *Vivante* and the drawings of Le Corbusier, Hannes Meyer, the Vesnin Brothers, Leonidov, Mart Stam and Tchernikov.

The more recent projects of Konrad Wachsman, Frei Otto, Alison and Peter Smithson, Yona Friedman and the Japanese Metabolist group were well-known to the Archigram group, as was the work of artists such as Richard Hamilton, Richard Smith and Eduardo Paolozzi, which was as much admired for the 'ballsy' presentation as its humour, message and the obvious enjoyment of the artist.

The 'This is Tomorrow' exhibition at the Whitechapel Gallery in 1956 was visited by Warren Chalk and myself. It comprised a series of set piece environments designed by members of the Independent Group and their friends. Two of the exhibits had a tremendous impact on Chalk and myself, primarily because they related so much to our own thinking at the time. One, by Lawrence Alloway, Toni Del Renzio and Geoffrey Holroyd, was a tackboard intended as a lesson in 'how to read a tackboard', the tackboard being a convenient method of organising modern visual information according to an individual's decision. The tackboard area included optical diagrams as a comment on information theory, photographs of a giant soap powder carton and Marcel Duchamp's 'Nude Descending a Staircase, No. 2'. The other exhibit,

designed by Richard Hamilton, John McHale and John Voelcker, included images of Marilyn Monroe, a jukebox, the use of ultraviolet light and a huge cut-out of a science fiction monster carrying a girl. It also included a poster by Richard Hamilton, made from a collage entitled 'Just what is it makes today's homes so different, so appealing?', which shows the home as a series of references which we have all been conditioned to understand, to make the point that our familiarity towards and reaction to this world is conditioned by these references and images. The collage includes elements of modern technology such as a tape recorder, television set and vacuum cleaner, and contains a reference to the cinema by means of a movie poster advertising an Al Jolson talkie, all this juxtaposed with 'beefcake and cheesecake' pictures of furniture from high street furniture showroom catalogues.

The catalogue of the 'This is Tomorrow' exhibition became a much-prized possession and was often referred to when the early Archigram exhibition work was being discussed, particularly at the time of Archigram's 'Living City' exhibition at the Institute of Contemporary Art, London, in 1963. To quote from Lawrence Alloway in the catalogue of 'This is Tomorrow': "In 'This is Tomorrow' the visitor is exposed to space effects, play with signs, a wide range of materials and structures, which, taken together, make of art and architecture a many-channeled activity, as factual and far from ideal standards as the street outside..." – a statement that coincided very much with the philosophy of 'Living City'.

Another major influence on the drawings of the Archigram group was the emergence of 'pop art' in England in the late 1950s, specifically the work centred around the various artists that emerged from the Royal College of Art in this period, the Royal College of Art magazine *ARK* and particularly the work of Peter Blake, Richard Smith and Joe Tilson, followed later by Peter Phillips, Allen Jones, David Hockney, Derek Boshier, Patrick Caulfield and Ronald Kitaj. A group of painters that for a while, and certainly historically, were seen to be cohesive enough to be regarded as a 'movement' in a real sense. American pop art was also of great interest, in particular the work

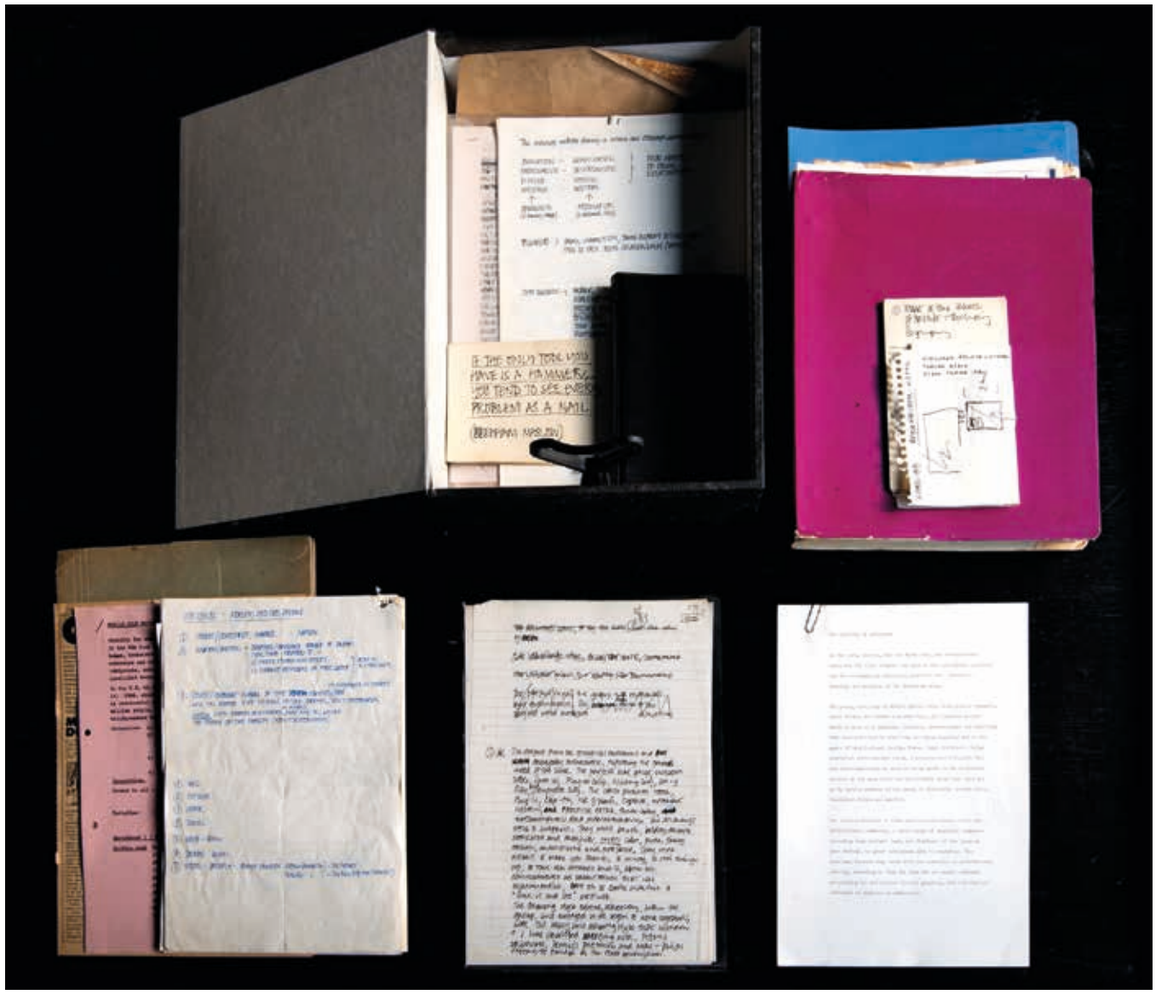


Fig. 5: *Box No.1: Unpacked* © Estate of Ron Herron. All Rights Reserved, 2016. Photos: Susanne Isa.

of Claes Oldenburg, Roy Lichtenstein, James Rosenquist and Andy Warhol, who said, "I love Los Angeles. I love Hollywood. They're beautiful. Everybody's plastic – but I love plastic. I want to be plastic".

The emergence of 'pop art' related directly to a new and universal consuming interest in the whole sphere of communications, which was beginning to be called mass media. The 'information industry' was a popular, fashionable area of academic study at the time and writers and scholars such as Greenberg, Packard and particularly Marshall McLuhan made it a part of everyday conversation, so much so that by the late 1950s so much attention had been centred on the previously sneered-at media and their contents that when pop painting appeared on the scene, the response was generally enthusiastic.

The essence of the McLuhan argument is that society has always been shaped more by the nature of the media by which people communicate than by the content of the communication. Through his books *Understanding Media*, *The Medium is the Massage*, *Counterblast*, *The Gutenberg Galaxy* and *The Mechanical Bride* he had a great impact on the group and opened our eyes to this electronic age and what effect this might have on our built environment, with statements full of astute guesswork and great showmanship, such as, "the circuited city of the future will not be the huge hunk of concentrated real estate created by the railway. It will take on a totally new meaning under conditions of very rapid movement. It will be an information megalopolis. What remains of the configuration of former 'cities' will be very much like world's fairs – places in which to show off new technology, not places of work or residence. They will be preserved, museum-like, as living monuments to the railway era".

Often, the more direct influences of other architects and designers were there but not discussed. We were not collectively sifting through and devouring graphic ideas from magazines, comics, the cinema and television and debating their use in our own work, or poring over the drawings of Le Corbusier, Vesnin, Kahn, Otto, Walt Disney and Hamilton searching for inspiration. Rather, it was a passing reference to things seen, which were then absorbed and reinterpreted into this style of Archigram by the individuals in the group.

The strength of a group such as Archigram lies in the collective effort and in the differences as much as the similarities of attitude; in the wide range of individual interests as much as those which are shared. In Archigram's case, the work of the individual, when added to that of the others, makes up a body of work that is of a whole and relates directly to that moment in time, responding to ideas that were 'in the air', even though the individuals in question were often operating independently of each other and were even geographically sometimes thousands of miles apart.

It has been noted that historically the ideas, drawings and presentation techniques of the 'masters' relate very directly to their attitudes to architecture, their response to the programme presented to them and the moment in time – i.e. the precise drawing technique and simple collages of Mies Van Der Rohe, the austerely drawn social housing projects of Walter Gropius, the freely composed, 'hairy' drawings of Le Corbusier and the engineering-like drawings of Buckminster Fuller. Matching technique to idea became part of our game and the sources were expanded into any area that had drawing, painting, collage, photomontage and audiovisual systems as the primary means of communication.

These new means, in an architectural sense, of drawn communication were used to depict, among other things, environmental concepts such as the responsive environment, change, movement, time, the simulated environment, ambience/emotion/atmosphere and architecture as process. These were concepts that did not lend themselves to communication through the standard architectural plan, section and elevation drawing or even the ubiquitous axonometric projection.

Drawings that told a story became necessary, drawings that included words – big bold words. As in advertising, words became part of the drawing. Collage was used partly to increase the potency and partly to give a sense of reality to the statement. The overlay of collage material, drawn images and words got the message across in a bold, punchy, heightened and non-architectural way.

Overstatement was used to get across an idea – and then the message was repeated and repeated and repeated. The ideas were often against everything that was held sacred by most architects, i.e. they represented the environment in change – a non-permanence, an architecture that was barely there, an architecture that metamorphosed, along with ideas that insisted on new means and ways of communication.

The drawings now look, inevitably, a part of history. They were very much of their time, together with the ideas they presented. The techniques have been absorbed into architectural know-how even if the ideas have not. But the group, although no longer operating together, still operate and still relate to one another. They still retain an absorbing interest in the communication of ideas and in new techniques of communication.

To quote from Hans Hollein in *Archigram*: "Many thoughts of Archigram seem, after having been formulated, so self-evident, almost so commonplace, that they soon will not be regarded as specific utterances, as individual viewpoints, but as expressions of common, hidden, subconscious longings. They became part of a new architectural verna-cular which to an outsider obscures the source. He mistakes the implementor for the inventor." That's the communication business.

Drawing a Volcanarium, or How to Represent a Very Large Figure

Adrianne Joergensen

We often hear it said that 'architects don't make buildings, they make drawings'. The same could be said for the scientist-explorers of the nineteenth century – among them, Alexander von Humboldt, Charles Darwin and Alfred Wallace – who not only amassed libraries of plant specimens (herbaria), but also produced volumes of graphic material from their travels. Their experimentation included developing new, rigorous methods of visually representing their findings. One such graphic precedent, Humboldt's 'Naturgemälde', a drawing of the volcano Chimborazo in Ecuador, was as revolutionary for its design as it was for its content (Fig. 1). On the metre-wide section, which accompanied the 1807 edition of the *Essay on the Geography of Plants,* he writes the names of plants according to their altitudes, and on either side of the image displays columns of supporting data – temperature, humidity, even the colour of the sky – all in spatial relation to their position on the mountain.[1] As Andrea Wulf explains in *The Invention of Nature,* Humboldt was "now ready to present to the world a completely new way of looking at plants, and he had decided to do so with a drawing [... He] used this new visual approach so that he could appeal to his readers' imagination, he told a friend, because 'the world likes to see'."[2]

A pioneer in infographics, Humboldt designed his 'Naturgemälde' as a "microcosm on one page".[3] Through the lens of the scientist-explorer, the drawing became an autonomous object, freed from its original site. It was a blockbuster in a time where scientific research, travel and wonder were closely linked. Lithography facilitated dissemination of this and other drawings to delight a primarily European audience, most of whom would never visit the tropics. Two centuries after Humboldt, his drawings, as artefacts of the journey and the research, still engender speculation about distant places. As an architect, I am interested in the connections between travel and representation, between the firmness of research and graphical delight. Rather than writing esoteric texts, I create autonomous worlds using different modes and types of rigorous architectural drawing. The word 'drawing' grammatically captures its double existence as both *process,* a vehicle for conducting research, and *product,* an artefact that represents these findings to an audience. Like my scientific predecessors, my aim is to compose a whole image, one possible representation of a site that is simultaneously liberated from it.

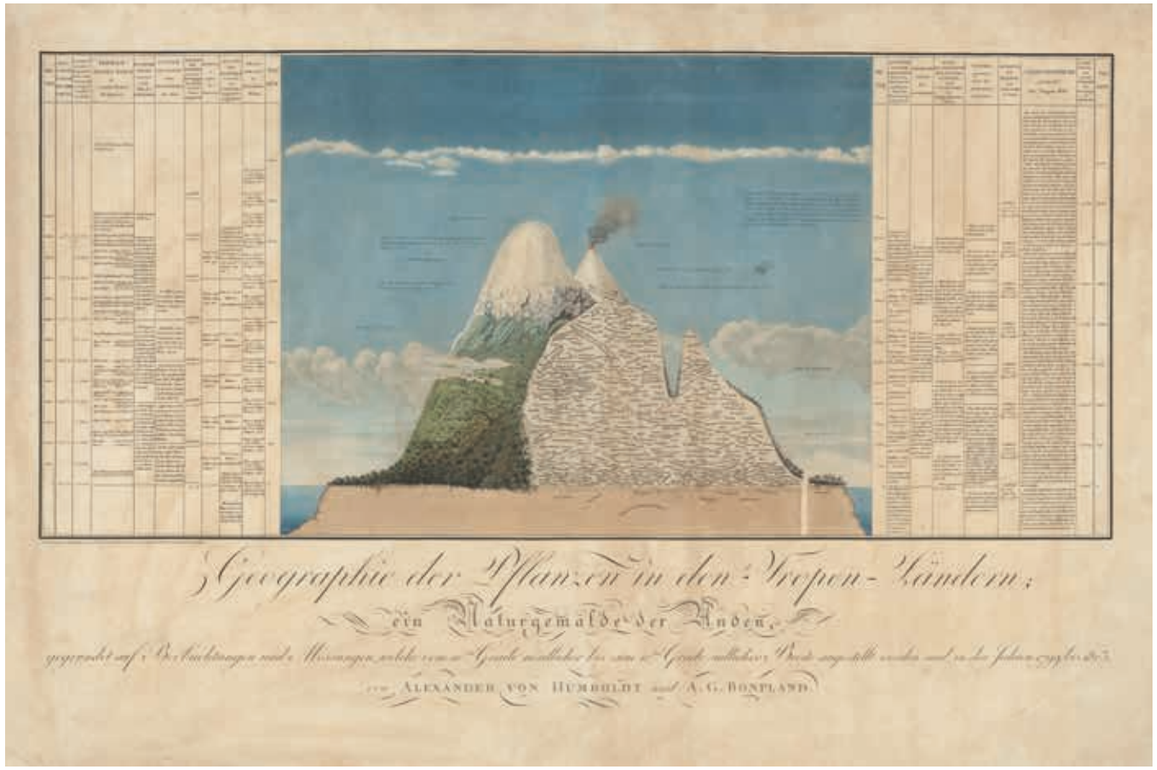


Fig. 1: Alexander von Humboldt, 'Ideen zu einer Geographie der Pflanzen nebst einem Naturgemälde der Tropenländer' ('An Essay on the Geography of Plants, together with a Nature painting of the Tropics') (Paris: Langlois, 1805). Humboldt's cross-section of the volcano Chimborazo was as revolutionary for its use of graphical representation as much as for its scientific content.

Fig. 2: Franz Wilhelm Junghuhn, 'Gunung Merapi' in *Java Album* (Leipzig: Arnoldische Bunchhandlung, 1856). Junghuhn depicts 'Gunung Merapi', the first volcano he climbed, with small climbers looking over the sharp edge of the summit crater against a bright blue sky.

As part of 'Tourism and Cultural Heritage: A Case Study on the Explorer Franz Wilhelm Junghuhn', a three-year research project on travel and research led by Professors Philip Ursprung and Alex Lehnerer and based at the ETH Zürich Future Cities Laboratory (FCL) in Singapore, I am retracing the journeys of Humboldt's lesser-known contemporary Franz Wilhelm Junghuhn (1809–64) across the island of Java. A German scientist-explorer in the service of the Dutch in the mid-nineteenth century, he was one of the first Europeans to climb and document Java's volcanoes. Later dubbed the 'Humboldt of Java', Junghuhn used various drawing methods and types to supplement his extensive texts on natural sciences. Working before the time of scientific specialisation, Junghuhn studied botany, mycology, cartography and geology, and these interests are clear in his rich compositions. Together our international group of architects, artists, historians and geologists climb seventeen of his favourite volcanoes to theorise about contemporary relationships between urbanity and nature, between the researcher and the landscape. My work mobilises Junghuhn's drawings as instruments for rediscovering Java's volcanoes and as a basis for my research on the connections between travel, research and representation.

A century and a half after Junghuhn's Java explorations, its landscape still intrigues, not only because it is continually being constructed and deconstructed by its 45 (known) active volcanoes, but also because it is highly urbanised. Roughly the size of England and with a population of 141 million, Java is the world's most populated island.[4] in the theoretical context of *Delirious New York,* we see Java as our Manhattan and its volcanoes as skyscrapers.[5] Like Hugh Ferriss' dramatic skyscraper envelope paintings, which he describes as 'buildings like mountains', the volcanoes are very large figures in elevation view, seemingly separate from their landscapes, and yet they are the dynamic structures that produce the very ground from which they emerge.[6] Like a skyscraper, the volcano is a concentration of human programmes and populations, and a centre of civilisation.[7] It is also a test of risk and resilience. This is a different narrative of nature – not a conception that is passive and vulnerable to human action, but a nature that is volatile and not always 'good'. Some residents regard the volcanoes as active beings, with their own personalities and moods, possessing the power to 'talk' and morally react to human actions. Scientists and spiritual leaders alike must 'read' the volcanoes for signs

of future activity.[8] Through a series of ongoing events, the volcano changes its own form and that of the surrounding landscape. Like Ferriss' process for evolving the skyscraper form, a primitive form that was later cut with terraces to allow light in and permit more regular interior programmes, the volcano rebuilds itself and the surrounding landscape in a cycle of construction and destruction.[9] During an eruption, the volcano assumes different states of matter, from steam and airborne ash to liquefied lava to rock flows and larger airborne rock 'bombs'; the worst of them, the pyroclastic flow, combines all three at a tremendous force and temperature. While the volcano proves dangerous due to its complete unpredictability as an event, its presence is welcome because its ash "makes these islands some of the most fertile on the planet [...] volcanoes spur rice fields to extraordinary bounty. Many farmers manage three rice crops a year [...] and they produce an abundance of fruit and vegetables too".[10] This extreme juxtaposition of unstable ground, agricultural landscape and increasing urban density makes understanding and representing conditions on Java an interesting architectural problem.

The outcome of my ongoing research will be a set of seventeen drawn portraits of Javanese volcanoes. This paper describes my method of drawing as a process and a product, taking the portrait of Mount Merapi as an example. This drawing attempts to compose these geological and programmatic relationships in space using a consistent architectural language. Like a written text, a drawing quotes, remixes and consolidates previous scholarship, but has a greater capacity for communication with more diverse audiences by overcoming barriers in language and disciplinary knowledge. As a verb, drawing demands a level of familiarity with the site; as a noun, the artefact resides in a historical research continuum with science, painting and architecture. Humboldt and Junghuhn understood that even non-specialist audiences could 'read' their drawings and be fascinated by their content. Rigorous architectural drawings, rather than sketches, maps and diagrams, are central to our research processes. We mobilise drawing as a high-resolution medium to focus on a very contained site and use our findings to speculate about urban issues in a larger area. The challenge of drawing the volcano is that it is opaque, and its inner forces unknown. Because it is not a scientific paper, the drawing allows me to speculate on this hidden dimension, albeit in a very serious way.

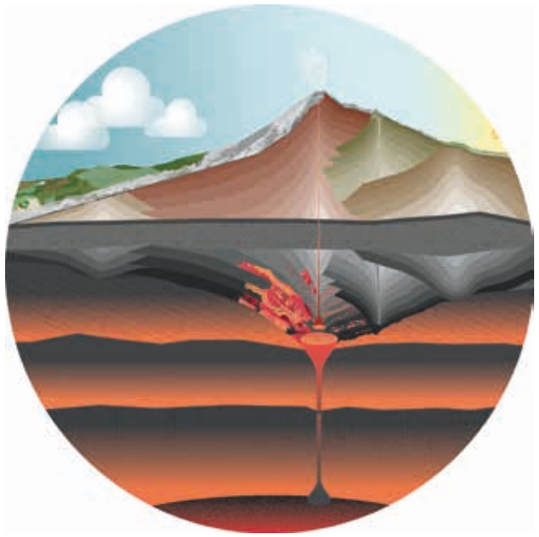


Fig. 3: Adrianne Joergensen, 'One possible view of/over/into Gunung Merapi', 2016, 36 × 36 in. This portrait of Mount Merapi depicts the spatial proximity of human conditions on the surface to the volcano's active interior, as well as the shifting states between, by combining different drawing planes (plan, elevation and section) within one composition.

BUILDING A VOLCANARIUM

Where my precedent explorers assembled herbaria, or collections of plant specimens, to develop theories about them in connection to their greater contexts, I am building a 'volcanarium', or a library of images of the volcanoes to inform my own composition. My research begins with on-site empirical research. Where Junghuhn spent years climbing and measuring the volcanoes, our group travels to Java for five days at a time on a series of expeditions conducted every six months over three years. These on-site observations are two-fold: to observe the whole volcano at a distance, sometimes from another peak, as Junghuhn often did; and to observe the volcano's changing ecological and climatic conditions while walking on it, as Humboldt did. I use Junghuhn's drawings, including the twelve renderings in the *Java Album* (1856), his detailed *Java Karte* (1855) and longitudinal sections as navigational tools, looking for the observation points from which he composed his images. They enable me to observe how the volcano has changed in the last 150 years, to see how the area has urbanised and to speculate on where he may have invented, collaged or embellished his composition. Along with the members of our group, I take photos and videos of conditions, materials and objects at each site. To inform and supplement my travels, I borrow from the experiences of others, including discussion with scholars and local residents, and reference others' images, disciplinary texts and scientific diagrams. Current and historic maps and satellite imagery help me to put the volcanoes in historic and physical contexts. The volcanoes are becoming increasing popular with tourists, especially Indonesians, and my work incorporates the viewpoints of the many tourist images and blogs of other volcano enthusiasts.

'ONE POSSIBLE VIEW OF/OVER/INTO GUNUNG MERAPI'

My intention is to portray the spatial proximity of human conditions on the surface to the volcano's active interior, as well as the shifting states between them, by combining different drawing planes (plan, elevation and section) within one composition. Depicting the relationships of different groups to the volcano – village residents, farmers, miners, tourists and scientists – means reconciling

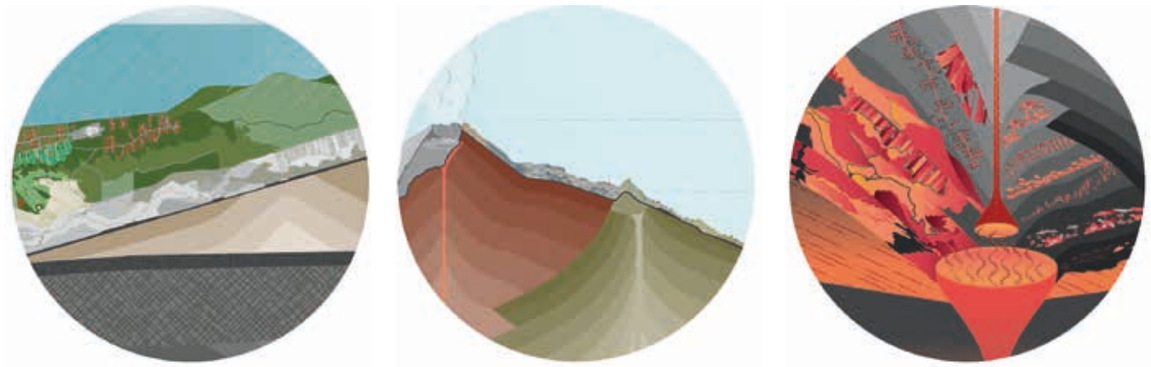


Fig. 4: Details, Adrianne Joergensen, 'One possible view of/over/into Gunung Merapi', 2016, 36 × 36 in. Details of Merapi's southern slope in plan, the summit in elevation and the interior in section.

the size disparity between the volcano and individual actors. It is fitting that my portrait series should begin with Gunung Merapi (meaning 'fire mountain'), the most dangerous volcano on Java. (It is the favourite among Indonesian volcanologists, because, as they say, 'He talks to us the most.')[11] Located in Central Java about 25 kilometres north of the city of Yogyakarta, Merapi has been the subject of much international press and scientific inquiry since its 2010 eruption, a '100-year' event that killed approximately 400 people, displaced hundreds of thousands and destroyed villages and fields.[12] It is nearly constantly active, and its volatility is evident in Junghuhn's rendering in the 1856 *Java Album* (Fig. 2). The frame is cropped to show only the rocky summit against a bright blue sky. The small figures of the climbers, having traversed the steep slope, peer over the sharp crater edge. Other renderings in the *Java Album,* such as 'Gunung Sumbing', frame a symmetrical, centred composition of the conical volcano in the background, with its botanical, agricultural, social and anthropological components in the foreground. Not only were these other elements important to Junghuhn's portrayal of the volcano's rich biodiversity, but they also demonstrate Junghuhn's various scientific interests and build his scientific credibility.

My Merapi portrait shows the elevation of the volcano contained within a circle, a cropping indicating that this is a detailed view of a much larger scenario (Fig. 3). The drawing starts from the lower slopes on the south to the saddle between Merapi (2,968m) and its taller dormant twin, Merbabu (3,145m), to the north.[13] The elevation consolidates the scars of Merapi's past, shown in the ghosted lava domes, which collapse and rebuild over time. In the 2010 eruption, the pyroclastic and lahar flows widened the Gendol River valley from the summit down the southern slope towards Yogyakarta. As shown in plan, some of the upland villages and farms were protected from the eruption by the Turgo and Plawangan hills; others, now covered in ash and sand, were not so fortunate (Fig. 4). These areas have since been deemed unsuitable for permanent residence, and villagers guide tourists around their ruined villages in jeeps. The highlights include the Batu Alien, a massive face-shaped rock, which was thrown five kilometres away from the crater; the Museum Sisa Hartaku, which displays ruined household objects and cow skeletons; and the Bunker Merapi, where two people seeking refuge from the pyroclastic flow were killed. Initially detrimental to crops, Merapi's "river systems bring the extraordinarily rich volcanic ash to the plains around [it] which could be hundreds of kilometres away from the origin, hence contributing to the fertility of the soil in the area".[14] Crops such as tobacco and coffee are grown on Merapi's slopes, and at a further distance rice and sugar flourish. The areas shown in plan are contained within the political bounds of the Yogyakarta regency, which runs up the south face of Merapi like a pie wedge. The deformation of the crater makes its exact terminus difficult to pinpoint.

Merapi was the first volcano that Junghuhn climbed in 1836, and one he would return to many times. He also climbed Merapi's dormant twin, Merbabu. His 1845 rendering 'Des Nordseite die Merapi' shows the elevations of the two peaks in closer proximity with an exaggerated figure of the explorer, carrying a walking stick and telescope (Fig. 5). Junghuhn's elevations more closely resemble our expected image of a volcano than his plans, which are primarily used in his *Java Karte*. His Dutch sponsors likely commissioned the map for resource speculation and military domination, but the result reflects his interests in cartography and volcanology. He was able to accurately measure the volcanoes by climbing them with a barometer, which must be carried upright at all times and made climbing a tedious and gruelling process.[15] His richly detailed topography shows how the volcano becomes distorted in plan. The detailed craters look like organs, and were probably not useful for the Dutch administration. A similar issue of distortion occurs in modern means, like Google Earth®, which makes it difficult to read the extremity of conditions or approaches to the summit. In this drawing, the north face traces the route of our re-enactment of Junghuhn's climb in plan and elevation. Our journey began in the middle of the night, following guides from the base camp in Selo, which lies at the saddle between Merapi and Merbabu. We climbed in darkness with headlamps, our surroundings invisible until after we

reached the summit and watched the sunrise. The track here is difficult but heavily worn, and there are resting posts along the route. The old Merapi peak makes a 'false summit' and made us groan with the realisation that we had not really reached the top. Returning down the slope, we encountered different types of rock surfaces, ecosystems and agriculture.

The ground surface is conversely the roof of the volcano. Since no one can see inside an active volcano, scientists and spiritual and political leaders develop different theories about its presence. During Junghuhn's time, volcanology was a controversial, developing discipline. He primarily uses sectional drawing, as in the 'Laengsprofil' from the 1845 *Topographical and scientific Atlas to Journey through Java,* to depict the heights of Java's volcanoes in relation to each other, rather than to speculate on their interior form and contents. Today, scientists monitor the volcano's changes visually and through seismographs. They tend to portray Merapi's interior in simplified diagrams, with layered strata and two magma chambers, one assumed to be between 1,500 and 2,500 metres below Merapi's peak, which is fed by another, larger one 10–30 kilometres below.[16] The two older Merapi peaks, now dormant, are visible to the right of the stratovolcano.[17] Where scientists look to the volcanoes to make scientific advances, some Javanese look to them for spiritual insight.[18] They believe that "there is a spirit world inside the crater of Merapi volcano that mirrors the world of humans", which also acts as a moral compass, capable of administering judgment for misbehaviour.[19] For example, some speculate that the 2010 eruption was partially instigated by the volcano's dissatisfaction with the golf course that was recently built on its southern slope. The golf course was closed for a year after being halfway submerged in ash. This concept of Javanese cosmology uses the landscape for power and positions the Keraton (Palace) in Yogyakarta at the centre of a spiritual axis that is meant to keep harmony between the Merapi volcano and Nyai Roro Kidul, the goddess of the south sea.[20] The Keraton was the first structure built in Yogyakarta in 1756, and the city grew around it. The Sultan of Yogyakarta has a *juru kunci,* a spiritual gatekeeper, whose role is to appease the spirits of the volcano through, among other things, an annual ritual called the *labuhan,* in which offerings are made "to the supernatural creatures for safety and wealth of Yogyakarta".[21] The previous *juru kunci*, Mbah Maridjan, was killed in the 2010 eruption when he refused to evacuate from his village, despite the government's official warning, believing that "the eruption would not do any harm since there was no sign from the supernatural creatures of Merapi volcano".[22] The site of his house is now a destination for pilgrims and tourists alike.
My section attempts to reconcile these two differing theories about Merapi's interior. Around the first magma chamber, the strata are occupied by this alternate world, which is drawn as an imagined company town that produces magma. Merapi is an infrastructural system whose interior activity produces the conditions and effects on its exterior.

OUTCOMES

In combining different planes of representation, my drawing of Merapi consolidates different aspects of urbanity and nature, of disasters and everyday life, into one possible portrait of conditions on Java. With destruction often comes reconstruction and innovation, as in cities like Chicago after the Great Fire of 1871.
As an architect conducting research at an institute in southeast Asia, I am interested in alternate methods of documenting and confronting urban issues, not by looking at the city, but by studying one of its formative structures. Our empirical research continues into 2017, and we will work on the exhibitions and book publication over the following eighteen months. The seventeen portraits will clarify the differences and similarities of each geological and ecological condition and its relationship to its surrounding urban and residential context. Whether shown in an exhibition or published in a folio like Junghuhn's *Java Album,* they will be informed by both their origin sites and by the reception and extrapolation of the audience. When Humboldt's friend Goethe received his copy of *Essay on Plants,* the 'Naturgemälde' drawing was missing, so Goethe drew his own.[23]
No longer Chimborazo, nor a complete flight of fancy, the drawing detaches from its original site to become an autonomous world. Like Humboldt's 'Naturgemälde', my intention is that the Java volcano portraits could become graphic artefacts for other researchers to wonder about and invent, in a volcano landscape or otherwise.

1 "The Invention of Nature", Last modified 5 February, 2015. http://geographical.co.uk/places/mapping/item/1542-the-invention-of-nature.
2 Andrea Wulf, *The Invention of Nature: Alexander Von Humboldt's New World* (Knopf Publishing Group, 2015), 90.
3 "The Invention of Nature",
4 "Indonesia: Urban Population of Cities", Retrieved 22 December, 2015. Last visited 9 July 2016. http://citypopulation.de/Indonesia-MU.html
5 Philip Ursprung, "Footnotes from East Java" (Presentation given at ETH Future Cities Laboratory, Singapore, 28 January 2016)
6 Rem Koolhaas, *Delirious New York: a retroactive manifesto for Manhattan*. (New York: The Monacelli Press, 2014), 125.
7 Ofita Purwani, "Javanese Power: Silent ideology and built environment of Yogyakarta and Surakarta" (PhD diss., University of Edinburgh, 2014), 59.
8 Adam Bobbette, "Getting to Know a Few Hundred Degrees: Scientists on Mt. Merapi Since 1900" (Presentation given at ETH Future Cities Laboratory, Singapore, May 5 2016.)
9 Koolhaas, *Delirious New York.* 112.
10 Elizabeth Pisani, *Indonesia, Etc.: Exploring the Improbable Nation* (WW Norton & Company, 2014), 175.
11 Adjat Sudradjat, personal interview, 6 September 2015.
12 "Merapi" on Smithsonian Global Volcanism Programme website, Last visited 11 July 2016, http://volcano.si.edu/volcano.cfm?vn=263250#bgvn_201102.
13 "Merbabu" on Smithsonian Global Volcanism Programmeme website, Last visited 11 July 2016, http://volcano.si.edu/volcano.cfm?vn=263240
14 Purwani, "Javanese Power. 59.
15 Renate Sternagel, *Der Humboldt von Java: Leben und Werk des Naturforschers Franz Wilhelm Junghuhn 1809–64*. (Halle: Mitteldeutscher Verlag, 2013), 86.
16 Ken Jorgustin, "XXX Magma Chamber deep under Merapi?" Last modified 7 November 2010. http://modernsurvivalblog.com/volcano/xxx-magma-chamber-deep-under-merapi
17 Surono and Subandriyo, eds. "1.1 Geological History" in *Visual Images of Merapi Volcano*. (Bandung: Geological Agency of Indonesia, Centre of Volcanology and Geological Hazards Mitigation: date unknown), 2.
18 Michael R. Dove, "The panoptic gaze in a non-western setting: self-surveillance on Merapi volcano, Central Java", *Religion 40* no. 2 (2010): 121.
19 Dove, "The panoptic gaze". 124.
20 Ibid., 124.
21 Purwani, "Javanese Power". 66.
22 Purwani, "Javanese Power". 87.
23 Wulf, *The Invention of Nature,* 37.

Fig. 5: Franz Wilhelm Junghuhn, 'Die Nordseite des Merapi, aus einer Höhe von 7500 Fuß vom südlichen Abhange des Merbabu gesehen.... Nov. 1836' ('Seen on the north side of Merapi, from a height of 7,500 feet from the southern slope of Merbabu') in *Topogr.u.naturwiss. Atlas zur Reise durch Java* (Magdeburg: 1845). Junghuhn shows himself as an adventurous explorer looking through his telescope at Mount Merapi from the summit of nearby Mount Merbabu.

Anamorphosis: An Inquiry into the Unknown

Thi Phuong-Trâm Nguyen

ABOUT INVENTIONS ARISING FROM MATHEMATICS

> "By the truth they revealed, they perfected our knowledge by providing us with thousands of advantages, they also recreated our senses, not just by pointless speculation by the inventors, but in taking delight in seeing the possibilities beyond what they expected." [1]
>
> Jean-François Niceron – *La Perspective curieuse*

This essay addresses the development of anamorphic drawing as a particular event in the evolution of representation and perspective, in order to propose a historical understanding of the relationship between theoretical research and making. Anamorphic images are a drawing projection technique that was developed in parallel with the science of perspective and whose refinement culminates around the end of the seventeenth century. While perspective has evolved towards using geometry to represent the appearance of space on a flat plane as accurately as possible, anamorphic images use the same geometrical principles, but carry them to an extreme and instead create a break in the real. In anamorphic images, representation is not a perpendicular plane in front of the viewer but a diagonal cut in the cone of vision, allowing an entry into the space of vision.

The core of this paper is rooted in the study of the development of anamorphic images by friars belonging to the Minim Order, more specifically through the work of the friar Jean-François Niceron (1613–46) and his seminal book on anamorphosis, *La Perspective curieuse*. It will analyse the practice-led research and experimentation by the Minims to capture the relationship between their research aims and their theoretical concerns, in order to understand the intention behind their making practices. I am interested in how their desire to grasp the world and its many unknowns was translated into specific types of experiment, text and discoveries. The study covers this particular episode of the development of anamorphic images because, beyond the play on vision, they represent an embodiment of the Minims' philosophy through research into vision, touch and desire for wonder. Moreover, I will argue that there is a resonance between their way of approaching research and experimentation and a contemporary concern about thinking through making.

If anamorphic images open up a space of desire for wonder manifested only in the physical encounter of the image, how in return can it be constructed? Drawing, for Niceron, established a way to inquire into the realm of optics and led to the elaboration of a drawing technique that allows the occupation of the space of vision. Focusing on the performative aspect of anamorphosis, this paper attempts to draw a parallel between how Niceron engaged with the unknown through his research and the construction of the space of wonder in anamorphic images, in order to establish a connection between our making and the world around us.

THE MINIMS – THE ORIGIN OF THE MINIMS

The Order of the Minims was founded in 1453 in Calabria by a hermit who would later be canonised as St Francis of Paola (1416–1507). The Order received official recognition by the Papal brief from Sixtus IV in 1472. St Francis was known as a thaumaturge – a worker of wonder or performer of miracles – who could heal through his touch.[2] The name of the Order comes from their humility and minimal way of subsistence; they were considered the most austere of the orders, due to their vows to live in a continuous Lent (a 'Lenten' way of life).

The powers of St Francis were well-known and were requested by King Louis XI of France on his deathbed in 1483. At his arrival, St Francis was too late to heal the king, but took care of him until his death, after which St Francis became the protégé of the royal family and

Fig. 1: Jean-François Niceron, *La Perspective curieuse*, Portrait of the author, Paris, 1638 (Institut national d'histoire de l'art – Collections de l'Ecole Nationale Supérieure des Beaux-Arts).

stayed in France. Under their protection, the Order was very prosperous and by 1609, under the patronage of King Henry IV, had founded its convent in Paris' Place Royale.

THE CONVENT OF PLACE ROYALE – A CENTRE OF RESEARCH AND CREATION

During the first half of the seventeenth century, under the guidance of the Minim Marin Mersenne (1588–1648), the Convent of Place Royale was an important centre for scientific studies. The collection of Mersenne's correspondence evidenced that he was in touch with men of many different fields, such as Descartes, Desargues and Pascal, to share their knowledge about subjects such as philosophy, mathematics and physics.[3]

Mersenne had the idea for an academy of science as early as 1622, but it was around 1635 that he established the *Academia Parisiensis*. Its beginnings are quite vague and clandestine, most likely due to the condemnation of Galileo in 1633 and the hanging of the chemist Chanloux in 1631.[4] Mersenne envisioned the *Academia Parisiensis* as a place to discuss the relationship between practice and theoretical knowledge, but also as a place for arts and crafts.[5] After his death, the model of his academy became the precursor of the *Académie Royale des Sciences* established by Jean-Baptiste Colbert in 1666, known today as part of the *Institut de France*.

MARIN MERSENNE, JEAN-FRANÇOIS NICERON AND EMMANUEL MAIGNAN

Marin Mersenne entered the Minims in 1611. His main interest was music, and through his treatise *Harmonie Universelle* he sought to reconcile musical harmony with both the movements of the celestial bodies and the sciences. "Mersenne was a supreme representative of that philosophical, scientific and aesthetic tendency that aimed to establish a kind of '*unified field theory*,' in which every level of order in the universal and world systems was representative of the same underlying structures."[6]

Under Mersenne's wing, Jean-Francois Niceron joined the Minims at the age of 18. He studied mathematics and was a gifted artist, but his greatest interest resided in perspective and optics. For Niceron, "[...] optics offered us significant progress in both science and arts, and very pleasurable entertainment for the satisfaction of our sight, which is the noblest of our senses".[7]

Finally, the friar Emmanuel Maignan (1601–76) entered the Minims in Toulouse in 1613. Following this, he was asked to the Minim convent of Santa Trinità dei Monti, on the Pincian Hill in Rome in 1636.[8] During his time in Rome, Maignan was part of the circle of the Jesuit Athanasius Kircher, a major figure in the development of the history of science. Kircher possessed a broad and eclectic knowledge across disciplines, sharing a particular interest with Maignan in light and optics.[9] Maignan is known for his treatise about sundials and various optical instruments, *Perspectiva Horaria* (1648), in which he describes his catoptric sundial in one of the corridors of the cloister.

Niceron first encountered Maignan during a visit to the Minim convent of Santa Trinità dei Monti. The contact between the two men is related in a late eighteenth-century unpublished manuscript by the Minim Charles Martin that recounts the history of Santa Trinità dei Monti. According to Martin, Niceron arrived in Rome while Maignan was working on an anamorphic wall painting on the west wing of the cloister. Niceron was so impressed by the work that he suggested, in the corridor opposite, painting St John the Evangelist on the island of Patmos writing the Apocalypse. During Niceron's stay in Rome, the two discussed the techniques of anamorphic drawing, worked on mathematics and studied Hebrew together. Moreover, Martin recorded that Maignan and Niceron in fact worked *together* on their anamorphic painting on the walls of the cloister.[10]

AN ANAMORPHIC MURAL PAINTING – A NARRATIVE PROCESS BETWEEN APPEARANCE AND APPARITION

The painting by Maignan in the convent of Santa Trinità dei Monti shows St Francis de Paola, the founder of the Order of the Minims. However, the anamorphically transformed image shows a hilly landscape with a stream, boats, fishermen, little villages and peasants, with a tree in the foreground. According to Professor Agostino De Rosa,[11] the anamorphic painting is meant to be seen first as the representation of St Francis de Paola and then as the landscape. Looking more carefully, one can recognise the similarity with the Calabrian landscape, home of St Francis. We can also observe the depiction of one of the miracles attributed to him: it is said that St Francis was refused by a fisherman to traverse the Strait of Messina with his followers, and as a result he used his tunic to navigate across the water, led by the light of God.

The configuration of the hallway first suggests to the viewer the primary image of St Francis, and then this first understanding is slowly shattered as the observer walks along the corridor. Gradually, another narrative appears – that of the landscape in which St Francis' miracles happened. The first image therefore gives way to an apparition; the hidden narrative of the story of St Francis de Paola. The fictional space of representation is now intertwined with the space of experience and the adjustment of the body within the space is required to re-establish a physical link between the fictive space of representation and the space of the real.

In *La Perspective curieuse*, Niceron describes both mural paintings and also another that he painted in the convent of Place Royale, representing St John. Unfortunately, little remains from the French convent after the French Revolution, and there are only fragments remaining of the mural painting of St John in Santa Trinità dei Monti.

Fig. 2: Emmanuel Maignan, view of St Francis de Paola in the convent of Santa Trinità dei Monti, Rome, photo by author.

Fig. 3: Emmanuel Maignan, detail of the anamorphic view of the mural painting in the convent of Santa Trinità dei Monti, Rome, photo by author.

THE PHILOSOPHICAL BACKGROUND

This section uses the philosophical roots of the Minims to explore common ground in the act of making, and to emphasise the idea of discovery through the senses and the importance of touch and desire for wonder.

ARISTOTELIAN INFLUENCES – THE IMPORTANCE OF MAKING

The philosophy of the Order of the Minims retained its roots from its medieval origins. The scholastic tradition of the Minims and the influence of St Thomas of Aquinas is present in the preponderance of the knowledge emerging from the senses in their making. St Thomas is known for having adapted the writings of Aristotle to the Christian religion. For Aristotle, the experience of things, the know-how (*techné*), the wisdom (*sophia*) and science as a demonstrative knowledge (*episteme*) are all modes to attain knowledge.[12] This Aristotelian understanding of the world is reflected in Niceron's treatise where he states his disapproval of Plato, "who rejected from mathematics everything that is related to matter or the material world and his belief that mathematics loses its purity when it relies on the perception of the senses to prove a hypothesis".[13] Instead, he gives Archimedes as a model to follow, "who perfected sciences through use and practice; we can't deny that mathematics developed with that aim has provided us with great useful inventions and produced amazing effects with the help of mechanics".[14]

Following Niceron's understanding of making as a way of comprehending the unknown, Vilém Flusser offers a contemporary take on the subject in his essay *The Gesture of Making*. The piece emphasises how making can help grasp the world in dialectical terms; or, indeed, how the dialectic can help reconfigure making. For Flusser, ideas are formed by dialogue – a negotiation with the real – and "new ideas are constantly appearing in the heat of theory's battle against a raw, resistant world [...] Through the gesture of creating, the hands develop new forms and impress them upon objects".[15]

The research at the convent on sundials, optics and musical harmony is not coincidental and possesses a broader significance related to the understanding of the position of man and the cosmos. The different creations or inventions were crafted as a way to challenge and reconcile with the external world. In this context, the act of making brings forth a communicative dimension by creating a narrative based on man's understanding of natural phenomena. Within the gesture of creating an anamorphic image, a dialogue is established between the idea of playing with the rules of perspective and the desire to engage with the phenomena of vision and light. Similarly, Maignan's catoptric sundial forms a mediation between the vaulted corridor of the cloister and the movement of the universe; between the world inhabited

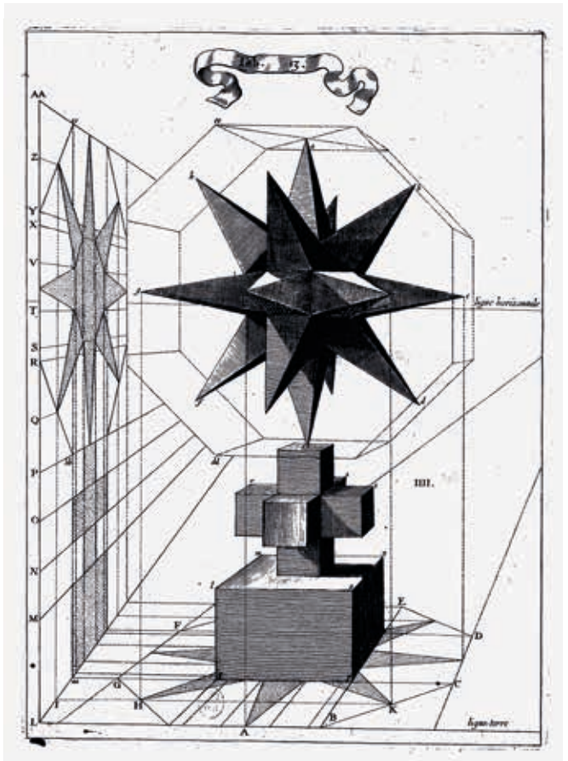


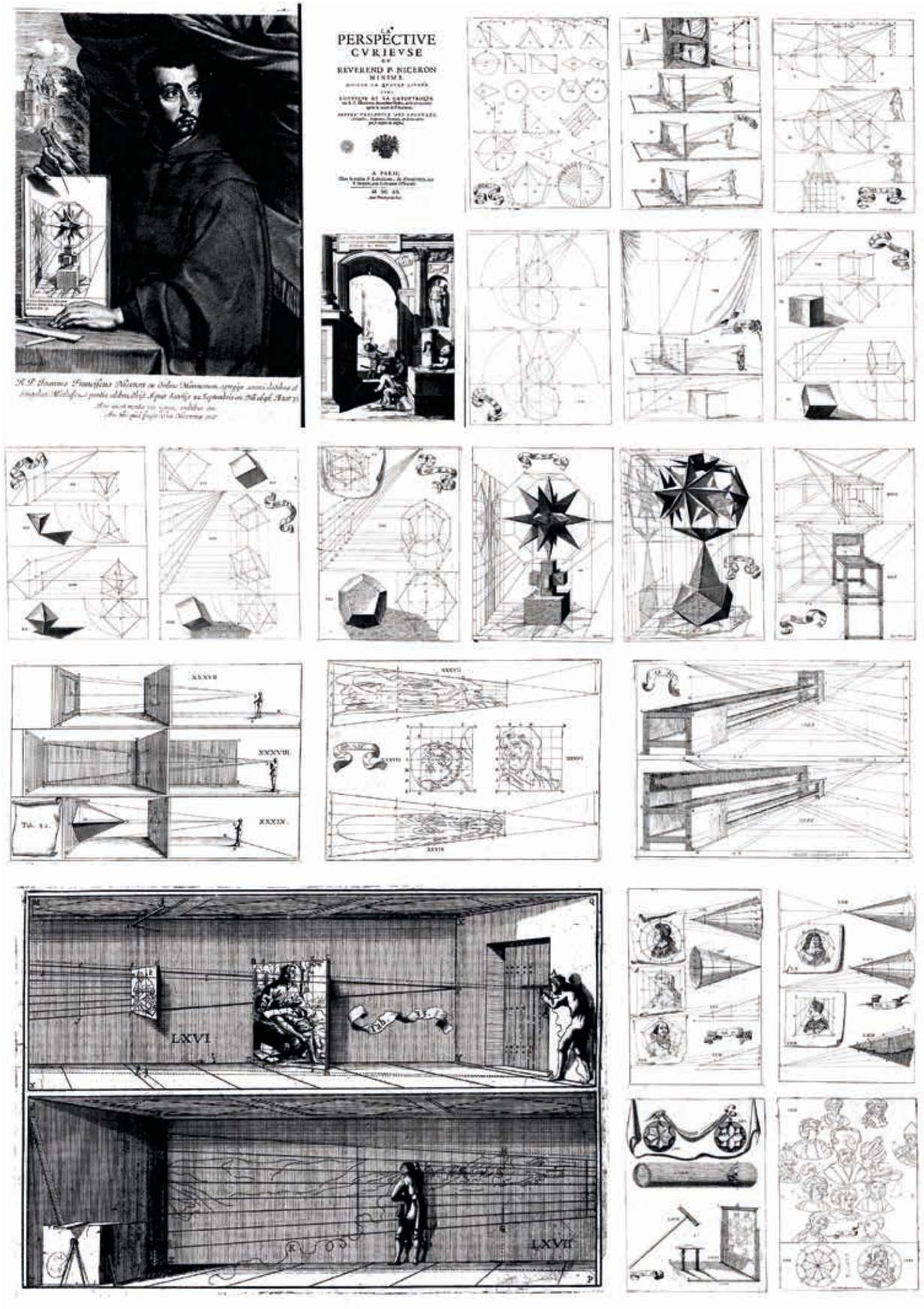
Fig. 4: Jean-François Niceron, *La Perspective curieuse*, example of a perspective drawing: plate 13, Paris, 1652 (Bibliothèque nationale de France).

by man and the external environment.[16] Anamorphic images, along with the sundial, are visible manifestations of our relationship with such invisible phenomena.

THE SENSES AS SOURCE OF KNOWLEDGE, PLEASURE AND DESIRE FOR THE UNEXPECTED

For the Minims, understanding the world through making and experimenting forefronted the essential role of the senses as not only a source of knowledge but also a source of pleasure. Regarding sciences that only prescribe rules and ideas that exist only through the means of discourse, Niceron declares: "they are almost useless until we put them into practice and for the pleasure of our senses, then only will they reach their full significance".[17]

The Minims' approach to the senses contrasted with Cartesian philosophy. Descartes was aware of the Minims' research through his correspondence with Mersenne, and even received a copy of Niceron's treatise, but for him anamorphosis was still a defiance of the senses. In his *Meditations*, he explained his distrust of the senses by pointing out the discrepancy between reality and perception. He argued for a conception of the world solely through one's own cognitions. The consequence of the dominance of the Cartesian cogito is also reflected in the desire for distinctiveness in representation. The rationalisation of vision is exemplified



in Girard Desargues' (1591–1661) completely self-referential perspective technique with a system of scales, published in 1636. With Desargues' method, there is no need to refer to elements outside the picture plane to draw. The loss of relation between the real and the represented leads to the flattening of representation.

The Minims' understanding of the world was based on sensorial perception. Lyle Massey, a historian whose research addresses the question of the body in the development of anamorphosis, describes how Maignan used the senses for his research: "Maignan constructed an empirically oriented, anti-Cartesian theory of knowledge that was founded on the premise that experimentalism and its concomitant testing of the senses could reveal the given truths of physical phenomena. According to Maignan, a sensationalist account of knowledge depends on the active, probing quality of the senses. The affirmation of truths about the world is only available to human beings through the experience of sensual contact".[18]

Moreover, for Niceron, the pleasure of the senses also meant the desire for the unexpected: "through the truths they revealed, mathematics perfected our knowledge and provided us with thousands of advantages, they also recreated our senses, not just by pointless speculation by the inventors, but in taking delight in seeing the possibilities beyond what they expected".[19] The seventeenth century did not possess a clear distinction between science and the 'supernatural'. Mersenne and the Minims felt their research did not contradict Christian belief; instead, they saw their findings as a way to acknowledge the idea of a greater power. Whitmore points out that Mersenne possessed a broadminded outlook towards scientific methodology and exploration, "admitting that there was always something beyond the limits of his investigations".[20] Stemming from this belief in something beyond reach, and driven by the desire for the unexpected, Niceron's treatise, *La Perspective curieuse,* and its anamorphic inventions invite a space for wonder.

THE CASE FOR ANAMORPHOSIS

For Niceron, anamorphic constructions contain a magical element – the desire to *believe in the impossible*. To the title *La Perspective curieuse,* he adds 'Magie artificielle des effets merveilleux' (artificial magic of marvellous effects). He also clarifies that '*magie artificielle*' was used not in an illegitimate way, but rather as Pico della Mirandola intended it to be used – as something that can perfect sciences. Niceron considered anamorphic images to be in the same category of artificial magic as the mirror of Archimedes that enabled the burning of enemy ships' sails, Daedalus' automata or Albert Legrand's bronze head, which was able to speak.[21] For him, the kind of wonder produced by the hidden

Fig. 5 (opposite): Jean-François Niceron, *La Perspective curieuse*, selection of drawing plates, Paris, 1652 (Bibliothèque nationale de France).

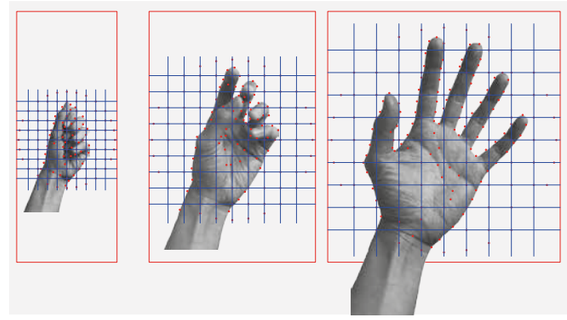


Fig. 6: Phuong-Trâm Nguyen, *The Reach – Unfolding of the Movement of the Hand*, 2016, photomontage by the author.

mechanisms that animated those machines was similar to the technique of anamorphosis.

Niceron wrote *La Perspective curieuse* on his return to Paris in 1638. An expanded Latin version, *Thaumaturgus Opticus,* was published in 1646, with further detail about the painting technique of the anamorphic mural and a section about light and cast shadows. A third version, a translation from the Latin version, edited by Roberval and Mersenne, was released in 1652 after Niceron's death – the present essay references this final version. *La Perspective curieuse* is divided into four books: Book One describes the method of perspective, Book Two examines different principles of anamorphic images on a flat and three-dimensional surface, Book Three explores reflection on flat, cylindrical and conical mirrors, and finally Book Four deals with the refraction of light in crystals.

Through the description of the different anamorphic methods with drawings, mirrors and crystals, Niceron plays with the idea of deception of vision – which he calls the 'most important sense' – to access wonder. The experience of the anamorphic image lies in the deception of the eye as the space unfolds. Niceron was aware of the difference between the real and the world of appearances, and understood the potential of the illusion of depth in painting:

> "[...] the science of perspective is the most dignified, and the most wonderful science because it encompasses the effect of light, which gives beauty to all perceptible things, and by this means, the lines we traced on a specific plane to express solid shapes can trick the eye, and deceived judgment and reason. Indeed, the artifice of painting consists precisely in bringing out the depth of appearance on a flat surface."[22]

According to art historian Jurgis Baltrusaitis, who authored the first book on the history of anamorphosis, the earliest known example of anamorphosis is from Leonardo da Vinci's *Codex Atlanticus* (1483–1518), showing an elongated head.[23] Anamorphosis was often cited in perspective treatises, but never with a clear definition of what it was; and before the seventeenth

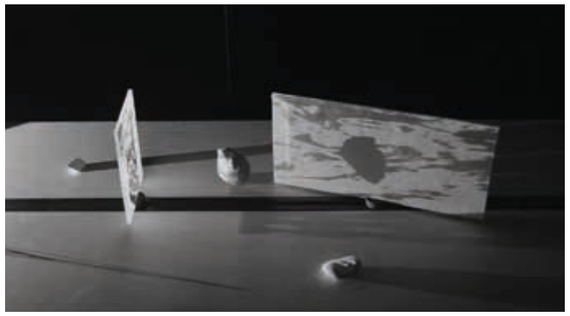


Fig. 7: Phuong-Trâm Nguyen, *Table, Reach and Fragments*, 2016, photomontage by the author.

century, it was merely described as a simple deformation of a grid. It was only at the beginning of the seventeenth century, along with the refinement of the technique of perspective construction, that the explanation of anamorphosis became more scientific. It was Niceron who linked the deformation of the image with the displacement of the distance point, in order to play with depth perception.

THE DEPTH OF THE SPACE OF EXPERIENCE

In the anamorphic method described by Niceron, the depth of representation does not recess within the picture plane any more, but is instead experienced in front of it. Massey emphasises this by displacing the distance point so that it is as close as possible to the vanishing point; the viewer is forced to come in contact with the picture plane, and therefore to realise that vision is necessarily embodied: "anamorphosis posits an embodied viewer who cannot escape contingency, temporality and performativity".[24]

The displacement of the distance point in Niceron's technique renders the tension in the boundary that constrains the image and provokes an intertwining of the appearance of one image with the apparition of another as the observer experiences the space. From this deceptive vision arises a return of touch – or the haptic – as a way of accessing truth. The movement of adjustment of the body in space to grasp the second meaning of the image also relates to kinaesthesia – the ability of our body to sense its movement in space. Therefore the process of transformation of the anamorphic image underlines the idea that a change in position provokes a change in perception, as well as the communicative dimension between vision and movement.

Anamorphosis is a drawing technique that invests the body with the agency to trigger – and to re-enact – the movement that enables the image and its multiple meanings to be brought forth. Anamorphic images bind the motion of the body to visual perception, thereby ensuring the necessity of presence in the interaction and creating a distinct sense of space.

Throughout this essay, I have explained key moments in the development of anamorphosis in order to suggest a precedent for understanding how we can harness the possibilities of new drawing techniques not only to represent architecture, but also to reach 'beyond the expected', as per Niceron. Driven by the desire for a tangible experience of invisible phenomena, anamorphosis exposes our desire for wonder. Through its construction, the Minims proposed a narrative about their tactile comprehension of the world. The example of the anamorphic mural of St Francis de Paola is in fact an allegory for this narrative. The story on the mural echoes the sense of discovering the apparition of the hidden scene behind the initial image. The movement towards the apparition of the scene – the landscape in which St Francis' miracles took place – enacts a sense of wonder upon our perceiving of this scene, while reminding us that the scene itself depicts a moment of wonder. The element of wonder in the fictional space of representation is also present through the performance of the physical space. The Minims explored their desire for wonder to develop and create inventions that are a means for others to reach and access it as well.

The opportunity to use the insights of anamorphosis in current architectural practice does not lie directly in the physical transformation of the image, but in its potential to break with our established understanding of the world to allow a questioning of our relationship with both the real and the imagined realms. Influenced by Niceron's making and research practice, I am undertaking this reflection on the potential of anamorphic images in a design project that aims to use their study as a critical tool to bring forth the body as a bridge between the physical environment and the imagined realm. The experience of the anamorphic image opens up a place for dialogue, in which the body is trying to adjust and engage with both the fictive space of representation *and* the space of the real. Using model-making and film, the different pieces attempt to reconstruct the space of discovery and the desire for wonder. Together they spatialise the idea of encounter through touch and the desire to reach for the unknown. The reach is defined by the poet Anne Carson as the primordial act, and most importantly as an act of imagination: "'Desire is a reaching out for the sweet' [...] and the man who is reaching for some delight, whether in the future as hope or in the past as memory, does so by means of an act of imagination".[25] In the project, a table allows the expansion of the depth of the spatial relationship between the primary image and the distorted image and enables the construction and occupation of the space of vision. On the table lie cast fragments – the imprints of the space captured by this primary gesture of grasping. Flusser reminds us that the two hands mirroring each other seek for wholeness in the gesture of making but, without ever reaching it, are resigned instead in the gesture of openness and of giving.[26] The fragments represent a moment in time in which the hands are trying to grasp the unknown. The traces on the surface invite the observer to hold them for its completion. Within the space disclosed by the anamorphic image, the project unfolds into a mise-en-scène of an atmosphere that calls for the observer's involvement.

Performing in the manner of the Minims allows the reconstruction of the story of their desire for making in an embodied way. Through the exploration of both the space and the experience opened up by anamorphosis, I hope this paper offers a foundation for a new research method that is driven by the same desire for wonder.

1 Jean Francois Niceron, *La Perspective curieuse* (Paris 1652), 1.
2 Patrick James Stignant Withmore, *The Order of the Minims in the Seventeenth Century France* (The Hague: Martinus Nijhoff, 1967), 4.
3 Jurgis Baltrusaitis, *Anamorphic Art*, trans. W.J. Strachan (Cambridge: Chadwyck-Healey, 1977), 61.
4 Whitmore, *The Order of the Minims in the Seventeenth Century France*, 150.
5 Ibid., 151.
6 Martin Kemp, "Harmonious Hand: Marin Mersenne and the science of memorized music," *Nature* 409 (2001): 666.
7 Niceron, *La Perspective curieuse*, 2.
8 Antonella Romano, "Mathematics and Philosophy at Trinità dei Monti: Emmanuel Maignan and his Legacy between Rome and France", in *Conflicting Duties: Science, Medicine and Religion in Rome, 1550–1750*, ed. Maria Pia Donato and Jill Kraye, vol.15 of *Warburg Institute Colloquia*, ed. Charles Burnett, Jill Kraye and Will Ryan (London: The Warburg Institute, 2009), 160.
9 Whitmore, *The Order of the Minims in the Seventeenth Century France*, 165.
10 Charles Martin, *Histoire du couvent royal des Minimes Français de la Sainte Trinité sur le Mont Pincius à Rome*, Livre III, cited in Antonella Romano "Mathematics and Philosophy at Trinità dei monti: Emmanuel Maignan and his Legacy between Rome and France", 162.
11 Agostino De Rosa, "Passi nell'infinito: Le opere dei padri Emmanuel Maignan e Jean Francois Niceron a Trinità dei Monti, Roma", in *Jean Francois Niceron: Prospettiva, catottrica e magia artificiale*, ed. Agostino a Rosa, vol.1 of *Storia dei metodi e delle forme di rappresentazione* (Rome: Aracne editrice, 2013), 159.
12 Julian Maria, *The History of Philosophy*, trans. Stanley Applebaum and Clarence C. Strowbridge (New York: Dover Publications, 1967), 63.
13 Niceron, *La Perspective curieuse*, 1.
14 Ibid., 2.
15 Vilém Flusser, *Gestures*, trans. Nancy Ann Roth (Minneapolis: University of Minnesota Press, 2014), 43.
16 Lyle Massey, *Picturing Space, Displacing Bodies: Anamorphosis in Early Modern Theories of Perspective* (University Park: The Pennsylvania State University Press, 2007), 108.
17 Niceron, *La Perspective curieuse*, 1.
18 Massey, *Picturing Space, Displacing Bodies: Anamorphosis in Early Modern Theories of Perspective*, 104.
19 Niceron, *La Perspective curieuse*, 1.
20 Whitmore, *The Order of the Minims in the Seventeenth Century France*, 152.
21 Niceron, *La Perspective curieuse*, 6.
22 Ibid., 3.
23 Baltrusaitis, *Anamorphic Art*, 33.
24 Massey, *Picturing Space, Displacing Bodies: Anamorphosis in Early Modern Theories of Perspective*, 68.
25 Anne Carson, *Eros and the Bittersweet* (Princeton: Princeton University Press, 1986), 63.
26 Flusser, *Gestures*, 47.

From Body Agents to Agent Bodies: Imagining Architectural Embodiment from the Inside Out

Alessandro Ayuso

Drawn images of the human body – inherently constructive, physical and steeped in epistemes – have a long tradition as generators and calibrators of designs. While in the past many body images that informed design were idealised (for instance, the Vitruvian man) and generalised (for instance, the standardised humans depicted in Neufert's *Architect's Data*), my drawings explore the architectural possibilities of images of non-ideal, deviant, playful and personal bodies.

An important part of my drawing process involves 'zooming' in and out of the body proper, a process that takes into account the leakiness of the contemporary body's boundaries as well as the unstable scale relationships exposed by digital media's capabilities. Through a series of drawings (and models), I view the body from the outside as an agent in architectural space, and by zooming in I imagine the body as architecture. My recent drawings, which speculate about generative architectural space inside the body, have altered my conception of the figure and its architectural potential.

Body agents are representations of the body from the outside. When these figures are incorporated into design drawings, they give visibility to a particular, posthuman, embodied subjectivity. They also enact subjectivity and impart it into design by catalysing a reciprocal engagement between design, designer and inhabitant. While I put forth these figures to address new conditions, they are also predicated on the importance of continuity with the past, and are informed by precedents, including figures from Mannerist, Baroque and more recent modernist and postmodern eras of architectural history.

Fig. 1: Alessandro Ayuso, *Body Agent Tempietto – Perspective View*, 2013, digitally rendered image with hand-drawing. Visualisation of a body agent's view from the Tempietto Site's dome down to the Body Agent Tempietto.

Body Agent Tempietto – Perspective View depicts a particular body agent's vantage point, looking down through a portal in a dome that enshrouds the Body Agent Tempietto, a structure that I designed by digitally animating body agents. The uppermost portion of the Tempietto is visible, encrusted with ornaments derived from frozen frames of animations of my initial body agent figures. This drawing was made to envision what a body agent could see as she moved through the walkways surrounding the dome. The ability to animate and to move through the digital model with paths and cameras was crucial in designing and locating viewpoints that would allow for particular interactions with the Tempietto.

In the creation of *D_I Arm*, I focused on a component of the D_I figure shown in the *Perspective* by constructing a full-scale representation of the figure's arm. The initial body agents arose from a process that incorporated 3D modelling, where they were visualised in software as mesh shells; the mesh became a defining feature of the figures. The model sought to answer the question of how a vision of seemingly disembodied figures defined by the mesh could be physically represented.

In *D_I Arm*, the mesh is realised as a structural lattice; it is the figure's functional exoskeleton and formal definition. Through its voids, the interior of the body is revealed. The lattice allows for the liberation of the interior of the body to become a zone of pure expression. Ribbon-like forms loosely held within the mesh shells coalesce in the interior, and an inhabitable architectural space is revealed: in this case it is occupied by 1:25 putti; they are 'workmen' helping to support an internal structure that connects the cast plaster hand component with the 3D-printed lattice and ribbons. In the making of this piece, where 3D modelling and scanning were integral, the ambiguity of scale inherent to digital media, and to my vision of the body, became apparent to me.

Body agents are a species of cyborg. It could be argued, following N. Katherine Hayles, that the cyborg is now an antiquated vision; current technology saturates our 'lifeworld' and bodies. She points out that at times this occurs through the prosthetics that are a signifying element of the cyborg, but perhaps more crucially, ubiquitously and nearly invisibly, through altering our sensoria and integrating our consciousness into vast networks.[1]These developments have changed our conceptions of the conditions that constitute embodiment; the body's scale, boundary, physicality and interiority are no longer fixed. Yet the obsolescence of the cyborg brings up a crisis, not only of the nature

Fig. 2: Alessandro Ayuso, *D_I Arm*, 2012, cast plaster, 3D-printed nylon and copper wire, 10 × 43 × 10 cm. Full-scale model of D_I body agent arm.

Fig. 3: Alessandro Ayuso, *Floating*, 2015, pencil, watercolour and acrylic on paper, 45 × 61 cm. Part of the 'Agent Body' drawing series.

Fig. 4: Alessandro Ayuso, *Cantilever*, 2015, pencil, watercolour, acrylic, found objects on paper, 152 × 254 cm. 'Agent Body' drawing. Part of the 'Agent Body' drawing series.

Fig. 5: Alessandro Ayuso, *Neon*, 2015, pencil, watercolour and acrylic on paper, 45 × 61 cm. Part of the 'Agent Body' drawing series.

of embodiment, but also of the visualisation of the body. How can something essentially invisible, which seems to surpass the body completely, be visualised? What are the feelings that arise from this new embodiment, and what is its constructive potential?

My previous work with body agents engaged the representation of subjects from the outside, as fantastic posthuman actors in architectural space. In my recent series of 'Agent Body' drawings, I bypassed the outward image of the cyborg to consider the body from the inside out. While the body agents I initially created were inexorably tied to architectural and animation software, as hollow meshes – literally bodies without organs – the embodiment captured by the hand-crafted drawings is more akin to the notion of organs without bodies.

Floating, *Cantilever* and *Neon* are examples. While the *Perspective View* shows the body in architectural space, and the *D_I Arm* shows the architecture of the body and reveals its interior, these pieces explore the idea of the interior as a conglomeration of systematic, organic parts. Parasites, cells and machinic prosthetics extend, attach and swarm around each other, forming a larger body. The depicted assemblages, including machinic and corporeal parts, architectural notations and *Looney Tunes*-esque cartoon forms, are meant to evoke and fascinate. The drawings are intended as spatial suppositions about body images that could occur when the limits of the 'original prosthetic' of the body is surpassed and the body itself becomes a source of expression.[2]

The Agent Body drawings are made with more traditional techniques and materials – paper, acrylic paint, pencil and watercolour – and traditional methods such as *pintimento*, the technique of obscuring previously applied layers of paint. Unlike the digital media employed in the *Perspective*, these traditional media provide immediate and irrevocable physical feedback; they react both predictably and unpredictably, leading to accidents, fortunes and misfortunes. In this process, nothing can be a mistake; instead, every action leaves a trace, and these accumulate to make the image. The physical size of the page and its positioning on the wall engages the body. The size of the drawings engages my own haptic sensibility (the page is a size that is comparable to my body, and in the case of *Floating* and *Neon* to my torso) and it influences the forms depicted: for instance, when my arm swings, a curve is created; in the Agent Body drawings, iterations and permutations of this curve recur throughout. Technology has altered my perception as a posthuman subject, and especially as a designer immersed in digital image-making.[3] My drawing style has embedded digital media's tropes and operations: in the Agent Body drawings, forms float in Cartesian space; the way that I draw the organs often begins with elemental forms and evolves through the gradual addition of complexity, similar to good practices in 3D modelling software; pockets of the images unfold through mutations and multiplications of a component, a process similar to parametric techniques.

Even with technology's contamination of the analogue process, drawing with physically palpable media – as opposed to predominant digital methods relying on mouse and screen – is a distinctly absorbing and physically engaging activity, where feelings can be teased out. Each image evolves with unexpected results. As I work, I grow more familiar with the media and the depicted systems that comprise the image. In the Agent Body compositions, I aim to maintain an ambiguity of scale and an incompleteness of form to allow for a shifting series of *mise-en-abymes*, where the drawing could present a convoluted space, a vast or minuscule object, a strange body or perhaps a vast construction. This oscillatory perception, in which the drawing alternately conjures an interior or exterior, object or space, at a large scale or a diminutive one, provoked me recently to return to viewing the body itself as an unstable object.

Body Agents Awaiting Deployment shows a series of scale figures where this vision of a dynamic and expressive interior created in the Agent Body series forms a more immediately recognisable image of a body. In these figures, the body's boundaries have become more negotiable and dynamic: their viscera appear; boundaries between inside and outside, as well as the agent and her environment, begin to dissolve. The figures contain architectonic DNA and stand poised to contaminate their surroundings with expressive, personal and playful subjectivity.

[1] N. Katherine Hayles, "Unfinished Work: From Cyborg to Cognisphere", *Architectural Theories of the Environment: Posthuman Territory*, ed. Ariane Louise Harrison (New York: Routledge, 2013).
[2] N. Katherine Hayles, *How we Became Posthuman* (London: University of Chicago Press, 1999), 3.
[3] Jonathan Hill, *Actions of Architecture: Architects and Creative Users* (London: Routledge, 2003), 34, and Antoine Picon, *Digital Culture in Architecture* (Basel: Birkhauser, 2010), 12.

California Bubblegum Autopark

Jamie Barron

The process of accumulating imagery fit for sampling is called scanning and was taught to me by Andrew Kovacs, a professor of architecture and designer located in Los Angeles. Scanning is a process of combing through literature such as journals, monographs, magazines, Pinterest or any other site of imagery and collecting a database of images or an archive. These will be the reference base. From the reference base, cohesive disciplinary trends can be identified by studying the images and drawing together similarities. These similarities will serve the visual argument as a set of precedents. When studying the images, it is important to pay attention both to the content of the image, which in this case will refer to an aspect of a building, and to the way in which it is represented. The creative expression of architecture cannot be separated from representational style, as this is the site of reality for many architects.

CABGAP (California Bubblegum Autopark) is an amalgamation of samples lifted by scanning over the course of a few months with the intention of designing a hotel in Los Angeles that incorporates automated parking as a design element. It was my ambition from the beginning to incorporate aspects of mechanical delight and bowellism/new brutalist sensibilities with inflatables and environmental sublime. The evidence for how these things are related is argued through visual adjacencies in the reference base. I believed those categories to be the most suitable for an architecture that celebrates a new mechanical technology (automated parking) while working with a sense of cultural removal common to destination hotels. A third set of references comes in formal and organisational strategies that help to organise multiplicitous composition or difficult wholes.

The list begins with mechanical delight and bowellism/new brutalist sensibilities. This category includes Norman Foster's Lloyds of London building, Renzo Piano and Richard Rogers's Centre Pompidou, Craig Kauffman's Sensual Mechanicals, Ben Nicholson's Appliance House, the launch pad for the Space Shuttle Endeavor, David Greene's Living Pod, Bernd and Hilla Becher's industrial typology analysis and The Jerde Partnership's Power Plant for Six Flags Corporation. These references are incorporated more into the building design than into the representation.

The second category, inflatables and environmental sublime, is the reference base that provided the most effective ammunition for representation. The list includes the airbrush renderings of Murphy/Jahn's State of Illinois Centre and The Chicago Board of Trade, The Jerde Partnership's Makuhari Town Centre and Metropolis Time Square, John Portman's Renaissance Centre and Bonaventure Hotel, Philip Johnson's PPG Place, a bouncy castle, Archigram's Casual City, Kevin Roche and John Dinkeloo's UN Tower, Bittertang's Burple Bup, Antfarm's Dolphin Embassy, Anish Kapoor's Leviathan, Olafur Eliasson's The Weather Project, Étienne-Louis Boullée's Basilique, Arata Isozaki's New Tokyo City Hall, Diller Scofidio + Renfro's proposal for the Hirshhorn Museum expansion, Pop Surrealist paintings of Mark Ryden and James Turrell's Virtuality Squared. These projects all include aspects of atmosphere and environment both interior and exterior. The most dramatic influences on the project come from the airbrush renderings and orthographic drawings of Helmut Jahn and the monolithic mirrored glass facades of the Portman Buildings. In fact, the unfolded axonometric animated gif is pulled directly from a drawing of Murphy/Jahn's State of Illinois Centre.

Finally, the third category is formal strategies for organising compositions of multiple elements. The images in this list include Frank Gehry's Loyola Law School and Rouse Company Headquarters, Arata Isozaki's MOCA in Los Angeles, Claypotts Castle, Charles Rosen's painting *Cliff Dwellings* and Cezanne's *Gardanne*. These images can be best explained as picturesque in nature, as they deal primarily with ruination in one way or another.

The evidentiary regime of visual knowledge is only loosely translated into written words. We are all familiar with the idiom 'a picture paints a thousand words' – a metaphor for how much is lost when switching mediums. However, because of copyright law for intellectual property, building an argument up with copyrighted material is prohibitively expensive even in an academic context. It may, then, require some research on the part of the reader to find the actual reference, but for now a dérive on the internet may prove to be a lovely endeavour.

Fig. 1: Four frames taken from an animated gif of an axonometric drawing displaying both worm's-eye and bird's-eye views through the central atrium spaces.

Fig. 2: Elevation oblique, plan oblique and section drawing.

A Fall of Ordinariness and Light: Regeneration! Conversations, Drawings, Archives & Photographs from Robin Hood Gardens

Jessie Brennan

"I felt emotional," admitted Abdul Kalam, former resident of Robin Hood Gardens, who collaborated with me on my project on the Smithsons' soon-to-be-demolished brutalist social housing estate in Poplar during 2014–15. "I could've emailed, I know. But you know what, I wanted to call you."[1] Kalam had just looked through a copy of our book: *Regeneration! Conversations, Drawings, Archives & Photographs from Robin Hood Gardens*. In his mind, the blocks were already consigned to history. For him, this book is not only a document that challenges the narrative told by property developers and politicians of the need for demolition and regeneration, but is also a painful reminder of the bureaucratic processes that have brought Robin Hood Gardens to its knees.

Most readers will be familiar with the history of the Smithsons' only realised public housing estate and, indeed, its current status – that a review of its listing was declined, making demolition almost a certainty – but fewer will know the impact the redevelopment is having on its residents. Known as concrete monstrosities or masterpieces by critics and supporters respectively, the buildings – and their apparent architectural successes and social failures – are debated and argued over, but the residents' feelings are often either ignored or misrepresented. This project attempts to address that imbalance in a small but meaningful way by exploring with residents the personal impacts of redevelopment and, more broadly, the politics of regeneration through drawing and dialogue.

When I invited residents to share with me their experiences of 'lived-in' brutalism, it did not begin as planned. A printed photograph of the west block (my poster invitation placed around the estate) was quickly torn, shredded and crumpled. The image visualised the planned demolition of the building in poignantly prophetic detail, and the initial start to the project appeared an utter failure, crudely summarised: a screwed-up poster; an unattended launch. Apparently nobody cared.

Of course, it's nonsense to believe that residents do not care about the regeneration of Robin Hood Gardens – they deeply do, and they question whom it's all really for. For instance, Sadia Aziza Islam, a 13-year-old who became homeless with her parents before moving temporarily to the estate in 2013, has noticed that "it's like they're driving us away to replace us with more wealthy people".[2] Kalam, who told me how he felt about the council-led demolition, agreed:

> "When boys sit down, or when mates sit down, what we say is, 'they are basically driving the poor people out'. That's what they're doing. In the most simple of forms. It's not racism – it's more about wealth. 'We don't want you here 'cause you don't belong here any more.' If we had a deep conversation, that's what we'd settle on. That's exactly what's happened."[3]

What potent politics these buildings contain. Thus, a radically different approach to engagement (socially, conceptually, critically, spatially) was required for the project and it came in the form – and act itself – of drawing.

Conversation Pieces (Fig. 1) is a series of drawings made on-site by rubbing graphite across the surface of a sheet of paper, revealing the pattern, and everyday wear and tear, of a doormat beneath. The drawings visualise a literal and metaphorical threshold between semi-public and private spaces; from the street deck to a home's interior. They reflect the apparently unlikely human qualities associated with brutalism and bring to mind the day-to-day experiences of lives lived within the concrete blocks.

The interviews developed out of that process of making doormat drawings, which was a starting point for engaging conversations. A brief exchange of words – on the doorstep, the walkway or the green – led to extended dialogue with several individuals over the lifetime of the project. In this case, drawing performed an opening to what D. Soyini Madison has named that moment when "ethnography becomes the 'doing' – or better the performance – of critical theory".[4] The dialogic framed as performative – through the action of materially tracing the site – emphasises the embodied interplay between human subjects and also the political injustices experienced by those who have had redevelopment 'done' to (rather than with) them.

Indeed, the lives of residents on council housing estates have often been overlooked and marginalised by policy and academia alike. As such, the drawings trace the materiality of the building but also the deviated histories of its spaces – homes from which people will be displaced

Fig. 1 (opposite): Jessie Brennan, *Conversation Pieces* (from top left to bottom right: no. 178, no. 27, no. 125, no. 123, no. 110, no. 201, no. 141, no. 202, no. 140, no. 214, no. 34, no. 146), 2014, graphite on paper, 102 × 66 cm. Doormat rubbings included in *Regeneration! Conversations, Drawings, Archives & Photographs from Robin Hood Gardens* (Silent Grid, 2015).

Fig. 2: Jessie Brennan, *A Fall of Ordinariness and Light (The Order Land)*, 2014, graphite on paper (framed in aluminium), 57.5 × 71.5 cm. Commissioned for Progress by The Foundling Museum, 2014. Courtesy of the artist and the V&A Museum.

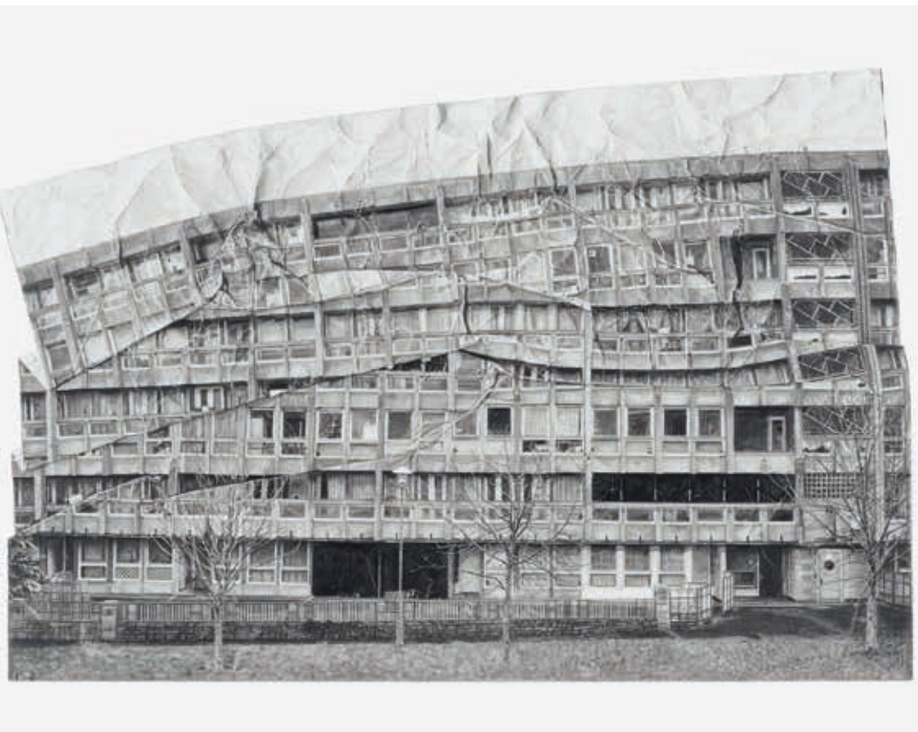


Fig. 3: Jessie Brennan, *A Fall of Ordinariness and Light (The Scheme)*, 2014, graphite on paper (framed in aluminium), 57.5 × 71.5 cm. Commissioned for Progress by The Foundling Museum, 2014. Courtesy of the artist and the V&A Museum.

as a result of regeneration. While the term 'regeneration' invokes renewal (in the prefix 're'), recent research shows that the process often results in the social *de*generation of a place, through displacement of existing communities who can no longer afford the so-called 'affordable housing' on the newly regenerated site.[5]

Another artwork, *A Fall of Ordinariness and Light* (Fig. 4), commissioned for Progress by the Foundling Museum, responds to the neglect and representational struggles the estate and architecture have occasioned. It takes the form of a series of four graphite drawings that imagine the estate's planned demolition. In the meticulously rendered drawings, the building appears to be in stages of increasing collapse, and the story appears to be one of social failure – the fall of post-war aspirations of progress, the end of architecture for social good. The four drawings have Orwellian subtitles – 'The Order Land' (Fig. 2), 'The Scheme' (Fig. 3), 'The Enabling Power' and 'The Justification' – taken from the Compulsory Purchase Order issued by Tower Hamlets Council in 2013 when it acquired the land around Robin Hood Gardens.

A Fall of Ordinariness and Light wears – in its intimate size, scale and carefully drawn graphite marks – the signs of social upheaval and uncertainty imposed by imminent demolition, and the complex processes and feelings evoked by the estate's regeneration. It carries, too, all the symbolic weight of political struggle under which the buildings will eventually collapse. To 'sink', after all, means 'to fail or fall'.[6] But the derogatory label 'sink estate' applied to Robin Hood Gardens (and so many other council estates across London) is challenged when details of washing and plants are evidenced on balconies and in windows, questioning the future fate of the place once the buildings and people – a majority low-income tenants who will be replaced by wealthier leaseholders – are gone.

Narratives, then – just like notions of progress – need not run merely in one direction. Richard Martin's analysis of the work shows that in emphasising a reading that moves from right to left, we are encouraged by the fact that Robin Hood Gardens' image is merely folded and crumpled. In this respect, he suggests the work echoes the thoughts of Owen Hatherley, who writes:

> "Brutalism, with its rough-drawn rawness, always was a vision of future ruins. This shouldn't console those who always hated it, however. The ruined is dead, safe, and can be regarded with relieved disdain. Brutalism is not so much ruined as dormant, derelict – still functioning even in a drastically badly treated fashion, and as such ready to be recharged and reactivated."[7]

Thus, the slab blocks and brutalist architecture are not at all in themselves bad. But the management and maintenance offered by the local authority often was. This is not to entirely blame Tower Hamlets Council either, which has endured decades of cuts from successive governments. However, in the absence of resistance to privatisation of public housing, the council endorsed the demolition of Robin Hood Gardens – and a reduction in proportion of social housing on the newly 'regenerated' site – for short-term rewards, undermining its long-term capacity to provide decent, low-cost homes for low-income households.

No wonder Robin Hood Gardens elicits such passionate responses from residents, evoked not only by the day-to-day experiences of life on the estate (plagued by broken lifts, a recurring lack of hot water or frequent blackouts) but also in how others – particularly the media – perceive and represent it. By inviting informal critique of the past in order to articulate experiences of the present, the project opens up critical space – inside homes and workspaces – in which uncomfortable histories of redevelopment are explored. The ideological attack on council homes and the dismantling of public housing are discussed at the level of individual lives. Through methodologies of drawing and dialogue, questions are raised about the language, processes and intentions of regeneration, namely: whom is it for? Drawing is both a turning backward and a looking forward: it traces the material surfaces of Robin Hood Gardens and lives lived in the concrete blocks; and it also visualises the estate's imminent destruction. Less an anticipation of loss itself, drawing becomes a political provocation to be performed as well as read.

1 Abdul Kalam, telephone conversation with author, September 2015.
2 Sadia Aziza Islam in Jessie Brennan, *Regeneration! Conversations, Drawings, Archives & Photographs from Robin Hood Gardens* (London: Silent Grid, 2015), 61.
3 Abdul Kalam in Brennan, *Regeneration!*, 65.
4 D. Soyini Madison, introduction to *Critical Ethnography: Method, Ethics, and Performance* (Thousand Oaks, CA: SAGE Publications, 2012), 14. See also Jim Thomas who argues that, '[c]ritical ethnography is conventional ethnography with a political purpose.' Jim Thomas, *Doing Critical Ethnography: Qualitative Research Methods, Series 26* (Newbury Park, CA: SAGE Publications, 1993).
5 See Loretta Lees, Just Space, The London Tenants' Federation and SNAG, 'The Social Cleansing of Council Estates in London' in *Regeneration Realities: Urban Pamphleteer #2* ed. Ben Campkin, David Roberts and Rebecca Ross (Northampton, Belmont Press, 2013), 8–12, accessed 11 July 2016. www.ucl.ac.uk/urbanlab/research/urban-pamphleteer/UrbanPamphleteer_2.pdf. See also Ben Campkin, *Remaking London: Decline and Regeneration in Urban Culture*, (London: I.B. Tauris, 2012), 77–104. From April 2012, 'affordable housing' is defined in the National Planning Policy Framework as 80% of market values: www.gov.uk/guidance/definitions-of-general-housing-terms.
6 Nadir Lahiji and Daniel S. Friedman, "At the sink: architecture in abjection", in Nadir Lahiji and Daniel S. Friedman eds. *Plumbing: Sounding Modern Architecture* (New York: Princeton Architectural Press, 1997), 39.
7 Owen Hatherley, *Militant Modernism* (Winchester: Zero Books, 2008), 6.

The Severed Head

Konrad Buhagiar
Guillaume Dreyfuss
Ephraim Joris

To operate as a critical space, a place of rupture to free ourselves from a preconceived and therefore reductive language. To invest in an idiosyncratic puzzle of part-ideas within a space of concentrated interiority; the space of a severed head.

The very idea of this writing – beyond its projected content – is to operate as signs symbolising the object in the absence of the object. For all we know, the space of the severed head has never been and only exists as symbol. The Lacanian interpretation of absence assumes that there cannot be absence in an objective world, for absence can only exist through symbolic or representative means. Hence the importance of representation (in our case, drawing) to explore this quality that there may be a presence where there isn't one.

How do we break a history of drawing in order to come to understand that very history of drawing more curiously? We see this as the only way in, succumbing our postmodern complex, through which history is seen as irreversible. So we called into being a particular drawing protocol. The Monolith Drawing synchronises analogue thinking with computational developments to enter history through our intriguing capacity to long for. Longing stands for the experience of something that is absent. To sustain this longing as an architectural quality, it is thus important to design architecture that sustains a kind of absence. We do this on multiple levels; our drawing protocol instills a mode of creating space through the act of subtracting mass from a predefined lithic core. As such, space is always created by means of two intersecting volumes, the continuing tale of stereotomy signifying the dialectical opposition between structure and *revêtement* (ornamentation).

The avoidance of drawing lines directly is also part of a strategy to surpass the presence of the *a priori* image and thus break the path of 'self-projection' in such a way that The Monolith Drawing can reveal something beyond personal imagination and allow a working with time through time. In line with Merleau-Ponty's 'figured philosophy of vision', through which he describes how the position and the act of looking are included within the drawing, we perceive The Monolith as that which looks at all things but can also look at itself. It sees itself seeing, making The Monolith and the severed head an expression of 'Dasein', which is not so much about a material separation (subtraction/decapitation) as it is about an inquiry into its own history, being in the world (looking inwards and outwards simultaneously). Our drawings exist as a present-day reading (machine) constituted by the idea of a living past.

The Monolith Drawings are in search of an architecture escaping any historical periphery in order to (re)enter history in search of productive points of intersection and overlap. The Monolith wants to erase any boundary between historicised and present-day architecture. As such, any safe distance between the historical and the contemporary is eliminated to engage in a process of self-seeking consciousness to question its own status. This is what makes The Monolith Drawing both a practice of architecture and an investigative practice of research, without any clear boundary between these two events. Of course, the drawing has previously been identified as a reflexive instrument; yet here we aim to deliver a more precise account on the specific capacity of The Monolith Drawing in relation to many other ongoing drawing practices within and outside architecture.

We consider Descartes's decision to disassociate vision into two orders – an external order of the senses within the realm of *res extensa*, and the order of intuition, described as *res cogitans*. Here, perceptual recognition of empirical qualities does not relate to the intellectual operation of seeing. However, Merleau-Ponty considers this split to delineate a much more dynamic field of operation, in order to consider vision to be always part *res extensa* and part *res cogitans*. Here, we do not have to bypass pictorial reality in order to access the intellectual act of representation. The Monolith Drawing, as a practice, is based upon this dual performance of *res extensa* and part *res cogitans*. For every Monolith Drawing engages with visualising traces of history as the recognition of empirical qualities, and equally understands the drawing as an intellectual act through its implicit qualities of distant-near. Such a collapse of terms wants to indicate a constant breakdown of barriers between past and present, the portrait and the portrayed, figuration and abstraction.

The Monolith as a severed head is engaging with the idea of material separation (subtraction/decapitation) and with the concept of occupying a double position. In art, many representations of severed heads exist, yet we refer to the cephalophore: a beheaded saint carrying his own head, the most famous probably being Saint Denis. The head carrier introduces the idea of the relic, representing a relinquishing of external knowledge or *res extensa* in favour of *res cogitans*. The carrying of the head illustrates a distanciation (at least in part) from the external order of the senses to surrender to the experience of something that is absent. Like the Resurrection, it is a construct that is based on the necessity of detaching oneself to become permanently displaced.

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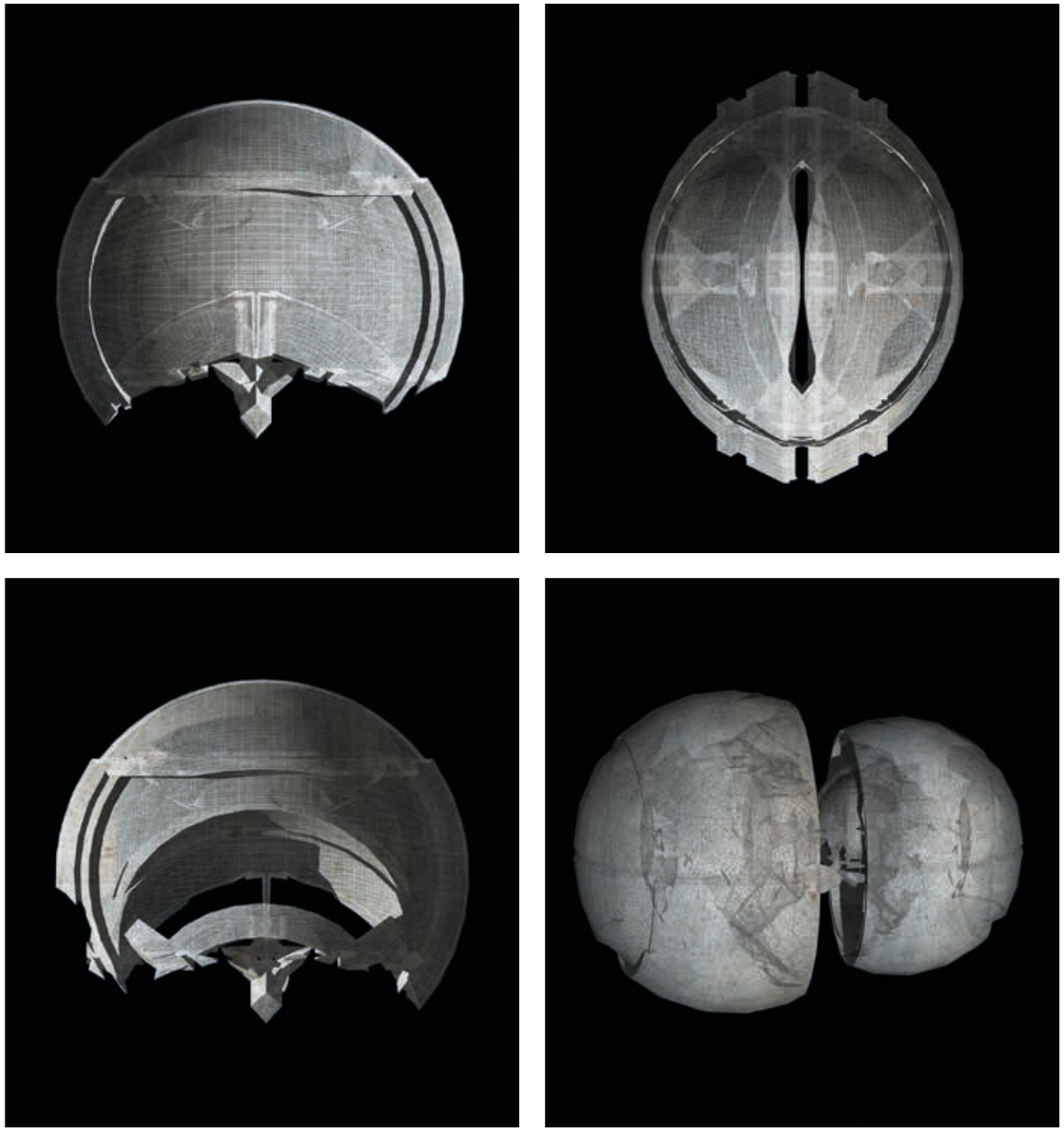


Fig. 1: The Monolith references ancient form without having to subscribe to strategies of historicised formal continuity (neo/post). The spatial intentionality of The Monolith is to create 'room' through subtraction, which consists of a slow process of carving into stone, as an antithesis to composing architecture by means of architectural elements such as column and beam. The Monolith as stone-cut architecture is characterised by the correspondence between form and structure.

Pontifical Academy of Sciences

Benjamin Ferns

The Pontifical Academy of Sciences, established in 1603 with Galileo as chair, is relocated to the City of London to provide a new education system to tackle the Square Mile's lack of moral purpose.

The Academy is a monochrome mass of libraries and ritualistic lecture spaces set in a landscape to induce physical and metaphysical wandering, meeting and reflection. Three environments are provided, inspired by the core natural elements of *mountain* for isolation and reflection, *river* for wandering and activity and *valley* for gathering. These contours do not form boundaries; instead, the frame of each drawing is continually broken, perforated and torn, as if the tracing paper itself were insignificant. The intensity of detailing and material makes the drawings difficult, if not impossible, to replicate, and deliberately so, in rejection of modern computation.

Collage in a modernist manifestation – grounded in an overly simplistic counterposing of background and foreground – was inherently static and reactionary in its aesthetic and purpose, as seen in the modernist architecture of the seminal book *Collage City* by Colin Rowe and Fred Koetter, which exemplified the artistic composition rather in the manner of the English Picturesque. Instead, today, modernism is beginning to be interpreted as simply another continuation of historicism, producing its own fetishised pop-culture objects, whether a shiny new graphic or a new development in the City of London.

The modern viewer is now asked the impossible: how to perceive a totality all at once and with equal significance?

Reinterpreted as a tool with which to perceive a subjective experience of space and as a dynamic concept that is more in line with the Baroque mode of thought, collage can be utilised for an innovative re-evaluation of tectonics, labour and objectification, and to propose a temporal understanding.

The series of hybrid drawings employ analogue and digital techniques, questioning the hierarchy of architectural form through drawn line, and secondary rendering through digital hatch. These areas of hatch are open to interpretation, with few defined 'knowns', and can only truly be achieved through experimentation. Imperfections are not seen as failure, but as a balance between harmony in a composition and an ever-improving technique. This speculative method creates ink drawings based upon enlarged pre-drawn pencil lines, hatches and unfinished details, which are then scanned and collaged to permit new discoveries.

The hatch exhibits a contradictory position concerning its inception, for manual skill and judgment are still required, and it is formed using a variety of methods including layering, distortion and blurring. These hatching methods develop inconsistencies and, unlike drawn ink, typically exhibit no traces of the individual, with an epic sense of scale and plasticity that echoes the Baroque. The hatch itself becomes stronger than the individual.

The ink line, however, sets quickly, almost as a result of shock, where the interplay between ink and digital hatch is consciously made contradictory in the drawings. Some digital areas are lined with drawn artifice containing cracks, shadows and imprints from a scalpel upon trace, as a collage not only of time but also of the human effort involved in its construction. This novel (mis)treatment of material, playing upon masking and revealing, can be traced back to Vienna, where the natural meaning of materials often became important. The monochrome drawings deliberately offset the red and gold of the papal robes of the narrative.

Heinrich Wolfflin's definition of the Baroque through the use of oblique perspectives and painterly characteristics is ambiguous through translation, and can be defined as creating disorder and utilising light to create greater

Fig. 1: Benjamin Ferns, *Pontifical Academy of Sciences*, 2015, isometric. The perception of the spatial threshold is modulated through spatial, sensual and semantic gaps.

Fig. 2 (opposite): Benjamin Ferns, *Pontifical Academy of Sciences*, 2015, anamorphic collage. A hatch becomes a real manifestation through a combination of inherent and post-process machining techniques.

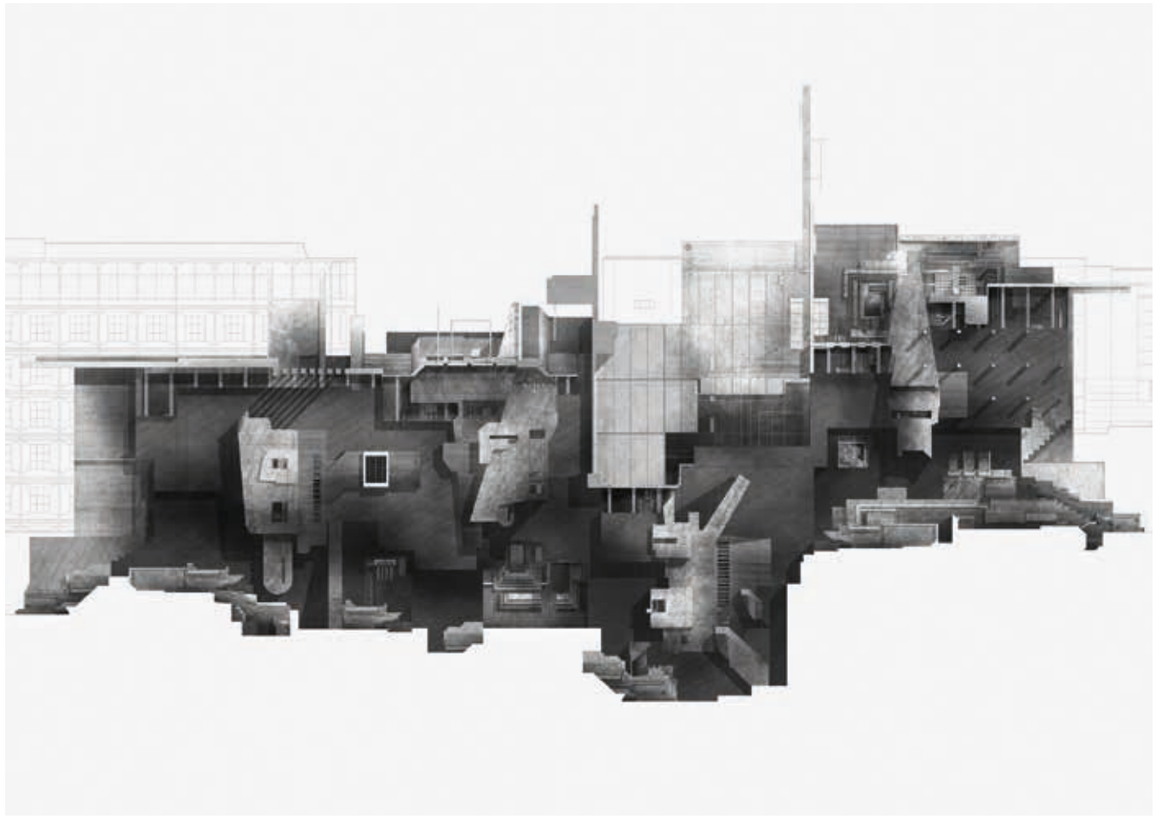


Fig.3: Benjamin Ferns, *Pontifical Academy of Sciences*, 2015, elevation. A subjective experience of space and collage as a dynamic concept, in opposition to the static and fetishised modernist objects within the city.

depth so that objects remain elusive through overlapping.[1] Relationships between programmatic fragments continue the chiaroscuro lineage of Piranesi, through hatched travertine and basalt articulation, holding an underlying opposition to the utopian permanence implied by mainstream modernism.

The spaces are grouped, as in Piranesi's *Campo Marzio*, around a figural centre, as oscillating forces between dispersal and repetition.[2] The collages are formed three-dimensionally, hinting at intense layering and fluid movement through space and hence time, while retaining coherence only from a fixed viewing point for each imagined scene. It is an intensity that Richard Sennett argues allows for curiosity and an expansion of the senses in tectonic and social terms,[3] proposing intriguing compositions where the fascination of an unseen permits constant change.

The drawings involve a relationship that is dynamic between subject, object and point of view, where the surface engages the viewer's anthropomorphic imagination to project human forms even when they are not present. The convoluted movements of the eye across the view trace the lines, planes, volumes and mirroring surfaces, to a degree bordering on illegibility.

In proposing an architecture that engages the fact that perception is not permanent, the emphasis should be placed upon the interweaving viewpoints of creator and viewer, making the subject (viewer) inseparable from its background (drawing). Allegorical of the Vatican, these drawings argue for architectural spaces that are ambiguously left open, migrating between time and typology, and thus always able to be completed by the viewer. As by the Pontifical Academy and the moral associations of faith, we have been led to believe the unbelievable.

[1] Heinrich Wolfflin, *Renaissance and Baroque* (Ithaca: Cornell University Press, 1966), 35.
[2] Jennifer Bloomer, *Architecture and the Text: The Scrypt of Joyce and Piranesi* (New Haven: Yale University Press, 1993), 21.
[3] Richard Sennett, *The Craftsman* (New Haven: Yale University Press, 2008), 277.

Campus Martius East

Parsa Khalili

Fig. 1: Parsa Khalili, *Campus Martius East*, 2013–15, digital media. The full-framed site plan reconstruction of Constantinople through the lens of Piranesi's *Campus Martius*.

If we read Piranesi's *Iconographia Campi Martii* as incendiary to the classical tradition, it is the ambition of this project to advance his ahistorical machinations – the hyper-radicalisation of reading architecture anachronistically in relation to its current form – and to do to the *Orient* what Piranesi did to the *Occident*. To continue his project today is to advance the idea that the city and its architecture operate under the twin authorities of perpetual amnesia and perpetual displacement. Following Piranesi's process of simultaneous documentation and design, this project investigates and re-assembles Istanbul (Constantinople) through the polemical interdict of the act of drawing as a form of both critique and design. Constantinople offers an interesting parallel to the development of Rome and a new site for investigation utilising Piranesi's anachronistic approach to design and history. In turn, this project is based on a reading of the former through the lens of the latter. *Campus Martius East* contrasts Western and non-Western urban development and develops representational techniques for the specifics of non-Western urbanism.

The initial postulate here is that iconicity in the Near East differs fundamentally from in the West. In the Western tradition, architecture's institutional presence is highly public and the relationship between structures is semi-autonomous, enabling the city to become a framework within which these disparate parts both respond to and deny one another. This relationship between objects and the city is the basis for Piranesi's invention, and the subsequent differentiation between figure and ground creates an endless field at all scales of the built environment. In its Eastern conception, both the siting of icons and their relationship to the ground are inverted and problematised almost universally. Most works of architecture are not singular constructs, but rather become small complexes buried within the irregularities of the residential fabric around them. Few concessions are made to maintain the autonomy of their organisations, requiring them to adapt to the figure of the city at the specific sites of their insertion.

If the Western city, exaggerated to its most logical (or illogical) extreme, is evidenced by Piranesi's *Campo Marzio* as an endless confluence of semi-autonomous buildings placed on a completely voided ground plane, the Eastern city, similarly exaggerated, would be its complete opposite; it would read as an aggregation of non-autonomous buildings stitched together by shared walls/thresholds that unify them into a series of voids cut into a totally *pochéd* rendition of the city. The exit of one complex becomes the entry to another, linking all of the projects and creating one large and perpetually iterative series of spaces, changing the city into one without architecture, for it becomes a singular machine *of/for* architecture.

Campus Martius East imagines a new relationship of form-making on an urban scale and does so through the medium of drawing as a critical tool for investigation and inquiry. To begin, the drawing establishes its focal point symbolically; Piranesi chose Campo Marzio for its historical character – a place of few, disparate monuments on a largely uninhabited field that served as imperial marching grounds just outside Rome's historical centre. The Eastern rendition exhibited here chose a similar yet opposite site for ground zero: the Thracian Fields. This area was also a marching ground in late Byzantine times, but quickly became a dense aggregation of residential/civic structures outside the symbolic centre of the Ottoman Constantinople.

The contextual frame was then rotated, leaving the strictures of the imperial north–south axis behind – an orientation rooted in Cartesian space within the Western tradition – and utilises a radial system of orientation using Mecca as the centre – where, in the Eastern tradition, a centripetal relationship to the Kaaba is primary. This way, the composition also encapsulates the limits of Constantinople's Theodosian walls in order to frame the entire drawing similarly to Piranesi's original map. In this manner, the artefact of the original Piranesi drawing becomes an object for 'archaeological' investigation in and of itself. The drawing is further developed by isolating significant gates to the city and placing one historically important Ottoman building at each entry point. Compositionally, subsequent structures are added in succession in line with formal/organisational patterns so that either walls or other major formal elements align from one structure to the next, creating a continuous and non-linear series of spaces. This is continued in theory ad nauseam, until the various threads of complexes begin to close in upon themselves, creating new figural 'enclosed' spaces for which new, totally hyperbolic structures are designed and inserted. Like Piranesi's, these fantastical buildings are mere fragments of an imaginary possibility within the Ottoman formal language; they are a mix between recordings and interpretations of the past – between an informative diagram and a portrait of a historical situation.

The act of creation here is constituent to the act of drawing, developing a methodological framework whose basis emerges from the implicit and latent tropes invented by Piranesi. His use of artificial tablatures, his annotations of plate numbers, his use of text, the subtleties in stippling and hatching: these are preserved and exaggerated within the framework of contemporary digital drawing techniques between contemporary software. The drawing itself is both an homage and a transformation. Accompanying the overall site plan drawing are a number of vignettes that attempt to re-imagine Piranesi's *vedute*, giving the impression of the spatial ramifications of this intentionally hyperbolic proposal. In this case, they are implemented at differing scales and degrees of isometric representation, again similar to the original vignettes, as a means to flatten perspective and convey the limitlessness of the overall composition.

Piranesi subverted classical architectural orthodoxy by dismantling its conventions, to both produce a formal methodology and disrupt the notion of history through drawing. The historical and critical rigour inherent in his vision becomes the justification for the creation of new forms of urban anomie and constitutes the dereliction of duty of the architect. Inverting Piranesi today shows how theorising urban history can occur beyond textual discourse in the realms of projection and practice.

Fig. 2: Parsa Khalili, *Campus Martius East: Vedute 1*, 2013–15, digital media. A close-cropped, high-oblique isometric vignette of overall reconstruction.

Fig. 3: Parsa Khalili, *Campus Martius East: Vedute 3*. 2013–15, Digital media.
A far-cropped, low-oblique isometric vignette of overall reconstruction.

Her Wildflower Gardens at One Hundred Five Orchard

Eric Mayer

'Her Wildflower Gardens at One Hundred Five Orchard' employs physical analogue drafting methods as a means to develop a set of drawings that explore nostalgia as a significant driver of architecture through the physical assembly of drawings. The drawings explore a method-ology that describes the processes of nostalgia-developed architectures within the obscure boundaries between the casual gardener in their small home plot and the present mechanistic state of commercial agriculture. Here, nostalgia is to be defined as the longing for or recollection of a previous image of a place when faced with its current, changed, physical state.

The now-defunct eighteenth-century Dolton Farm in Feasterville, Pennsylvania acts as a site for investigating nostalgia as an architectural driver in two significant ways. First, the former farm is a site with some intact structural remains, allowing new architectures to be physically situated within an existing context and informed by existing materials. Second, the site provides a historic programme that can be recalled and redeployed on a new scale. On the site of a once-historic rural farm is a new automated garden in what is now a suburban residence. The subtle shift in the scale and purpose of the land's farming programme explores how expectations and reality can diverge, which triggers sensations of nostalgia.

The drawings exploit historically-based expectations of farming and personal responses to idealised images of manual labour in the vast fields of early twentieth-century farming. These images are pitted against the mechanistic nature of modern computerised farming equipment. This mechanisation of a once-massive human effort is translated to the physically laborious yet recreational pursuit of gardening.

The production methods for the drawings provide a manual means to describe an automated system. Ink, pencil, tape and collaged imagery on and between sheets of vellum and Dura-Lar allow for multiple formal, material and sub-programmatic propositions to be overlaid, combined and challenged. Their simultaneous inclusion among the multiple physical drawing layers gives each proposition its own space to dawdle within the historic timeline and project new definitions of place onto the site.

Constructed at the same time is a model developed within shallow drawers. Divided by the drawers' boundaries and partitions, existing site topography and labelled landscape artefacts are organised according to seasonal plantings. The drawings and the model feed off one another as moments of the models are collaged into the drawings and moments of the drawings force the reorganisation of the model. Moments of the model's reorganisation are captured within the drawings to act as a record of the garden's movement. This action physically captures and redisplays a moment in time when the garden differed from its existing state, thereby forcing the model and drawings to act according to the triggers of nostalgia.

The drawings also explore a series of new minor programmatic protocols that support the wildflower gardens and recall the garden's historic use, including rabbit deterrence boundaries, duckboard boot-washing platforms and arborvitae view obstacles. The minor programmes are introduced to support the new automated wildflower garden. Beneath the larger programmatic headings, minor themes more personally related to the neighbourhood residents yet related to the site, such as neighbourhood hearsay, rumours and familial tall tales, are introduced to avoid complete

Fig. 1: Eric Mayer, *Storms of the Spring and Early Summer, Site Plan of Her Wildflower Garden*, 2016, ink, collage, graphite on Dura-lar and vellum, 17 × 22 in. The obscured limits of the garden depicted during spring storms recall the seemingly limitless fields observed by a farmer.

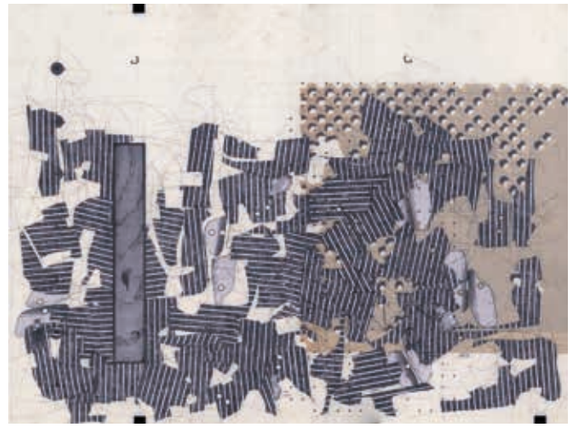


Fig. 2: Eric Mayer, *Collection Platforms and Tidal Pistons,* 2016, ink, collaged model photographs, graphite, spray paint on Dura-lar and vellum, 17 × 22 in. The drawing continues to speculate on the structures responsible for collecting necessary rainwater, starting with recorded and repositioned model photographs and making inferences in drawn mediums.

Fig. 3: Eric Mayer, *Wildflower Garden Irrigation Lines, Bladders, and Seed Hoppers*, 2016, ink, collaged model photographs, graphite, spray paint on Dura-lar and vellum, 17 × 22 in. Below grade, the irrigation lines and seed hoppers act as arteries for the automated garden, defining the limits of growth.

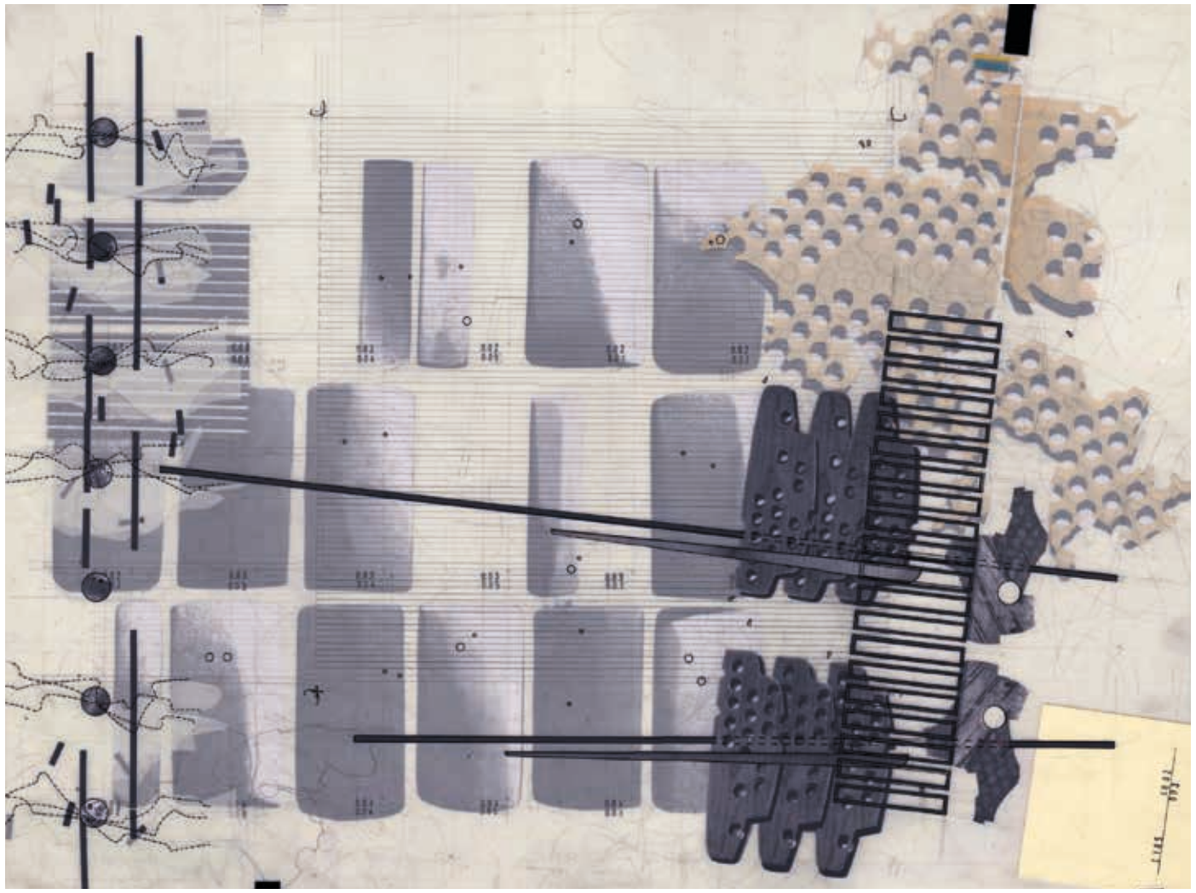


Fig. 4: Eric Mayer, *Reconfigurable Garden Landscape Artefacts,* MDF, spray paint, glass, bass wood, ink, brass fittings, bearings, drawers. The ever-changing boundaries of the wildflower garden are explored in the model and then recorded in drawing, as an architectural means to explore nostalgic triggers of then versus now.

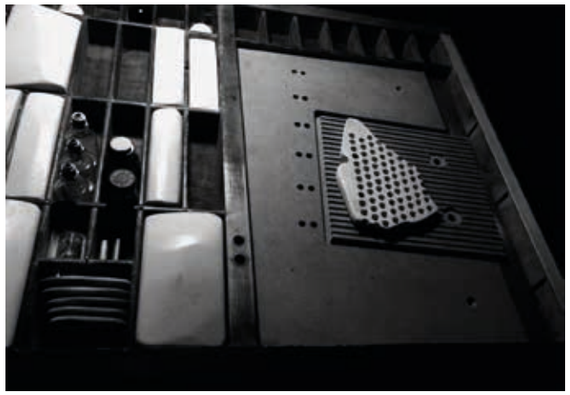


Fig. 5: Eric Mayer, *Extents of the Suburban Garden Parcel as a Dimpled Silt Surface,* model photograph, aspen, MDF, aluminum, spray paint, drawer. In model form, the site itself is represented as an object similar to developed landscape artefacts, in order to be reconsidered as a nostalgic souvenir.

autonomy or continuous circular referencing between the history of the farm and the new automated gardens.

Seven gardens of wildflowers are irrigated by collected rainwater from the storms of spring and early summer. Sub-surface expansion bladders are pressurised by six tidal pistons driven by the tidal inlet of the Delaware River and, in the event of piston failure, one hand pump. The collected rainwater is pumped through a series of irrigation corridors, which are infused with varieties of wildflower seeds, and deposited directly into a dimpled silt earth surface above. The gardener views her wildflowers from atop a copper patina filtration platform. The garden's boundaries are ever-changing within the two-acre plot, as they expand and contract at the will of the tidal pistons compressing water into the irrigation lines. At the end of the season, she sets out a roaming chimney, turning the fields into charcoal to reload the filtration platforms and prepare the earth for another season.

Although scale is rigorously enforced during production of the drawings, the final products do not directly portray the garden's relationship to the human body. The autonomy of the garden's programmatic actions excuse the gardener from daily tending in order to attend to her new roles as both an intermittent system mechanic and an observer of the garden. The ambiguous sense of scale within the drawings frames the recall of images of vast fields once required by commercial farms. That image is positioned against the state of the wildflower garden, which is situated on a selected parcel fluctuating within the more recently established boundaries of residential property lines. This further undercuts expectations brought on by the site's expanse when considering its history.

The physically developed drawings and model furthermore act as newly developed artefacts which track variations in the life of the wildflower gardens. Thus, the gap between initial contact and development of a memory of place and the return contact and recall of what the place once was is bridged. From this, one can develop an architecture from the processes of nostalgia.

Developing Self-Methodologies for Drawing: Open Air Performance Museum

Oğul Öztunç

The idea that drawing is not only a representational tool but also a critical instrument of the design process has been adopted very well. Designers use drawing to research, to imagine, to communicate ideas and to address a plethora of other issues. In this process, formulating a self-methodology – a *modus operandi* – for drawing is critical. Not only *why* it's done but also *how* it's done will crucially affect design. Designers can modify or mix conventional techniques, develop their own tools, use software for unexpected purposes, multiply drawing stages or learn from ancient techniques and so on. Personalising drawing techniques can open up a broad spectrum of possibilities. To explore this idea, a set of drawings and visuals developed within the scope of the project 'Open Air Performance Museum' will be discussed.

The project focuses on Kadıköy Seafront, which is a radial-shaped field; the proposal is a performance centre. The project first puts forward several concepts and observations about the programme and site. The seafront and the urban space are disconnected; it is therefore argued that the radial field of the seafront has the potential to connect Kadıköy with the sea by organising public movements across the site. To show this hypothetical potential of the seafront, a way to experience this radiality must be invented.

The standard consecutive section technique with even intervals would not be sufficient, but angular sections from a centre point might work. This inquiry resulted in the idea of radial sectioning. The area was cropped with a circular mask, so it would have a centre point in the middle of the sea. Then the site was sectioned in order to complete one full round tour around the bay. The suggested radiality has the potential to bring dynamism to the seafront. The radial sections that are produced are compiled into an animated drawing. Finally, a method for working with dynamic sections was derived. Within this moving canvas, one can see the intended urban movement and therefore work with it sequentially.

Another basis for this project were the concepts that arose by thinking about context and programme in the initial phase. Designers often use mind-mapping for harvesting ideas. This can be seen as a form of drawing, but using ideas and words instead. Conventional mind-mapping can be cultivated to build up a technique. Words and phrases are written on paper, then arranged and connected in a way that allows them to be compiled into conceptual fields. This is a somewhat instinctual stage, resembling the early sketches of a design project. After this, these fields are isolated from each other and potential problematics and outcomes are drawn out which the project could perhaps address. With this method, the drawing instinct is used instead to organise complicated concepts and produce meaningful connections, correspondences and interrogations.

When a project emerges through working with words and concepts, a visual challenge occurs. Words only define concepts, but spatiality depends on images. At this point, a method for translating these concepts into images needs to be discovered. Therefore some of the powerful concepts are focused on and then drawn freely, one by one. The drawing process is recorded and compiled into an animation, so that the process of transformation can be tracked. These animated drawings generate a strong basis for the project's visual and spatial character.

The project sees hundreds of poles placed on the waterfront, with stages floating between them where performances can take place. This transforms the sea into an open air museum. Anybody who wants to perform can design, decorate and use these stages as their set. Performance is defined as an urban activity that can be anything that performer envisions; a protest, a spatial experiment, a playscape or a traditional piece of theatre. This opens the door to endless possibilities, as a space defined for performance can be anything. To show the richness of spatiality this will bring to a city, random stage set proposals are imagined and drawn side by side with an oblique perspective. Using this method, spatial possibilities emerge from each other through the repetitive act of drawing. Arrayed on a basic grid, combinations of these drawings appear as a series of unfolding possibilities. This makes the drawing set align with the project's initial conceptual proposal.

The proposed formation fragments its programme and scatters around the seafront, dwelling on very specific points. This is intended to amplify the radial experience and reveal the potential uses of the area. For this purpose, a canvas which can cover this entire field is required. Conventional city planning techniques could be used for this kind of challenge, but many elements of the site would be overlooked and the main characteristics that the proposal aims to bring to the area would be missed out. Instead of using conventional city plans, the hierarchical perspective and permissive rules of Central Asian Miniature Technique are adopted and interpreted. Detailed visual and spatial research has been done to understand parts and particles of the city and outcomes are rearranged according to these rules. The method here can be understood as a way of reproducing the image of city in the dimension of a hierarchical world,

Fig. 1 (opposite): Oğul Can Öztunç, *Random Possibilities of Spatiality*, 2014, drawing. Spatial possibilities emerge through drawing random stage set proposals in oblique side by side.

composed by gathering together and disposing elevations. This drawing became an operational tool for the development of the project. Fragmented elements of the project, urban activities, characteristics and surroundings can be tracked and worked using this canvas.

Drawing methods emphasised here can be understood as the designer's mini-inventions in response to encountered problematics and potentials of the project in different phases. Drawing can be used as a tool to interpret the city in a particular way, to look inside one's subconscious, to translate words into images, to imagine endless possible realities or to reproduce the city in the form of a working canvas in a different dimension. Drawing uncovers a very resourceful toolset and, when self-methodologies are developed, it has almost unlimited use.

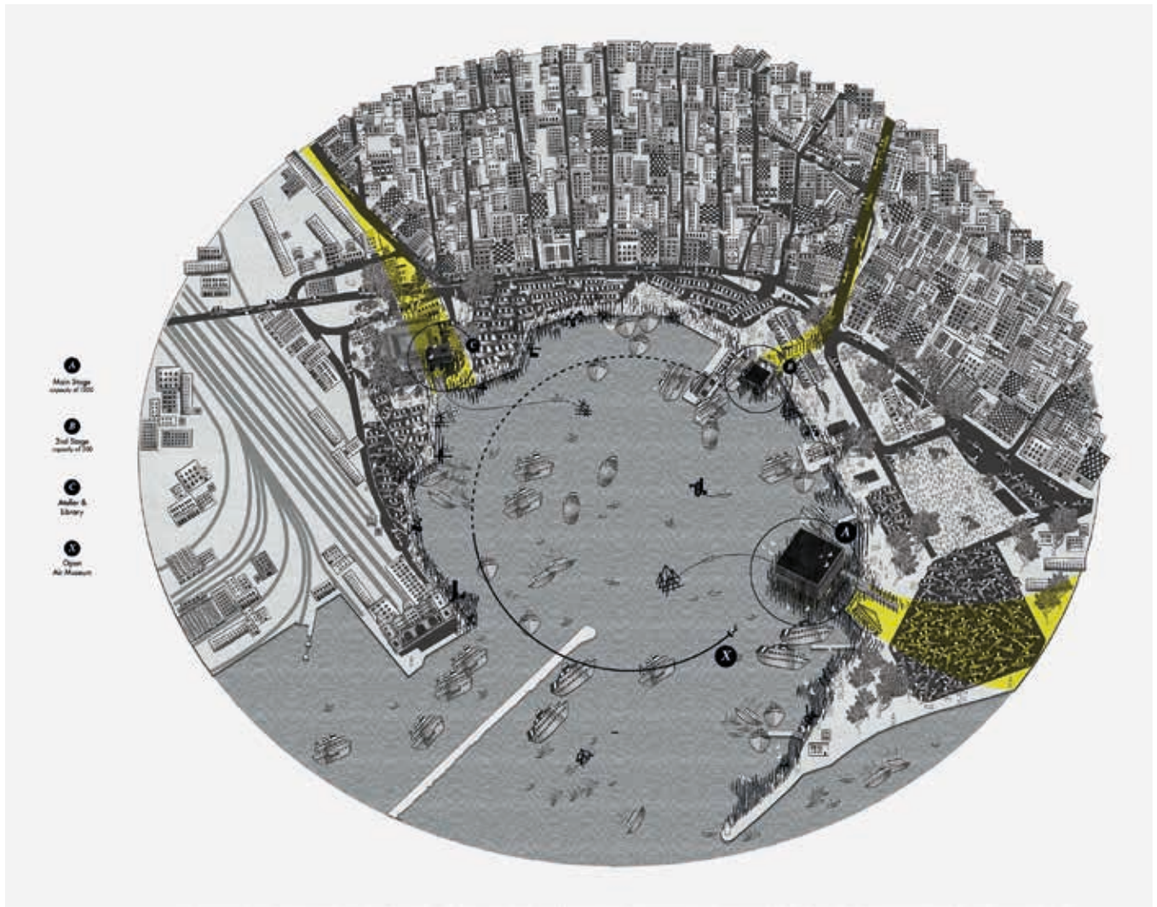


Fig. 2: Oğul Can Öztunç, *Miniature Perspective*, 2014, drawing. Detailed visual and spatial research has been done to understand parts and particles of the city; outcomes are rearranged by the permissive rules of ancient miniature drawing techniques.

Architect as Urban Ghostpainter

Drawing Architecture Studio

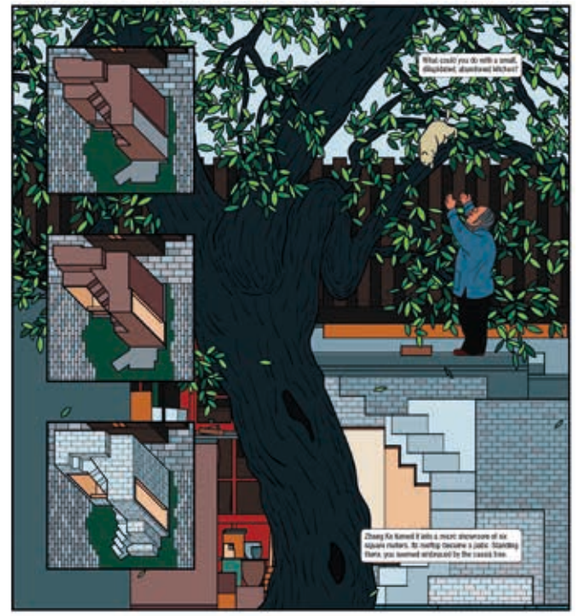


Fig. 1: 'Micro-Yuan'er', spread from *A Little Bit of Beijing: Dashilar*, 2015. Authors: Li Han / Hu Yan. Publisher: Tongji University Press.

The traditional role of architectural drawing is to present graphically the architect's design idea. Therefore the use and appreciation of architectural drawing mostly remains within a professional context. However, we believe there is great potential for architectural drawing – not only due to its infinite variety of techniques, but also because it provides us with a truly expanded perspective on the world. Architectural drawing deserves a much broader audience.

Living in Beijing – a rapidly changing metropolis – stimulates our urge to document by way of drawing. Different stages of urban development co-exist and overlap, which makes the city a great inspiration. We are fascinated by how the many and varied relationships between the urban environment and human activities play out through the city's relentless transformations. Our interest has nothing to do with the 'goodness' or 'badness' of design, but rather is due to the crazy, or even absurd, status of contemporary metropolises. The aim of our work is to represent this status in architectural drawing.

Our project comes in two formats. The first is large-scale panoramas, such as *Dashilar* and *Tuan Jie Hu*. Here, we document a specific area of the city by presenting its architecture, landscape and human activities in the language of axonometric projection. *Dashilar* depicts the traditional *hutong* area in the old part of Beijing, while *Tuan Jie Hu* represents a residential neighbourhood built in the 1980s. Through these panoramas, we try to explore the value of architectural drawing as artwork. We are not trying to make precise architectural maps, but are more concerned with composition, colour and visual impact created by rich detail.

The other format is the graphic novel, in which we represent the relationship between space and people in the style of comic strips. In our two publications, *A Little Bit of Beijing (San Li Tun, 798, Nan Luo Gu Xiang)* and *A Little Bit of Beijing: Dashilar*, we use images of plan, elevation and section generated from 3D models to depict the urban environment. The stories of our graphic novels are mostly based on the documentation of certain intriguing spaces in the city and interviews with the people who create or use them. For example, the story of 'Micro-Yuan'er' explains the ideas behind the *hutong* re-development project by the Chinese architect Zhang Ke.

We believe that today's architectural and urban design frameworks are challenged by increasingly complex issues, and that these frameworks might sometimes indeed seem too flimsy. Architects could give up their position as saviours of the world and not limit their roles to only making design proposals to change the real world. Then they might find that their capabilities naturally expand towards more extensive work.

Very often, architects consider themselves as professional elites who know better than other people how to make a better world. They tend to believe that their design

Fig. 2 (overleaf): *Tuan Jie Hu Panorama*, 178 × 109 cm, 2014.

proposals for making a physical building or environment are ultimate solutions to urban issues. But we don't think such design proposals can solve problems. They have limits, and there are far more other factors to consider in complex urban issues. One alternative method is for architects to observe and represent the phenomena of the city so as to raise awareness and inspire other people. This could also be an important role for architects to play for the world.

In many cases, cities need expression rather than design. Cities have their own lives and inner logics. Because they allow scope for the continuous creation of wonders, they are the perfect stage for the expression of strong desires. In his book *Delirious New York*, Rem Koolhaas describes New York as a movie star: "Movie stars who have led adventure-packed lives are often too egocentric to discover patterns, too inarticulate to express intentions, too restless to record or remember events. Ghostwriters do it for them. In the same way, I was Manhattan's ghostwriter." By the same token, we will try to become the 'ghostpainters' of contemporary Beijing.

In many cases, cities do not need architects to design for them, as they generate interesting spaces by themselves. Many exceptional spaces are not designed by architects but created by average people who use them. We shall just represent those naturally grown spaces, not try to design them.

Fig. 3: *Dashilar Panorama* (detail), 95 × 135 cm, 2015.

Future Fantasticals

Drawing has always been a tool to speculate on the future. It forms a surface for enacting the desires of society and proposing new ways in which architecture can facilitate them. From the seminal speculations of Archigram to Paul Rudolph's hulking megastructures in pen and Hugh Ferriss' crystalline 'Metropolis of Tomorrow', the twentieth century took drawing towards a multitude of possible futures. Most of these futures will never come to pass, but the potent power of speculative drawing continues on. If science fiction is always using the future to say something about the present, then speculative and fantastical drawings speak of our contemporary concerns. It could be the utopian desire to build the world again from scratch, or simply the making of a critical argument about today via the imagery of tomorrow – but either way, fantasising through drawing remains an evocative and seductive act.

In the following chapter, we will see work that speculates on the future of drawing as much as the future of worlds. *Future Fantasticals* takes us on a journey from Neil Spiller's singular world manifested in drawing through to the work of science fiction legend and *Blade Runner* concept artist Syd Mead. As we zoom towards the horizon, we will encounter strange machines for drawing, buildings that combine with biological creatures and cities that revel in their unrestrained scale. Within each of these projects, there is a sense of contingency, of a future that might never come into being except through the act of drawing it. Yet in each case, there is the sense that drawing as a speculative tool, with its human subjectivities and missteps, still has the power to pull us into its realm and let us dream of things to come.

Drawing as Communicating Vessels: An Apologia (or Not)

Neil Spiller

> "Let us watch him with reverence as he sets side by side the burning gems, and smooths with soft sculpture and jasper pillars, that are to reflect a ceaseless sunshine, and rise into a cloudless sky: but not with less reverence let us stand by him, when with rough strength and hurried stoke, he smites an uncouth animation out of the rocks which he has torn from among the moss of the moorlands, and heaves into the darkened air the pile of iron buttresses and rugged wall, instinct with a work of imagination as wild and wayward as the Northern Sea; creations of ungainly shape and rigid limb, but full of wolfish life, fierce as the winds that beat and changeful as the clouds that shape them."
>
> John Ruskin, 'The Nature of Gothic', *The Stones of Venice*

For me, the 1980s were a perfect storm of architectural education and creative inspiration. During this time, I was taught the conceptual, tasteful modernism of the Cambridge School but was really inspired by Archigram and Cedric Price; his era also coincided with the halcyon days of high-tech, architectural postmodernism, Alsopian and NATO splurge and deconstruction – a heady, eclectic mix of styles and ideas. I was also reading a lot about Victorian neo-gothic architects – Billy Burges, Goodhart-Rendel's rogues and Pugin also loomed large in my fevered imagination.

Also at the same time, while still a student, I had read an article by Charles Jencks that looked at ancient and contemporary column orders as microcosms of architectural epistemology, and asked: what might new contemporary orders look like? I picked up this idea in my diploma project and designed the *Dorian Gray Column* – a column for the foyer of an architectural school to be 'dressed' by generations of students, creating a barometer of architectural fashion and preoccupations.

Towards the end of the 1980s, a college friend and I set up a fledgling architectural practice; we were full of young men's bravado, energy and iconoclasm. The new practice's goal was to invent a new architecture, element by element. We developed a way to work as a team, yet independently – neither of us wanted to lose what we believed to be our innate talent by fully collaborating with the other. We divided up drawings and worked in a surrealist exquisite corpse sort of way. This method of working we called 'schizophrenic architecture' and it produced 'interstitial drawings' (between art and architecture). Railings, columns, monuments, tombs, lights, a gallery, exhibition designs, stage sets and even master plans for Milwaukee and Genoa followed.

As the 1980s drew to a close, and with a number of projects under our belts, we went into self-publishing (making architectural books continues to be a preoccupation for me). We managed to convince Cedric Price to write a preface. The booklet was entitled *Burning Whiteness*, *Plump Black Lines* (1990). Cedric was very flattering in his writing and tried to explain to us that we didn't need to use all our architectural fruit in every architectural cake we baked. Like 1980s heavy metal guitarists, we liked a good 'noodle' up and down the fretboard. But Cedric was talking about architectural blues – slower, more emotional, with space between the architectural notes: "There is no lack of richness but the resultant 'cake' may contain too much fruit. Accepted disciplines of cost and timing are not ignored but too often add to the mix rather than refine it. This is not so much a criticism as a suggestion that future works need not use the whole palette all the time. The avowed 'Search for Architectural Language' could well be a task left to the grateful receivers of this intelligent, delightful practice. I for one will be watching".[1]

The early 1990s were marred by economic recession, but *Burning Whiteness*... brought us some notice and regard. In particular, it brought us to the attention of Peter Cook, who was just assembling a teaching team to rejuvenate The Bartlett School of Architecture. After a few years, my practice disintegrated and I was on my own again; but thrown into the creative turmoil that was The Bartlett, my drawn work changed – it embraced colours and evolving technologies, such as cyberspace and nanotechnology, and it became more informed by surrealism and science fiction writing. I also started to write about spatial ideas and technology. This writing became my book *Digital Dreams – Architecture and the Alchemic Technologies*, written between 1993–95 and published in 1998. I was already teaching about the architectural ramifications of new technologies on architectural design at The Bartlett in my diploma unit.

Digital Dreams featured projects that included *The Alchemist's Church* and the first panel of the *Genesis to Genocide* triptych. This triptych was a harbinger of another phase in my architectural trajectory – a return to a series of black and white Rotring pen drawings exploring protein geometries, DNA ribbon models, surrealism, Bosch and the impact of technologies on human bodies.

In 1992, *AD* invited us to exhibit in the *Theory and Experimentation* exhibitions. This was the first time my work was shown alongside some of my idols – including Lebbeus Woods, Peter Cook and Himmelblau – which was a great thrill. After this exhibition, I remained in close contact with *AD* and was asked in 1994 to guest-edit an edition with Martin Pearce, Architects in Cyberspace. This was the first international established journal to explore these issues. A series of guest-editorships of *AD* have followed. In 1998, I was asked to collate a monograph on my work to date – *Maverick Deviations*. This was again another cathartic moment in my career, and a celebration of my greatest hits to date.

After *Maverick Deviations* was finished, it heralded the beginning of a new project, one I'm still pursuing: *Communicating Vessels*. I have always admired architectural theoretical projects that were long-term, open-ended and speculative, such as Mike Webb's *Temple Island*, Ben Nicholson's *Appliance* and *Loaf Houses* and Daniel Libeskind's *Micromegas*, *Chamber Works* and *Theatrum Mundi* – projects not borne out of the financial expediency of traditional practice but full of the prima materia of architecture. *Communicating Vessels* was to be my contribution to this canon; it began in 1998 and runs to this day. Everything I have drawn and designed in the last twenty years is part of this project; it now consists of around a thousand drawings and thousands of words of text.

Communicating Vessels is a rumination on the impact of twenty-first-century technology on architectural space and materiality. It is also a personal memory theatre, a surreal contemplation on the house/garden dialectic in the contemporary world and a meditation on reflexive space and augmented reality. The project re-examines traditional paradigms and elements of design such as the house, gazebo, garden shed, walled garden, birdbath, entrance gates, riverside seats, love seats, vistas, sculptures, fountains, topiary and outside grown rooms, among many other objects and spaces. It redesigns them, electronically connects them, explores their virtual and actual materiality and their cultural and mnemonic importance, and reassesses them in the wake of the impact of advanced technology and the surreal protocols of contemporary architectural design in the twenty-first century. The project was initially conceived as a set of objects set in a psychogeographic landscape that resonated with my youth – a very small island in the River Stour, two and a half miles outside Canterbury in Kent, near where I was brought up. So it is an island of memories, of hot sunshine bicycle rides, burgeoning sexuality, secret underage beers and illicit 1970s liaisons. The site exists simultaneously both geographically and in my memory.

As I have written: "*The Island of Vessels (Communicating Vessels)* is a huge chunking engine, a communicating field, full of witchery and sexuality. Its neurotic things are 'pataphysically enabled and surrealistically primed. The island's geography is cyborgian and always teetering on the edge of chaos. Its groves and glades are haunted by ghosts, some impish like Alfred Jarry, some nude on staircases, some with Dali-esque moustaches and some muttering about defecating toads. On the island lives a Professor – a madman, an idiot savant or a genius – perhaps all three. The Professor is attempting to work out the shock of the new, its architectures and its desiring poetics. The Professor likes his things – they tell

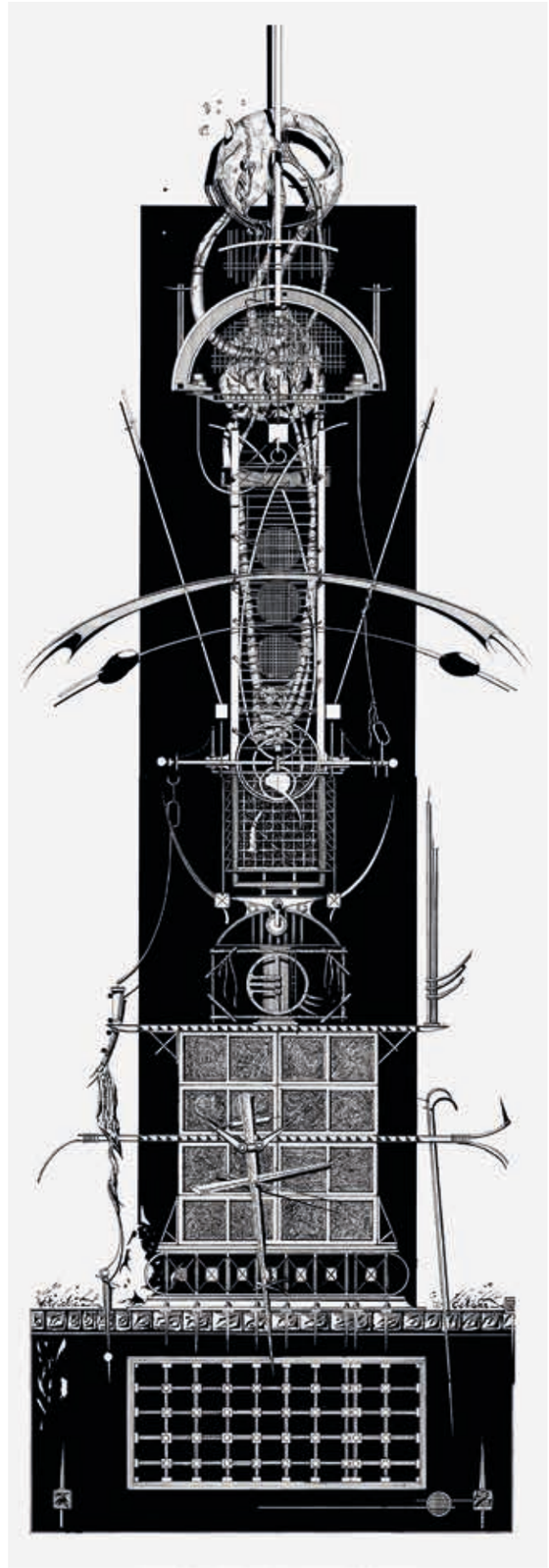


Fig. 1: Spiller Farmer Architects, *Vitriolic Column*, 1986.

him where he's been and where he is. He dwells in this world and builds in it everyday, without fail. He works at the intersection of art, architecture and science. He uses desire as a welding torch and the pen as a scalpel. Like Duchamp's Handler of Gravity, he likes to surf on precarious and fleeting equilibriums".[2] initially, the first ideas for the project were about the simultaneity of forms in different fields and the embroidering of architectural space through various scales of technology. So the first phase of *Communicating Vessels* was in developing surreal reflexive systems that utilised the virtual, the nano and the chance dynamics, both within the site and further afield.

The assorted architectural tableaux are powered by mysterious grease, a nanotechnological substance, highly flammable, created within desiring machines. Desire is the other great motivational force on the island, alongside memory. This is the celebration of the marvellousness of desire fuelled the Surrealists' creative odyssey.

Another cathartic moment occurred late in 2012, when my friend Lebbeus Woods died. Lebbeus had championed my work since I first met him back in the early 1990s. I set about weaving my memories of Lebbeus into *Communicating Vessels*. This resulted in *The Walled Garden for Lebbeus* and coincided with a massive outpouring of work that galvanised the *Vessels* project further.

"Initially, there were only a couple of drawings of the Garden; over the past year, these have blossomed into a suite of twenty-five or more. I wanted the Garden to channel all manner of architectural ambiences and make some familiar quotes, not only from my architectural lexicon, but also from Leb's, Aldo Rossi's Moderna Cemetery and OMA's La Villette Competition entry. October 30th was also the day Hurricane Sandy ripped through New York, where Leb lived (this is not to suggest that the two events on the same day were connected). As the year has progressed, a series of ideas has evolved in the work, mainly about the choreography of augmented reality and gravity gradients over time. I wanted the Garden to have another virtual side, a side that would augment the simple world of walled space, trees, conic forms and statues I had created. This I saw as a new area of architectural detailing, one barely explored by contemporary architects. I wanted the drawings to explore this juxtaposition of virtual and actual, of points of view, ghosts, light and black."[3] The garden is presided over by a statue of Electra, the back of whose head is hollow. It is through this hollow, if one's head is placed within it, that one can see and hear a storm rising and abating, formed of augmented reality vectors.

The Garden has a frustum within it, consisting of an upper and lower chamber. The upper chamber is an homage to Piranesi's Plate IX of the *Carceri* and Bocklin's *Island of Death*. The lower chamber is reflexively linked to moving figures in the upper chamber that dodge the storms, real and augmented, as they pass over the open top of the frustum. This movement above activates grease below and it starts to create a surreal tableau of *Leda and the Swan* – another myth beloved by the Surrealists.

By 2015, it was clear that it was time to start to design the major piece of the constellation, the Professor's house,

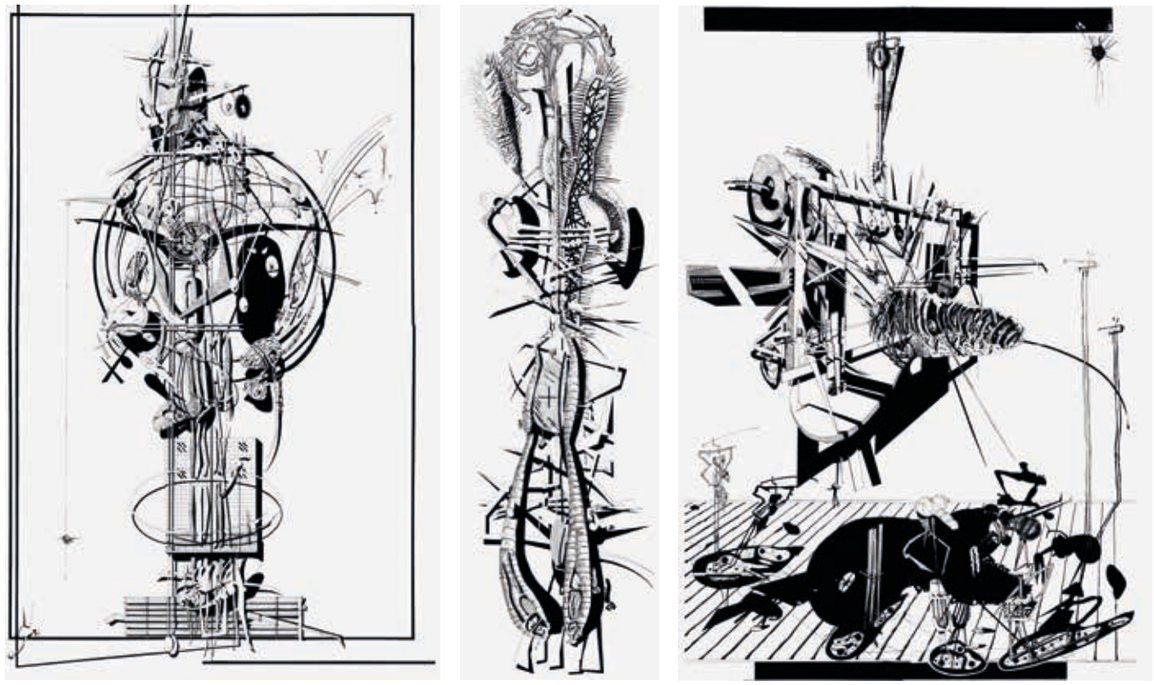


Fig. 2: Neil Spiller, *Genesis to Genocide*, 1995.

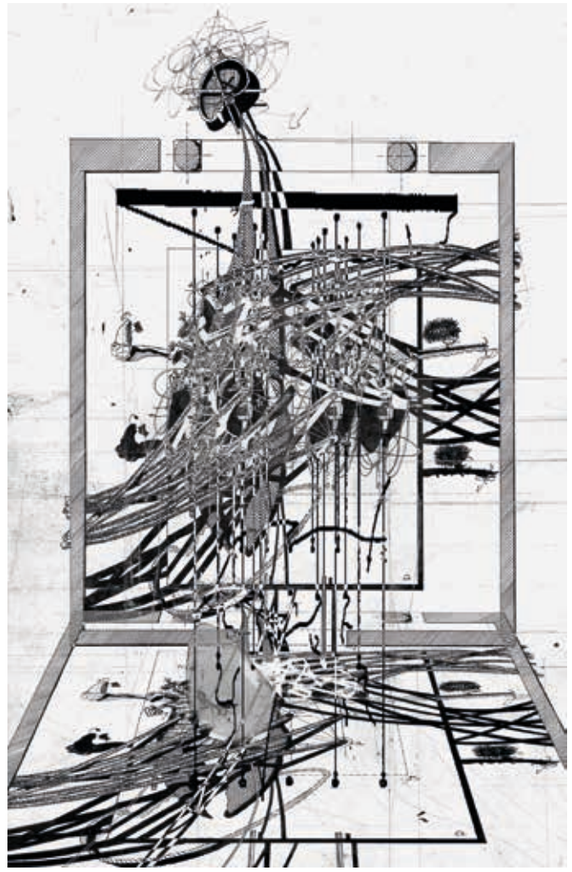


Fig. 3: Neil Spiller, *Communicating Vessels, Genetic Gazebo*, 2005.

Fig. 4: Neil Spiller, *Communicating Vessels, Genetic Gazebo*, 2005.

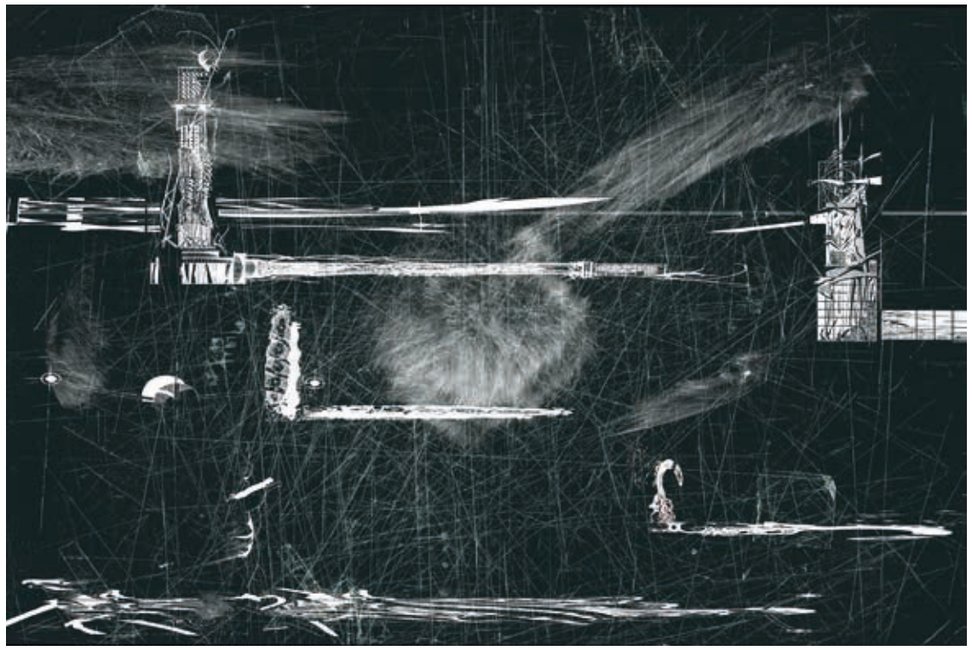


Fig. 5: Neil Spiller, *Communicating Vessels, The Walled Garden for Lebbeus – Ballard of Crafty Jack*, 2013.

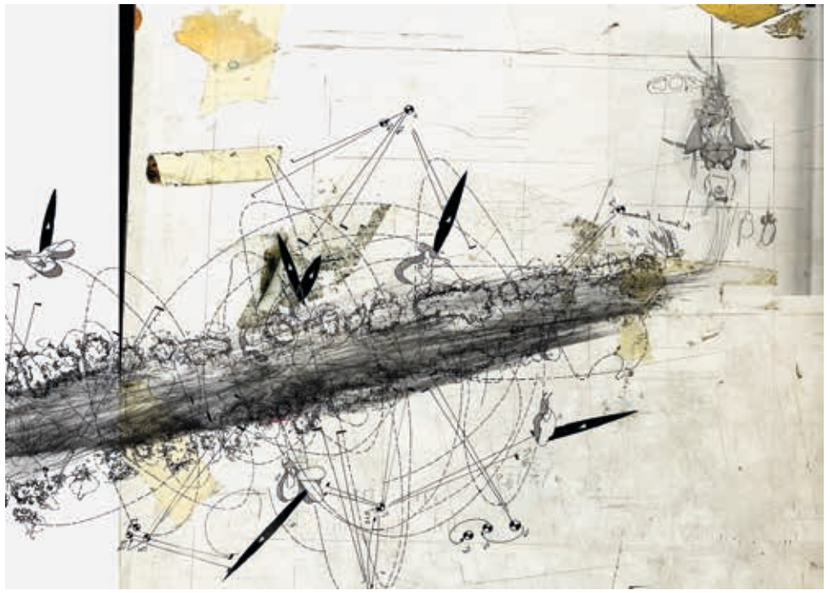


Fig. 6: Neil Spiller, *Communicating Vessels, Baronesses Filaments*, 2008.

which had by then become called the *Longhouse*. It is a *prytaneion*, a place of surreal banquets inhabited by ghosts, dreams, desires and mythic creatures; a memory palace of shifting relationships, momentary flutterings, cartographies and trajectories, where objects have the same accountability as people. It is a place of flame, of heat, of a rotten sun, of dusk and dawn, where the vertical is assimilated into the horizontal and where modernism breaks down. The Longhouse is a highly reflexive and responsive series of spaces and relationships. The house choreographs itself and develops this daily choreography by reading its site; this site is a virtual changeling site.

The traditional lexicon of tactics that architects use to place their works in the context of specific sites – how they respond to the *genius loci* – has been radically augmented by myriad new, virtual and reflexive technologies. Changes are upon us; the vista has changed, is changing and constantly changes. Cyborgian geomorphology is a movable feast and here to stay. Permanent architectural context, material sympathies and synthesis, massing, phenomenological and anthropocentric sensitivities are now imbued with the accelerating timescales of virtual and chemical metamorphosis, combined with the virtual choreography of chance. Both positions of, and the nature of, objects and architectures are conditioned by mixed ontologies, scopic regimes, numinous presences and reversible time. This reversible time stalks objects and disturbs their gentle entropy and peaceful rest. The vitality of architecture has increased a thousand-fold. To the twenty-first-century agile architect, these disruptive technologies breathe new life into the language of architecture. The verbs of architecture are being recast.

Time-based sensitivities are mixed in the cauldron of the virtual world, seen by augmented eyes enhanced by dimensions of chronological slippage, coalescing in a digital dance above and beyond the pragmatics of actuality. This is a house of augmented reality, nano-enabled ghosts and mythic chimeras whose movements are cross-programmed with the house's sites, both real and imagined.

The house interiors are yet to be fully designed; this is my next task.

What drives some architects to make drawings/models of architectures that are clientless and therefore unbuilt or currently unbuildable? Firstly, the commercial world of architecture is a world of value engineering, of committee consent and limited material palettes – a world that is highly legislated and therefore often normative and often, arguably, having lost its lifeblood, ARCHITECTURE. What is architecture, and can it be held within a drawing/model as well as a building? Architecture is the 'mother of all arts'. It is a synthesis of poetry, fine art, sculpture; it flows over time like music and its spaces have establishing vignettes, oscillate across the scales (from macro to micro) – and have a dénouement, as in film or prose. One could go on. Above all, architecture is the manipulation of space, in all its manifestations. Space can be both imagined and graphically represented.

Indeed, as our world sails headlong into culturally, demographically, ecologically and technologically uncharted waters, we badly need our ability to speculate about the future of our discipline and its centrality to society. This is not utopian, and it is not something that the prevailing capitalist mentality often encourages. This is shortsighted and could potentially cost us our whole discipline.

Fig. 7 (opposite): Neil Spiller, *Longhouse Hecate both within and without*, 2015.

A good architectural drawing is about, on one level, what one leaves out. A very good architect over the years develops a series of personal protocols and idiosyncrasies that have connected histories and evolutionary meta-morphosis from one drawing to the next. This is also true for buildings as much as it is for drawings.

Our era will hopefully be seen as being responsible for the blossoming of the virtual word and the beginning of a sustainable world. We are here, now, to find and achieve positive outcomes – and to this achieve this, we need to speculate to accumulate.

This is what I have done and will do. Simultaneously, my day job is making students see the same but different opportunities in this bizarre but beautiful world. All my work is connected in the massive Communicating Vessel of my mind. It's a life's work and I make no apologies for it! It's what architects should, but seldom, do!

1 Spiller Farmer Architects, Burning Whiteness, Plump Black Lines – A Search for Architectural Language (London: Spiller Farmer Publications, 1990).
2 Neil Spiller, "The Poetics of the Island of Vessels in Drawing Architecture", ed. Neil Spiller, *Architectural Design*, Sept–Oct 2013, 112–119.
3 Neil Spiller, "Detailing the Walled Garden for Lebbeus", in Future Details of Architecture, ed. Mark Garcia, *Architectural Design*, July–Aug 2014, 118–127.

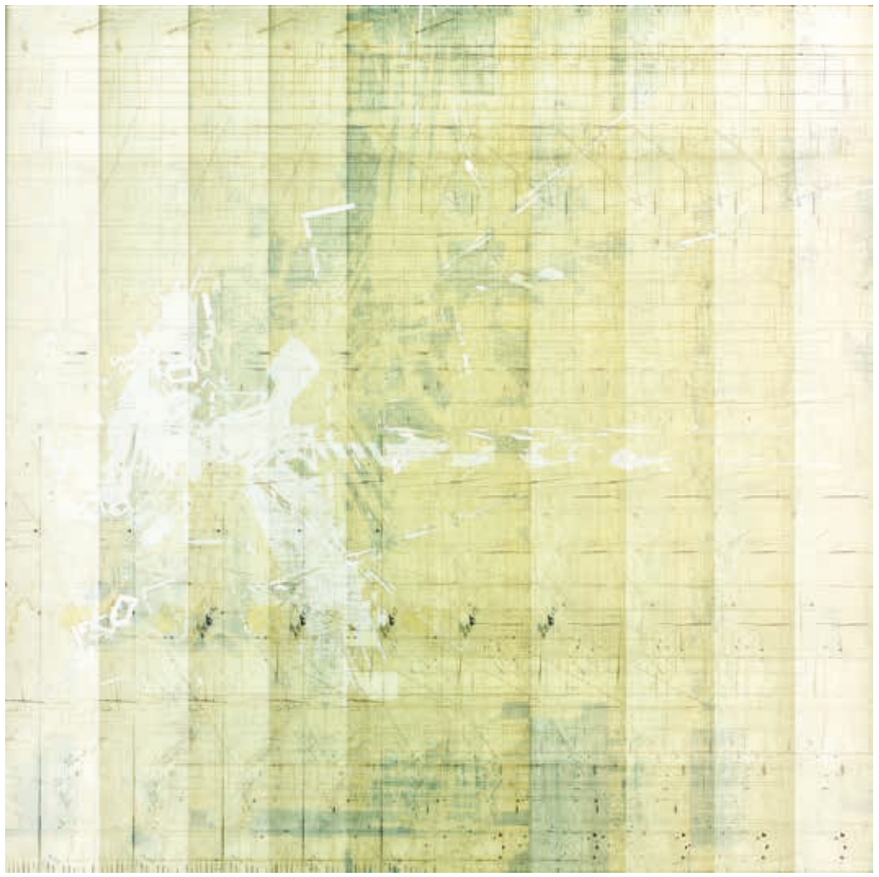


Fig. 8: Neil Spiller, *Longhouse Figured Ground Plan*, 2015.

Paradoxical Sciagraphy

Nat Chard

The conventions of architectural drawing concentrate on things we think we know – what will take place, what the architecture will be made of or what it will feel like to be there, for instance. The question discussed in this paper is how to draw those aspects of architecture of which we are less certain – the sublime, uncanny and indeterminate occurrences that are also significant parts of our lives.

One of the main ways in which we are implicated in the content of a drawing is through interpretation. Typically, architectural drawing leans heavily on the conventions of contract drawings, where there is a legal imperative for all parties to understand the drawings in exactly the same way. Their rigour is in denying any interpretation other than that of the drawing's author. This project therefore seeks other methods of drawing so that the observer might be implicated in the drawing's content, especially by spatialising the drawing. From earlier research looking into work which plays between material and pictorial space (especially natural history dioramas), it became apparent that two promising agents in such a construction would be anamorphosis and folding the picture plane.

The research described in this paper covers a sequence of attempts to build an apparatus to draw uncertain conditions. Early instruments play with the mechanisms of optical projection, especially the picture plane. Since at least Leonardo,[1] artists have curved the picture plane to establish veracity in their images. If folding the picture plane has such a capacity, it must also have the potential to act as a critical agent. The first three instruments worked with projection through light, and on their original terms they were successful. While the folding picture planes allowed for a critical reception of the projection, the instruments revealed that the original terms were not the most precise site of inquiry. The instruments demonstrated the idea but the author was in complete control, in a condition of certainty.

The potential of the folding picture plane was promising, but light proved too unwavering in its physics. To address this, latex paint replaced light as the medium of projection. Latex paint is a non-Newtonian fluid like blood, for which forensic scientists have digital and analogue means of divining the narratives of blood-splatter.[2]

Instead of the projection holding the figure of the object – as with an object and its shadow – thrown paint (standing for occupation) would hit a model (representing the architecture) and the resulting splatter would discuss the coincidence of the two for a particular occurrence. The model is part figurative but also acknowledges that it will be occupied by flying paint. A folding picture plane collects the splatter.

A sequence of instruments works out how their various parts can be tuned so that the splatter (a sort of shadow), along with high-speed photography, could reveal potentials in the realms of uncertainty. Simultaneously, the instruments were developed so that the author might experience the conditions of indeterminacy that are being drawn while making a drawing.

Normally, an architect is commissioned to design a building by a client who has the motivation to enact certain things at a particular place. The client's request is formed into a programme that sets out what it is that the architecture has to achieve. Typically, what is discussed in the programme is in the form of explicit knowledge – ideas that we know we know about and can articulate clearly to someone else. The conventional architectural programme attaches itself to the architecture rather than the occupant, and yet we all occupy it in different ways – even each person might deviate in this from day to day. What is at stake is not just the capacity of architecture to adapt when circumstances change, but also its capacity to be relevant to multiple simultaneous sorts of occupation.

The programme is a necessary tool but, in trying to articulate the specifics of what might take place in the project, many of the sensibilities learned from our experience of inhabiting architecture are lost – in order to be reliable, it becomes reductive and leaves out much of the richness of life that emanates from the unexpected or from things that we are less certain about or are unable to articulate. Our understanding of this realm is not readily accessible as explicit knowledge. Instead, we understand such conditions through our tacit knowledge, discussed by Michael Polanyi as the fact "that we can know more than we can tell".[3]

The devices I have built to pursue the pleasure of the indeterminate in architecture might at first seem paradoxical, as they appear as didactic instruments – instruments of certainty. In practical terms, they are instrumental – they are set up to test a range of specific ideas – but their appearance is also an attempt to seduce the observer. One way in which this might work is that the precision, care and apparent purposefulness of the instruments might persuade the observer that the splatter drawings that they produce might be of some substance. There is, however, another dimension to their apparent didactic nature. While I was studying the potential of the picture plane, I constructed a set of cameras to understand the projective techniques of James Perry Wilson's[4] diorama background paintings, the dioramas providing an intriguing world where material and pictorial space met each other seamlessly. While I learned what I needed to understand about the picture plane from this work, the intensity of my involvement with the dioramas opened up a greater understanding of the potential of didactic instruments that at first seems to run counter to their purpose.

For my purposes, the didactic instrument has the potential of a translator between explicit and tacit knowledge. The dioramas I was studying were built with exquisite care to reveal the relationships between contextual ideas such

as topography, climate, available nourishment (plant or animal) and environmental colouring and material with the physiology, appearance and social behaviour of the exhibited animals. They were constructed so that the museum visitors could tacitly construct for themselves the understanding that had been embodied in the dioramas from explicit knowledge by the museum's scientists and curators. While the didactic ideas are embodied with great care and precision so as to amply provide for the interpretation that the curators prescribed, as with any creative medium the reception is not entirely reliable; beyond our understanding of what we are supposed to discover, these sites of wonder provoke our imagination beyond the didactic intention. They have the capacity to relate tacit and explicit knowledge as well as to seduce the imagination to delve into unexpected realms.

My early optical instruments, which made drawings by projecting the image from a physical model onto a folding picture plane to produce a drawing on photographic paper, attempted the first seduction. The instruments hold a model in a box, which is illuminated so that its image is projected via a lens onto a folding picture plane. The plane also holds a second model, identical to the first (except in size, to compensate for the optical cone of projection), so that it casts a shadow on the picture plane that appears to come from the original model. When examining the consequent drawings, the paradoxical shadow – which sits on the image plane rather than within the perspectival depth of the image – requires the observer to construct their own logic for the image if it is to make any sense. The instruments worked well, implicating the observer in the content both in terms of their capacity to choose how to receive the image by adjusting the fold of the picture plane and also through their imagination when making sense of the image. The instruments work as things provided for this to happen, both mechanically and as a seduction to engender belief that the consequent images were worth investigating.

The limitations of the early instruments lay in their causality – as with the prescription of the architectural programme, they supported what they set out to do but were limited beyond this performance. Their capacity was understood in advance of construction as explicit knowledge that was confirmed and elaborated on when making their drawings. The veracity of light is so unerring that it provides little scope for the unexpected. The question was how to hold onto the potential of the folding picture plane (that the early instruments had teased out) in relation to projection without the strictures of light, and how to enrol the instruments to help construct tacit knowledge.

When an architect makes a drawing of a building to satisfy a programme we can look at two sets of causality. One is that when built, the architecture will support the activity that is predicted for it. The second is that what is drawn is set out to describe such a thing. In making

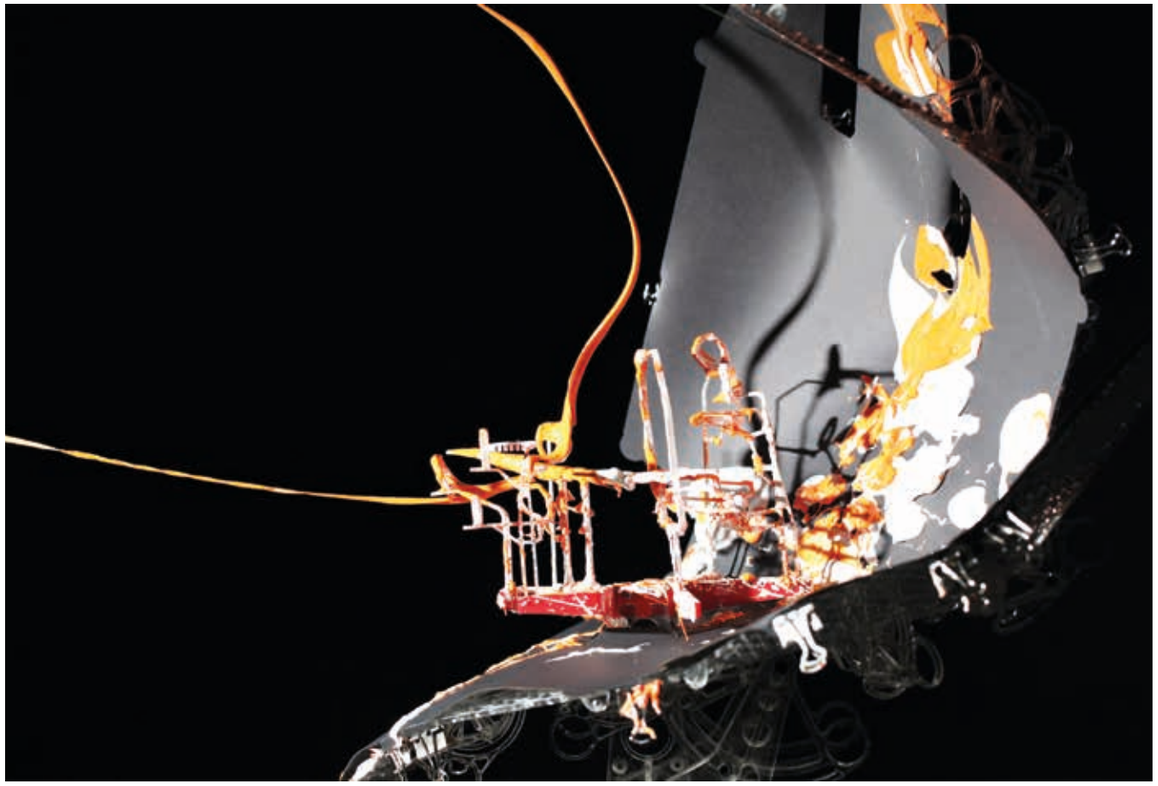


Fig. 1: Nat Chard, *Instrument Five in action*, high-speed flash photograph. The latex paint (accurate for direction but different in character for each throw) engages the drawing pieces.

a drawing, the thing that is drawn is likely to differ from the thought in the architect's head in advance of making the drawing. This happens through the normal occurrence where the creative mechanism – the process and materials of drawing – teases out ideas (from wherever creative ideas come from) that might go further than the original thought. By working through a medium, ideas are infected, corrupted and nurtured and this is typical of most creative processes. The point of clarifying this part of the creative process is to make the distinction of a causal relationship between idea and technique. While drawing architecture to meet a programme, the process of drawing is likely to contribute to and alter the architect's noting of what they will draw. The early optical instruments had a similar role and are successful in playing it out. Their failure is that they were in service to a premeditated idea, rather than teasing out ideas that had not yet occurred.

The question of how we might design for those things that we do not know will happen raises a paradox that makes sense of the programme. In order to make a drawing instrument that might enter this territory, I opted to make the act of drawing relate to content that was only partly premeditated. The instruments make the shift from a medium that supports an idea to one that might intervene more actively. To test this possibility, the new instruments projected paint rather than light. An arm-like catapult projects the paint towards an architectural model. The flying paint stands for the occupation of the architecture, represented by the model, which I called the *drawing piece,* as it is that that transforms the flying paint into whatever figures the resulting splatter might take. The splatter from the collision between the paint and the drawing piece is collected by a folding picture plane that learns from the earlier optical instruments.

To set up the instruments, the catapult is aimed at a part of the drawing piece. I had not made a paint catapult before and the accuracy of the paint throw exceeded my expectations. Each throw of the paint, however, has a unique character, something I discovered from taking high-speed flash photographs. The aim might relate to a general idea of programme but the nature and character of the flight of paint in the given direction opens up a wide range of ways in which that programme might (or might not) be acted out. The throw of paint is not a random image-maker. The degree of chance is therefore subtle and allows the discussion of indeterminacy to be held within a range of ideas rather than as completely open-ended.

The instruments throw latex paint. As mentioned before, this is different from other sorts of paint in that it is a non-Newtonian fluid like blood. Forensic scientists have a range of digital and analogue tools to recall narratives from blood splatter at a crime scene. There is software available to reverse-engineer the origin of splatter registered by hand-held 3D scanners. Equations are used to establish a bloodstain pattern index[5] that helps establish an area (if not point) of origin. This body of knowledge of how to understand what might have taken place to cause splatter made latex paint a helpful accomplice.

When the first flying paint tests were made with Instrument Four, it was immediately apparent that the drawings were telling only part of the story. The throw of paint happened so quickly that the occurrence was hard to fathom, even if it could be deciphered. To discover what had happened during the throw, high-speed flash photography was employed. The images proved revealing as well as compelling so that, in combination with the drawings made by the instruments, two partial stories were told – implicating the observer to fill in the space between them. Arthur Worthington's[6] attempts to register the nature of splashes,[7] at first through flashes and drawing the after-image on his retina and subsequently through flash and photography when photographic emulsions became fast enough, constitute one of the earliest academic uses of high-speed flash photography. The process was later popularised by Harold Edgerton.[8] Both used milk in their experiments, as the pigmentation of the liquid made it more apparent than water. The first tests with Instrument Four were with white paint for similar reasons. The photographs revealed all sorts of twisting and bending actions in the air, so subsequently two colours of paint were placed (unmixed) in the catapult's cup for each throw – usually white and an orange similar to international orange, the colour that is used next to white for the chequerboard patterns on structures that occupy the infield of civil airfields. The combination of colours describes the twisting of paint more precisely in the high-speed flash photographs.

The paint catapults are adjustable for power, line and length. The first versions were made using disposable plastic spoons to hold the paint, but the first test with Instrument Four suggested other forms should be tested. In subsequent instruments, measuring spoons with a partially spherical bowl were used in Instruments Five and Seven and ones with a cylindrical bowl in Instrument Eight. The sharper lips on these paint-holders provided a range of character to the throws that suggests that the profile of these components provides an opportunity to further characterise different throws of paint. This is being tested in the current set of instruments. For the first few instruments, the general nature of a round cup made sense – that the character of the paint (occupation) should not be prescribed. Now that the process of drawing with flying paint is better understood, it is time to explore the range of modulation in that process.

The drawing pieces mix figurative elements with parts that understand that they are being occupied by flying paint. Part of the adjustments from the figurative relate to straightforward practicalities that acknowledge the nature of the paint throw. The character of the flying paint tends to consist of stretched-out lines of fluid. Just as the stage sets for marionettes have to accommodate their strings, which make some architectural elements, such as walls above a door, impractical, the architecture is altered in the model to accept the paint.

There are several temporalities discussed in the drawings. Each drawing witnesses a number of throws, so there is

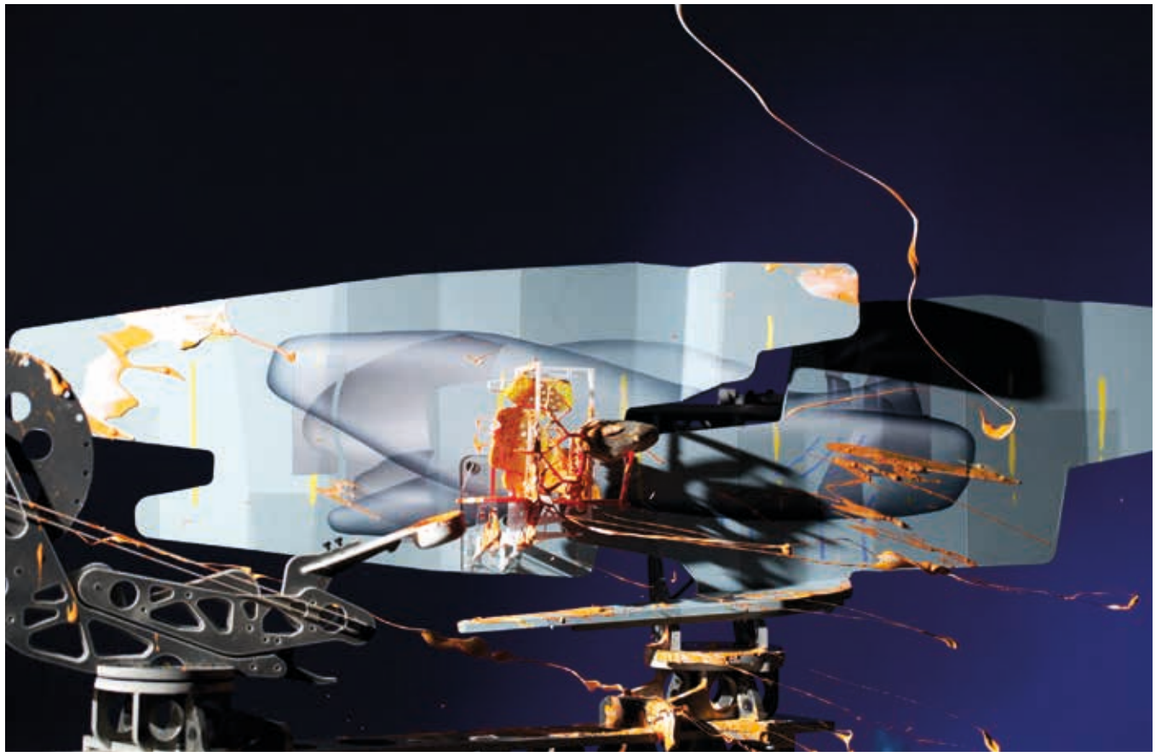


Fig. 2: Nat Chard, *Instrument Eight in action*.

Fig. 3: Nat Chard, *Two versions of Instrument Eight* (a collaboration with a research colleague). As with Instrument Five, they throw paint at each other. A difference is that the picture plane lies beside the trajectory of the flying paint so as to catch just the splatter – not the main throw of paint.

an accumulation of times through sequence. In the later instruments (Seven and Eight), the drawing pieces are made so that the accumulations of paint will have an effect on their subsequent performance – a memory of previous throws – especially where transparency is concerned. Within each throw there is some paint that collides with the drawing piece and causes splatter while the rest flies past. There are drawing pieces that, as well as holding the capacity to characterise the deflection of paint, are also made to hold onto the paint in different ways so that it might be active in making a register on the drawing at a later time than the particular throw when they were hit – perhaps even after a subsequent throw. One type of such a component is the hoop, which can gain a meniscus of paint when hit (a little like the film of detergent on a bubble-making hoop). Another is the comb-like element, which behaves in a similar way to those extruded pasta shapes that provide a large and accommodating surface area on which the sauce might attach itself. The paint meniscus will eventually burst and make its own character of splatter, while the comb will hold paint for a while until its viscosity lets it drip onto the part of the picture plane that sits below the drawing pieces.

The most active part of making a drawing with the instruments lies in the relationship between the catapult (with its paint cup) and the drawing pieces. These are the things that can be modulated to offer up new possibilities in the drawings. As with the optical instruments, the picture plane also plays a role. The picture plane is an imaginary surface that sits between the person making the image and their subject. The points on this plane that register its interruption of the line between the artist's eye and a particular part of what they observe is transferred to the canvas on which they paint or draw. Since Leonardo, artists have devised ways to curve the picture plane, usually so that the outermost edges are brought closer in plan towards the eye of the artist, so that the peripheral perspectival distortions are less pronounced, with the consequence that the picture appears more natural, in effect replicating for a picture what our eyes and perception construct when picturing the three-dimensional world. In the case of the optical instruments, the degree of fold on the picture plane provides a critical reception of the image in such a way that the receiver is implicated in the content of the image they collect.

With the projection of paint, the nature of sciagraphy changes from that in the optical instruments, where the picture plane distorts a projected figure to form its shadow. When flying paint hits the drawing pieces, the shadow is shaped by the collision between the paint and the drawing pieces to produce a splatter that is usually unrecognisable from the figure of the drawing pieces. In the test instruments (Instrument Four) and the first series of operational instruments (Instrument Five), the picture plane sat behind and under the drawing pieces, just as an optical screen would sit in the line of projection. As a consequence, the delicate splatter from the collisions could be smothered by the general throw of paint. In Instruments Seven and Eight, as well as those currently

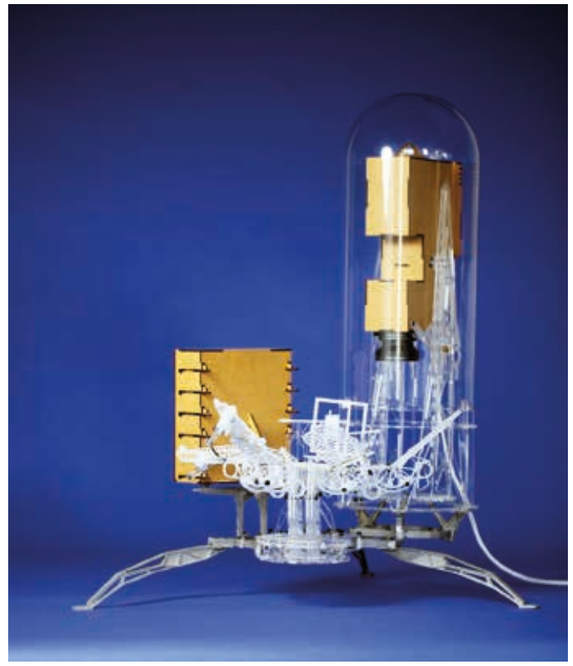


Fig. 4: Nat Chard, *Instrument Three for optical projection*. A model in a box is illuminated so that its projection lands on a folding picture plane that also has a replica of the model sitting on it, constructing a paradoxical shadow.

under construction, the picture plane sits alongside the trajectory of paint, with a small extension sitting below the drawing pieces to catch any drips or bursting meniscus. This position collects any splatter from one side of the collision, yet it lets the paint that does not hit anything (and therefore does not have an opinion worth registering) sail straight past. These folds are more subtle but have a much greater influence on the reception of the splatter, as the projection is more anamorphic than the earlier frontal planes. From my research into natural history dioramas, the combination of anamorphism and a folded picture plane had promised a way of receiving projections that could help spatialise the image. With the later instruments, this had come together – but in a less figurative manner. The sensitivity of the latest picture planes to a small adjustment in angle or fold has made the picture plane as active as the catapult and drawing pieces when making a drawing.

The act of making a drawing is somewhat complex, as there are several forms of representation in play. Apart from the image constructed by the splatter, the picture planes in Instrument Eight[9] already have a pre-made drawing on them. These drawings understand that they will be understood from two different directions – from the origin of the projection and from the side view of the camera that captures the paint in flight. The accretion of splatter on these drawings alters their content but also their sense of trajectory. There are also adjacent small models, protected from flying paint by glass domes, which remind the person who is drawing of the content that the drawings are trying to discuss. The high-speed

flash photographs record the paint in flight as it hits the drawing pieces – the moment of occupation documented by the splatter. But there is another form of representation that is drawn out through the process but does not register as an image. While working with the instrument, it can construct for the person who is drawing a condition analogous to that which it tries to draw.

The act of drawing might go like this: the author sets the fold of the picture plane in relation to the drawing pieces and aims the catapult. This aim holds a desire for a sort of occupation; similar to the way an architect might imagine their architecture being occupied. The paint is loaded in the cup, and in the dark, holding the trigger for the catapult in one hand and that for the camera and flash in the other, the author fires the paint and then almost immediately the camera. At this point, the author might have a desire for the sort of occupation represented by the flying paint and be inquisitive about what might be drawn in splatter as a result. Yet there is a second set of desires, for the author knows that beyond what is in their control the intervention of the flung paint's own will might open up the discussion beyond what has been predicted, so that there is one hope for what will happen but a second hope that the first hope will be eclipsed by greater things – the intervention of the instrument. The manual triggering of the camera and the speed of the paint means that only about one in three throws of paint are captured, so there are two levels of expectation in the photographs – was the paint registered and, if so, what does it show? The accumulation of anxieties and desires played out in this process involves a range of uncertainties that can help construct the very conditions of the sublime and the indeterminate that the drawings are trying to discuss – there is therefore a resonance between the process and enacting the process. The personal or tacit knowledge accumulated through doing this helps the author to understand the more explicit nature of the splatter with greater depth in such a way that *drawing* in this case is simultaneously a verb and a noun.

1 Leonardo da Vinci (1452–1519), identifies the marginal distortions in linear perspective in a line of equal diameter circular columns when using a flat picture plane.
2 Martin Matisoff and Larry Barksdale, "Mathematical and Statistical Analysis of Blood Stain Splatter" in *The Forensic Examiner*, Vol. 21, No.11, Spring 2012, 26-33.
3 Michael Polanyi, *The Tacit Dimension*, Chicago and London, University of Chicago Press, 2009 edition (first published 1966), 4–0.
4 James Perry Wilson (1889–1976), trained as an architect at Columbia University and subsequently applied the rigour of architectural perspective projection to natural history dioramas, starting at the American Museum of Natural History in New York. The author built a set of cameras to understand his projection method that related to his Cold Bog diorama at the Yale Peabody Museum.
5 Matisoff, "Mathematical and Statistical Analysis", 33.
6 Arthur Mason Worthington, (1852–1916), physicist who pioneered high-speed photography.
7 Arthur Mason Worthington, "The Splash of A Drop" a reprint of a discourse delivered at the Royal Institution of Great Britain, 18 May 1894 (1895), London, Society for Promoting Christian Knowledge, 1895, (reprint by Kessinger Publishing's Rare Reprints, LaVergne, TN, 2010).
8 Harold Eugene Edgerton (1903–90), professor of electrical engineering at MIT who developed high-speed electronic flash photography.
9 Instrument Eight was built in collaboration with Perry Kulper.

The Fall and the Rise: Lebbeus Woods' Metaphorical and Narrative Drawings

Massimo Mucci

Nowadays, digital architectural representation has accustomed designers to the rapid consumption of images, even when they are very complex, leaving us little time in which to analyse all their meanings. Blueprints and drawings that hang on the walls like art are not supposed to be seen as theoretical and paper architecture, although this can happen. On the contrary, we expect to receive a deeper theoretical message from what we perceive to be a sublime scene.

In the case of Lebbeus Woods, his drawings have great evocative power and are aesthetically appealing, but their real message can easily be misunderstood if it is not analysed in terms of its usefulness to architectural theory. Lebbeus Woods' work is not currently collected in a single monograph; instead, it is spread over numerous articles and critical essays. A strong stimulus of the dissemination of his drawings and theoretical texts has come from books written by Woods himself and, although they are still rich sources of information and indispensable for outlining any critical path, they influence any interpretation we make because of Woods' use of a narrative storyboard. However, what we need for Woods' projects is a new interpretation of his ideas of architecture and city reconstruction. This paper therefore proposes a consideration of the dialectic reasoning that could be said to exist between the 'rise' and the 'fall' contained in Woods' optimistic projects, from 1988–89 with *Underground Berlin* and *Aerial Paris*, when he began inserting visionary architecture into the real background of cities.

This essay takes both Woods' designs and theoretical texts into account in order to find a connection in their meaning. What are the figures of the rise and the fall in the drawings? What writings justify them? Are there any recurring architectonic metaphors? This study searches for the relationships between image and text in order to illuminate any hidden layers of meaning.

THE RISE OF CITIES IN CRISIS

Lebbeus Woods had drawn up several utopian city plans by the end of the 1980s. His criticism of existing society was expressed through a vision of alternative worlds which had the typical characteristics of a utopia: the absence of a well-defined real place, the setting of an indefinite future time and the great faith in technological development being at the service of humanity. The society imagined by Woods is balanced both in its relationship with community and in its relationship to the Earth, from whose energy sources it benefits.

In his designs for *Underground Berlin* (1988), a previously conceived utopian community is lowered into a real city, highlighting a conflict between utopian thought and its implementation. In the writings and drawings of Woods, conflict seems to find a solution in a form of active cultural uprising, started at first secretly and illegally and, indeed, underground. The designer proposes the reuse of abandoned subway tunnels to establish a heterarchical community that pays no attention to political and territorial divisions of the surface city.

Woods' criticism of the Berlin Wall and the German state's coercive control of citizens' life becomes clear: "In this project the subversion of an existing authoritarian system of social control is accomplished by architectural means [...] The construction of a new city within and in opposition to an existing one amounts to an act of renunciation and even of violence, more lasting in its effects than those achieved by the gun".[1] Woods believes in architecture's ability to change a city's culture and does not exclude the possibility that this change will be as violent as a weapon. The uprising takes place from below; the obscure depths of the contemporary city and the occupation of the Berlin subway are unauthorised; instead, it is a spontaneous refusal to participate in contemporary society.

In some places, invisible underground architecture emerges and appears with all its explosive strength, raising the Earth's crust, pushing out skyward and finally throwing out its subversive message: "The hierarchical surface city is met by the heterarchical subterranean city in structures built to break the physical and ideological barrier between them. The projection towers are architectural weapons *par excellence*. They have every intention of disrupting, of tearing the fabric of the surface city and its way of life".[2] The drawing is made so that the focus is on the central building, which has a dynamic form consisting of curved and flat surfaces mounted as fragments on an unbalanced skeleton, as if it were folded by dynamic forces coming from underground. The tower is brighter than the background and is in sharp geometrical contrast to the other grid-based existing facades of buildings. Hence, Woods depicts the idea with the dialectical juxtaposition of opposite-meaning couples: dynamic/static, bright/dark, irregular/regular.

The second example is the set of drawings for *Aerial Paris* (1989), which appear even more radical and visionary precisely because they are inserted in a real context and accompanied by texts that increasingly have the tones of an exhortation to uprising. Antigravity, as opposed to the detaining force of gravity, becomes a symbol of liberation. "Antigravity refers to struggle, tension, anxiety and restless assertion of the kinetic and animate against stasis. Gravity is an insidious enemy of the animate".[3] The dialectic between static and dynamic, which is also reflected in the metaphorical opposition of death and life, is developed in Woods' political discourse as a dialectic between

authoritarian power and individual freedom; and it is the prerequisite for taking a radical position against societal control – the basis for his oppositional, symbolically determined and continually changeable open society. "I therefore declare myself against gravity, because I am for animation and movement [...] I reject gravity's arrogance and claims, and assert a counterclaim – I am a free spirit, autonomous and self-determining, a being and an architect of antigravity".[4]

In the drawings, these concerns are depicted via air-hovering 'aerial houses', which do not follow repetitive rules but rather express individual freedom. This is a subversion of the concept of architectural tradition, because in Woods' vision the inhabitants are never inspired by the past, as time is incapable of fixing any form in the air. The constructions are continuously adapted to the changeable forces of the air and are unpredictable because they do not respect any plan. However, perhaps the most incisive symbols used by Woods to represent this extreme autonomy are the huge sails unfurled in the sky, which inflate and move as if they were flags of freedom.

Yet to some extent the *Underground Berlin* and *Aerial Paris* projects remain detached from reality because of their overly extreme visionary criticism, which at the same time, of course, assures their sublimity. But what happens when change really comes, as with the fall of the Berlin Wall? What happens to this idea of dynamic architecture? How is this sweeping change represented?

As Peter Cook has written, the kinetic condition in architecture had already established itself in the 1960s and developed in the following decades via the concept of metamorphosis, perhaps best represented by the explosive collision between architecture and high technology/the digital world.[5] This condition emerges clearly in Woods' work when he returns to Berlin in 1991 with the speculative project *Berlin Free-Zone* (1991), because he sees in the passing of crisis a great opportunity for cultural transformation.

This set of drawings is closely linked to the *Berlin Underground* and *Aerial Paris* projects through a narrative that was perhaps not foreseen at the beginning. "The aerial habitations above Paris find their way back – in the *Berlin Free-Zone* project – to the city of their subterranean origins. Yet they do not return underground. Instead they enter – in a conceptual sense – the existing structures at the centre of the re-united city of Berlin, at a moment of profound political, cultural and existential crisis and transformation".[6] But this fiction is a pretext to introduce the new concept of Freespace: "Having no pre-determined use or presupposed meaning, being therefore 'useless' and 'meaningless' space [...] Taken as a group, the heterarchy of Freespaces comprise a Free-Zone of shifting interconnections and interactions between inhabitants using nodes of electronic instrumentation located in each Freespace. Thus a type of urban order is created without hierarchy or fixed form, changing continuously...".[7]

There is no room here to expound this issue; instead, we will focus our attention on the well-known section of *Berlin Free-Zone* where we can see the Freespace as a metaphorical representation of the impact of digital technology on architecture. The drawing represents a hybridisation between the existing city, still exemplified by the prevalence of a regular grid, and the new Freespace, consisting of a fluid volume which, because of impact, is folded and crumpled at various points. Inside this shell, there are technological objects and tentacular cables of interconnection passing through the space and invading the rooms. This drawing is clearly a metaphorical representation of two different ways of thinking, or two systems that have to live together. In fact, the sharp section seems like an anatomical and scientific drawing that shows how the organs work, and is a disturbing and surreal scene.[8] The new technological age will lead to anxiety and uncertainty, despite the fact that it could be positive if the hybridisation leads towards a heterarchical society – as Woods says: "it is the ideal type of organization for the increasingly democratic (not to say anarchic) information and electronic-age".[9]

What we want to highlight here is the architectonic theme of the intersection between non-homogeneous entities symbolically represented with conflicting opposite geometrical forms, according to the dialectic of regular/irregular, linear/curved, static/dynamic. The intrusive object, the Freespace, is an empty space which invades the rooms of the host object, establishing new connections between the internal spaces. This theme had already been explored by Gordon Matta-Clark in his performances, such as *Conical Intersect* (Paris, 1975), where the empty volume inserted inside the existing traditional building establishes a new radical order and hierarchy through a different interconnection of interiors. In a similar manner, Steven Holl composes this dialectic in *Simmons Hall* (MIT, Cambridge, 1999–2002) and Thom Mayne, too, in *The Cooper Union* (New York, 2006–09).

The rise after the dissolution of the ordered world in *Berlin Free-Zone* is the end of a period in which a metaphorical narrative binds together a group of projects that pursue a representation of a positive social evolution, albeit driven by subversive forces. In subsequent years, the figures of rising are closely linked with the idea of the fall in Woods' experimental 'radical reconstruction' theory; the projects defined by this theory have in common the image of physical collapse as a metaphor for the collapse of the established order, enabling opportunities for a new social order.

In fact, the book and drawing series *War and Architecture* (1993), devoted to the ongoing war in Sarajevo, announces the end of Woods' period of visionary and optimistic narratives about the spontaneous uprising from the underground. Instead, there emerges the awareness

Fig. 1 (opposite): Lebbeus Woods, Architect, American (1940–2012). *Perspective View of the Project from the Hudson, Looking East (from World Center)*, 2002, digital painting, 19 × 26 in. © Estate of Lebbeus Woods.

of a traumatic and violent deconstruction with unpredictable outcomes. These drawings show a violent dynamism in which deconstruction and construction are both seen as inherently configurative forces, able to create new forms including fragments caused by the conceptual shattering explosion of the past world, in a similar way to that stated by Zaha Hadid in her early projects. The fall and rise are intertwined; indeed, it is unclear whether the new monstrous biomorphic figures appearing in the ruins are destroying or rebuilding the city, and if the fragments are coalescing or bursting (Fig. 2). We can see these drawings as the beginning of a new story, one about reconstruction as a physical and existential transformation, which will be Woods' main theme in the following years. Moreover, in this case the coloured pencil technique has the important role of homogenising opposite entities, so that existing ruins, new forms and energetic trajectories appear as one.

Woods criticises the idea of reconstruction as mere restoration of the pre-war city, because, he suggests, this would be the symbolic reaffirmation of the conditions of the society which *caused* the war. On the other hand, he disapproves of the modernist *tabula rasa* and the idea of 'urban renewal', as this erases history – including the memory of the war itself – and therefore also loses the variety and complexity of the old city.[10] Hence, he proposes the acceptance of ruins as an existential remnant of war, and to use them as a source of inspiration for spontaneous new forms, requiring active participation by the people. "The new spaces of habitation constructed on the existential remnants of war do not celebrate the destruction of an established order, nor do they symbolize or commemorate it [...] There is an ethical and moral commitment in such an existence, and therefore a basis for community," he says.[11] in this case, the reconstruction of ruins is the real act of uprising by the population, which leads to a psychological and cultural healing through a biological analogy with the physical healing process.

The first step is the 'injection' of spontaneous inhabitable structures in the gaps formed within ruins, which require inventiveness and creativity to make inhabitable, as "they are not predesigned, predetermined, predictable, and predictive" spaces[12] – exactly like Freespaces. After that, there begins the building of temporary protective structures called 'scab construction', and finally the permanent 'scar construction'; that is, architectural parts bound together and fused with existing ruins, though remaining recognisable. Thus, even the most visionary images representing 'new tissue' in formation – as if we were looking at the building processes of matter – are metaphorical narratives of a reforming psychic and social tissue.

Perhaps the best representation of the new relationship between rise and fall is the *High House*, a metaphorical house anchored to the ground by metal rods under tension and held in firm position by cables. It represents dynamic energy reassembled and restrained, expressing the continuous tension needed to rebuild society while avoiding the mistakes of the past. Woods states, "these houses respond to people's powerful need to achieve freedom of movement in space through a fuller plasticity of experience, and to exist in the full dimensionality of space – to fly and yet, paradoxically, to be rooted, to belong to a particular place and time".[13] in other words, the *High House* conveys the idea of balance as a constructive tension between contrasting forces, for both architecture and society. This concern also appears buildable thanks to the pencil technique. In fact, we can see perspective with kinematic projection and technical cross-sections, explaining the structure and its possible mobile capabilities, although in fact it does not actually have its own engine. We think of it as an efficient metaphor for the concept of social reconstruction understood as the coexistence of opposite but inteconnected parts, which have to move together to find a balance once again.

In subsequent years, this idea has been developed elsewhere to understand other sociopolitical crises or situations of neglect and decay, such as in Havana, or the post-earthquake conditions in *Inhabiting the Quake* in San Francisco, or in the destruction of the 2001 terrorist act in New York. In the case of Havana, the revolutionary uprising message is explicit in Woods' writings: "I do not want to see the Cuban revolution end. I want to see it succeed, even more so than it has been able to under the pressure of economic siege from without and oppressive, totalitarian governance from within. Because of these two sources of pressure, which are closely linked, the revolution has not yet found its architecture".[14] As in Sarajevo, Woods believes the restoration and reconstruction of Havana's historical old city should be based on popular participation. For instance, the project involves the construction of a new monolithic urban wall containing all necessary services, on which people can spontaneously add temporary slab-formed structures which over time become permanent and spread along unexpected paths.

The rise here is a form of resistance against the fall of revolution, represented by the spontaneous and unpredictable forms filling the empty space around the existing infrastructure, both in the old city and along the new wall. We can see this evolving process in the sections in perspective, which show scenes of everyday life in improbable rooms with suspended and interconnected floors linked in turn to sloping walls. Similarly to the *High House*, the image represents a potential kinetic energy that, if released, would involve all other elements, perhaps with the exception of the great wall. Thus the drawings for Havana are the architectural representation of a dynamic balance as interconnection between different components, in which individuals may continue to add other parts in a similar manner, forever increasing the complexity of the system.

The *Inhabiting the Quake* project is set in San Francisco, although it is inspired by the disastrous destruction caused by the earthquake in Kobe (Japan) in March 1995, where the collapsed buildings suggested the failure of designing according to the orthogonal grid. The grid structure is still seen as the symbol of a rational society that excludes the unexpected and the irrational, not only in the geological field, but even in the political, social and artistic ones. "It would be more rational to put aside doctrinaire ways of thinking and their inherently vulnerable systems, and to create new systems of shaping space, new types of behavior and patterns of thinking and living that incorporate earthquakes as an essential aspect of reality".[15] However, the interesting aspect of this analysis is that it has an original design outcome compared to previous cases and carefully considers the seismic characteristics of the site.

As for expressive language, can architecture represent these balanced tensions? Woods suggests a shift in structural thinking, no longer with grid-based frames too weak to withstand dynamic forces, but rather with a composition of variably sized plates, imagining that their juxtaposition has been completed by an earthquake. The composition created by the seismic wave spontaneously finds balance and greater stability. Therefore, as with Havana, there is in this process a random component aside from the external action of the designer – the earthquake and gravity – that transforms and completes the form and in this case the structural functioning as well. We could call it a kind of settling of the composition, which becomes architecturally expressive through the poetics of fragments.

In the case of *Slip House* and *Shard House,* the fragments are the collected and reassembled remains of previous civilisations, whereas the splinters of rock in *Fault House* are inspired by the geometry of the local geology. Everything is drawn with mixed technique and assembly sketches, plans, sections, dynamic representations and the usual perspective view made using coloured pencils, full of details to give the effect of a sublime atmosphere.

THE FALL AND THE RISE

The themes which emerged from Woods' projects for Sarajevo, Havana and San Francisco are collected in his book *Radical Reconstruction.* In the following decade, he develops them, changes his formal register with new abstract linear compositions and, in particular, begins to eschew the architectural realistic image. This transition had already been anticipated in the study *Terrain: tectonical landscape* (1999), in which he developed the idea of a settled composition caused by external forces, a phenomenon found in the analysis of the terrain's morphogenesis and which becomes the model for understanding how different components, both natural and artificial, can reach a balance while maintaining a state of internal tension.

But the event that induces Woods to apply this idea to the broader political dialectic of fall and rise is the 9/11 attack on the Twin Towers in New York. "Because we need to defend against possible and imminent recurrences, we naturally look for the most immediate and direct cause of the fall and of its disastrous consequences [...] This is reasonable only if we do not consider them first aid applied to a traumatic wound [...] The deeper wound, the trauma itself – embodied in the fall and its memory – is examined only in medical and academic quarters, far from public forums and discussion".[16] The message that we can read in his next projects is his warning that we must become aware of the political and social interconnection of globalisation in order to deal with the 9/11 trauma. Therefore he proposes a cathartic step-by-step project of two consecutive installations and a plan for the Twin Towers' reconstruction, linked again through a narrative that suggests a redemptive, optimistic cultural and social evolution.

The first installation is *The Storm* (2002), set up at The Cooper Union in New York, comprising a horizontal bundle of steel cables which hold metallic rods at their ends, inclined in various ways and sometimes joined by horizontal bars. The metaphor of the storm is generated by the effect of a flow of vectors with variable intensity depending on their density. Moreover, the work is also a real physical model which enables us to visualise the operation of a complex interconnected system. In fact, when a rod is moved, there are unpredictable effects on all the others, because they are not connected according to a regular grid-based pattern. Furthermore, by adding other vectors, the tension throughout increases. The unexpected breakage of a weak element does not cause a general collapse, because the load is distributed across many elements, reducing the tension of the overall system. Therefore, as Woods declares, "the idea of transformation in a tension field is linked with the interdependence of the elements within it, and, more accurately, to their interconnectedness".[17]

The issue is taken up in *The Fall*, an installation performed at the Fondation Cartier in Paris (2002), representing the trajectories followed by the structural grid-based elements during the collapse with a maze of deformed metal bars. The theoretical rectilinear trajectory caused by gravity is disturbed by perturbation forces external to the system, which make unpredictable and non-linear paths. Thence ruins are the result of a spatial distortion, but are not seen as irregularities, rather as a different form of regularity "in ways unaccounted for by the former system".[18] in other words, Woods has taken the same concept of reconstruction adopted in Sarajevo and developed it, being inspired by complex systems, which also include the unexpected perturbative element. Ultimately, as in Sarajevo, he wants to strengthen the thesis of the critical reconstruction without rebuilding exactly the same as before and without *tabula rasa*.

However, in this period, the drawings are an abstract composition of linear vectors and shattered volumes moving in space; only in some of them is there a nod to a vague tower shape, an echo of the World Trade Centre (Fig. 1). Where is the architectural figure? Woods states that his interest is in "these ideas and techniques in the service of building design in ways that emphasize process

Fig. 2: Lebbeus Woods, Architect, American (1940–2012). *Meditation: "Architecture resisting change, even as it flows from it, struggling to crystalize and be eternal, even as it is broken and scattered..."* (from War and Architecture), 1993, graphite and coloured pencil on board. 20 × 12 in. © Estate of Lebbeus Woods.

instead of product, and conceptual integrity instead of finished form",[19] but why does he destroy even the image of architecture? As Anthony Vidler wrote a few years later, when Woods proposed another similar installation and performance in Wien, this way of stimulating change through a dynamic and temporary event was one of the artistic methods used by the Situationists, based on the idea of psychogeographic energy, where people are linked emotionally and create a community network in a psychical spatial map of the city.[20] This psychical relation energy interacts with physical spaces and events, and Woods seeks to represent it and to act on it with his drawings and installations.[21] However, nobody had built a work "that matched their imaginary worlds of intersecting psychic freedoms and physical ambiances that might redeem the cities of capital".[22]

The third phase of the cathartic process to get rid of trauma is the shared construction of a new large 'perpetually under construction'[23] tower in place of the World Trade Centre, which, as a symbol of regeneration, is constantly changing. This time, Woods returns to his visionary storytelling to launch a social renewal message about the rise after the fall, to build "a community that brings together diverse social classes – a new democratic realm rising above the competitive tumult of the city below, a place where contentions can be informed by new perspectives and possibilities".[24] Within the tower, he draws four ascending exhibition paths on the subject of 9/11, with different visiting times and which differ in their difficulty. The first is for pilgrims and takes one month; the second is for those who are looking for answers and takes one week; the third is for holidaymakers and takes two or three days; finally, the half-day path is for tourists. These temporary visitors will find themselves at the top with permanent residents, mostly artists and scholars gathered in a constantly evolving community.

In conclusion, we can see in the first period analysed – Berlin and Paris – a clear juxtaposition between rise and fall, where uprising predominates as a positive social evolution through a strong individual autonomy. The projects are linked by a metaphorical narrative composed of dialectic figures of opposing concepts: dynamic/static, regular/irregular, linear/curved. In the second period, on the other hand, from Sarajevo to New York, the fall assumes a catastrophic role and introduces unpredictable elements into the project. The dialectic fall/rise is presented with less juxtaposition: there is more inter-connection and interdependence between the different parts. The narrative does not link the projects but remains within the single set of drawings, while the metaphorical figures represent the dialectic relationship between construction and deconstruction, and the concepts fall/rise are melded in the same world. We can see in the drawings, models and installations an increasing use of the image of physical dynamic balance as a metaphorical complex interconnection among several components. As in Sarajevo, the act of reconstruction after the fall can precipitate the transformation of a community that wants to change after the mistakes of the past, but in New York Woods does not want to fix the process through architectural form, perhaps to avoid it becoming an empty icon. Is this the failure of architecture or an admission of its power? Woods does not seek the contemplation of a monument, but rather the participation of individuals in the reconstruction process. He does not even want to construct an architectural monument in the world of images, perhaps because he fears its externalisation and therefore that the image of architecture might become the monument itself and impede the change of history.

[1] Lebbeus Woods, *Anarchitecture: Architecture is a Political Act* (New York: Academy Edition, London/St.Martin's Press, 1992), 50.
[2] Woods, *Anarchitecture*, 51.
[3] Woods, *Anarchitecture*, 64.
[4] Woods, *Anarchitecture*, 64.
[5] Peter Cook, *Drawing. The motive force of architecture* (London: Wiley, 2008), 48.
[6] Lebbeus Woods, *Lebbeus Woods: Terra Nova 1988–91* (Tokyo: Architecture and Urbanism, August Extra Edition, 1991), 22.
[7] Woods, *Lebbeus Woods*, 22.
[8] Peter Cook, *Drawing*, 116.
[9] Lebbeus Woods, *Lebbeus Woods*, 22.
[10] Lebbeus Woods, *War and Architecture* (New York: Princeton Architectural Press, 1993), 10.
[11] Woods, *War and Architecture*, 14.
[12] Woods, *War and Architecture,* 21.
[13] Lebbeus Woods, *Radical Reconstruction* (New York: Princeton Architectural Press, 1997), 18.
[14] Woods, *Radical Reconstruction,*19.
[15] Woods, *Radical Reconstruction*, 21.
[16] Lebbeus Woods, *The Storm and The Fall* (New York: Princeton Architectural Press, 2004), 107–8.
[17] Woods, *The Storm and The Fall*, 51.
[18] Woods, *The Storm and The Fall*, 113.
[19] Woods, *The Storm and The Fall*, 22.
[20] Anthony Vidler, "Drawing into space/In den raum zeichnen", in Peter Noever, eds. *Lebbeus Woods. System Wien* (Wien-MAK: Ostfildern-Ruit Hatje Cantz, 2005), 38.
[11] Lebbeus Woods, "System Wien", in Peter Noever, eds. *Lebbeus Woods. System Wien* (Wien-MAK: Ostfildern-Ruit Hatje Cantz, 2005), 13.
[22] Anthony Vidler, "Drawing into space", 40.
[23] Lebbeus Woods, *The Storm and The Fall*, 176.
[24] Woods, *The Storm and The Fall*, 177.

Creatures Afield:
Drawing the 'Dioramatic' Caricature

Joseph Altshuler
Julia Sedlock

ANIMATING THE ANTHROPOCENE

As scientists continue to debate the precise status of the Anthropocene, architects have eagerly absorbed the premise as a provocation for disciplinary speculation. The fact of human impact on climatic, geomorphic and ecological systems triggers the architectural impulse to reimagine the terms by which we define our present and future relationship to the environment, challenging binaries such as natural and artificial, inside and outside, subject and object. In a recent symposium organised by Columbia University GSAPP, Neyran Turan quotes geographer Mike Hulme's description of climate change "as an imaginative resource around which our collective and personal identities and projects can and should take shape'".[1] Hulme's provocation echoes the philosopher and design theorist Tony Fry's proposal for the Sustainment – a cultural movement on the scale of the Renaissance or Enlightenment that "has very little to do with 'saving the world", but instead calls for a reboot of how we make and think that manifests via "critical inquiry, argument, literary and visual creative projection and value-transformed lifeworlds".[2]

Architecture is in a unique position to contribute to this process, as it "exists as both fiction and reality simultaneously [...] The actualisation of the imaginary into the real is architecture's fundamental mode, its inescapable condition as a medium".[3] This process of actualisation happens through the act of representation, in the production of images and drawings that are both artefacts in their own right and instructions for the construction of something new. In her response to Hulme's prompt, Turan joins the Sustainment through an 'expanded geologic realism' that can engage the material reality of environmental contingencies with the representational potential of realism. Her examples are photographic images that deploy realism "as a form of strategic abstraction, [to produce] a subtle and unexpected separation from reality".[4] Visually complex with the detail and richness of the material world, these images possess an eerie and quiet gravitas. Avoiding the extreme of a post-apocalyptic dystopia, yet unapologetically devoid of life, they are ambivalent in their attitude towards inhabitation, human or otherwise, and are therefore mute in addressing the question of subjecthood in the context of our new environmental reality.

In contrast to Turan's 'expanded geologic realism', this paper explores the possibilities and potentials of what we call the 'dioramatic caricature'. As opposed to the complexity, simulation and gravitas of realism, we explore how the representational techniques associated with caricature – simplification, distortion, exaggeration and humour – can be used to produce a convincing, yet not quite complete image of an alternative world, in which our own subjectivity is augmented and altered through the subjectivity of other creatures and objects. Whether through human engagement with live animals or through creature-like architectural form, the projects discussed below use the disciplinary means of simple line drawings to portray an expanded environment of animated interaction. As a deliberately reductive process of representation, the dioramatic caricature playfully, shamelessly and humorously asserts and amplifies the perspective of both author and subject through its selective inclusion of information and biased promotion of a particular worldview. The low resolution of these drawings leave room for interpretation, distortion or further articulation by its audience. As an alternative version of Sustainment practice, the dioramatic caricature mines the condition of the Anthropocene as an opportunity for architecture to create a new vision of an animated collective life that expands the boundaries of its environment to include various subjectivities of both the non-human and inanimate kind.

THE EXPANDED DIORAMA:
FROM CONTAINMENT TO COMPANIONSHIP

The inanimate taxidermy that fills the dioramas in the Akeley Hall of African Mammals at the American Museum of Natural History represents an outdated worldview that used captivity and conservation to maintain control of a growing empire. Donna Haraway's 'Teddy Bear Patriarchy' situates the invention of the diorama at the Museum as a 'meaning machine' within the context of early twentieth-century New York City, where the ruling patriarchal elite manipulated an aesthetic of organic realism to project an image of purity and order in a rapidly growing and diversifying city. According to Haraway, the danger of realism is that it "does not appear to be a point of view", but rather hides the artifice of its construction so as to present the illusion of naturalised truth.[5]
From the point of view of Carl Akeley, the mastermind taxidermist behind the Museum's great hall, the diorama represented a direct translation of his safari experience in Africa via the composition of realistically preserved animals set in a lifelike reproduction of their native ecology, with simulated vegetation and rock outcrops in the foreground and a painted mural of the native landscape on the back wall to convey the larger context. The intention at the time of its production was to reproduce the truth of nature as it existed in the African wild and in its taming by white American men.

In today's high-resolution world, the artifice of the diorama is both obvious and unsettling, and therefore suggests its potential as a technique to be harnessed towards more subversive ends. Leaving behind the aspiration of realism, we learn from these dioramas about the creation of worlds through the juxtaposition of 2D and 3D representation, through the illusion or flattening of space and the selective inclusion of detail. Yet for the diorama to operate as a truly productive and progressive machine of knowledge, we must heed Haraway's call for a definition of social relations that "include[s] the entire complex of interactions among people [...] objects, including books, buildings and rock [...] and animals".[6]
From an architectural perspective, this expanded social environment invites human interaction and engagement with both live animals and creature-like architectural forms. These projects ascribe a subjecthood to architecture such that companion subjects of people, animals and animated built forms might integrate the ecological inputs and outputs that surround them. By letting creatures afield, these architectural examples transform our built environments into diorama-esque machines for knowledge-making and sustainment.

Studio Gang's recent proposal for the Gilder Centre extension to the American Museum of Natural History reconfigures the logic of the diorama within the interior layout of the institution's new wing. Exuberantly swooping concrete walls form large-scale arches and exhibition niches that resemble the interior skeleton of an enormous eviscerated beast. The interior is populated with animal replicas on display, as if this prehistoric beast of a building had swallowed an ecosystem of contemporary species before going extinct. With humans and animal specimens occupying the same space, the Gilder Centre demonstrates one step towards reconfiguring our relationships to animals, shifting the hierarchy of power and mechanism of agency away from a eugenic elite and towards a more variegated public. Here, the diorama has expanded to the entire museum interior and humans are included within its ecological display. Nevertheless, all the animals remain captive within this expanded and reconceptualised dioramic context. The architecturally ingested human visitors and animal artefacts together glimpse a glimmer of the outside world through the building's open nostril-like clerestory. Escape into the city beyond is almost visible and teasingly palpable.

Over thirty years prior, on the European continent, such architectural liberation was achieved by the masques of John Hejduk. A nomadic tribe of structures, each with their own distinct profile, character and story, these exist on a scale that lies somewhere between a full-size building and a sculpture. Though born from the context of a specific city, the masques move freely from place to place, occupying and inventing new territories as they accompany Hejduk on future travels. In this sense, the masques constitute a form of dioramatic urbanism, staging novel situations and scenarios that transform a given context into a machine for new forms of knowledge. What appears playful is also "deadly serious [...as] it invades and repopulates cities en route [...overturning] daily routines and commonplace thoughts, upsetting hierarchies and crowning fools".[7] The masques turn the logic of the diorama on its head – instead of containing taxidermy animals within the monumental form of an institution, Hedjuk animates architectural animals and lets them run wild as companions to their urban and human counterparts, providing an opportunity to challenge the fixed monumentality of the European city as well as the rationalism of modernism. The realism of the traditional diorama is thus replaced by the surrealism of the situationist dérive. Whereas traditional dioramas kept a safe distance and ensured a privileged gaze from human viewers to mounted animals, the projects discussed below assert the formal and operative potential initiated by creatures that, like Hejduk's masques, break free from hegemonic institutions, be it museums, aquaria, farms or even the atmospheric bounds of our planet, to produce a startling and surreal new atmosphere of near-Earthly existence.

THE CHARACTER OF CARICATURE:
LIKENESS AND TRUTHINESS

If the dioramas of Akeley Hall used realism to simulate a particular version of truth, the projects discussed here use representational strategies aligned with caricature as defined and discussed by art historian Ernst Gombrich and psychoanalyst Ernst Kris in their 1938 essay 'The Principles of Caricature'. Unpacking the relatively recent history of caricature, the two Ernsts describe it as an art that is less interested in "proximity to reality" than in a "projection of an inner image" and a "penetration of the innermost essence of reality [...] to reveal the character, the essence of the man".[8] By deliberately distorting, simplifying and exaggerating the physical features and behavioural traits of human characters, caricatures produce a "comic sensation" and a "likeness more than mere imitation could be". Despite their often primitive and unserious appearances, caricatures manipulate subject matter to sincerely transform an audience's perception: "[The caricaturist] consciously alters his model, distorts it, plays with its features, and thus shows the power of his imagination – which can exalt as well as degrade. Instead of an objective portrayal of the outer world he substitutes his subjective vision".[9]

Similarly, the political satirist and contemporary living caricaturist Stephen Colbert promotes 'truthiness', the practice of understanding the world through what feels right 'in your gut' rather than by thinking with your head. "I don't trust books," Colbert explains. "They're all fact and no heart... The truthiness is, anyone can read the news to you. I promise to feel the news at you."[10] Truthiness capitalises on likeness, emotion and charm to remake the world in the image of our desires. While Colbert's career-long commitment to propagating truthiness is in part a tongue-in-cheek gag lampooning conservative sensationalist news outlets, it also attests to a larger cultural shift in which exaggerating essence constitutes a truer identity than reality. Truthiness may be truer than truth.

While caricature is often prematurely dismissed as an overly reductive or one-dimensional rendering of a character, we see renewed potential in leveraging the caricaturist's tactics of visual simplification, bodily distortion and serious pleasure to amplify subjectivity and architectural agency in the built environment. When applied to architecture, the notion of a building 'having character' and 'being a character' enables a mindset in which built matter actively participates in tandem with human actors to affect how the world looks and operates.[11] The notion of a building 'becoming a caricature' does not detract from the nuance of personality, but rather reinforces both the imaginative intention required to exaggerate character traits and the truthy narration enacted by those characteristics. The artist Mike Kelley situates caricature in relation to the contemporary art of the 1980s, especially as it informed practices of biomorphic abstraction and aesthetics of "sculpting with flesh".[12] in a related spirit but with disciplinary-specific techniques, caricature also informs a cohort of architectural work that foregrounds human interaction with live animals and creature-like built forms. By animating inert form or by outfitting live animals to engage the environment in new ways, these creaturely caricatures help articulate new understandings about the world.

DUDE RANCH DOPPELGÄNGERS: *ANIMAL FARMATURES* AND *FARMLAND WORLD*

Design With Company's *Animal Farmatures* lets loose animatronic creatures into the agrarian landscape of the American Corn Belt. These livestock-shaped overscaled farm implements simultaneously cultivate farmland and entertain adjacent interstate car travellers and future high-speed cross-country rail passengers.

The Animal Farmatures are zoomorphic caricatures of conventional farm implements. Drawn primarily in section, each of the six different Farmatures takes the shape of a simplified animal silhouette which is stuffed with technological apparatuses. The beast-machine mashups cleverly couple animal anatomy with mechanical functions. For example, the Cow Combine's head serves as the 'primary intake unit', using its 'teeth' to cut grain from the stalks and ingest it for further processing.[13] Threshing and winnowing occur within an abdominal cavity and, in full comic effect, the fully 'digested' grain berries are expelled by conveyor belt through an aptly located anal aperture.

Drawing explicit cues from Jean-Jacques Lequeu's famous rendering of a cow stable in the shape of an Assyrian bovine, the Animal Farmatures restake a claim

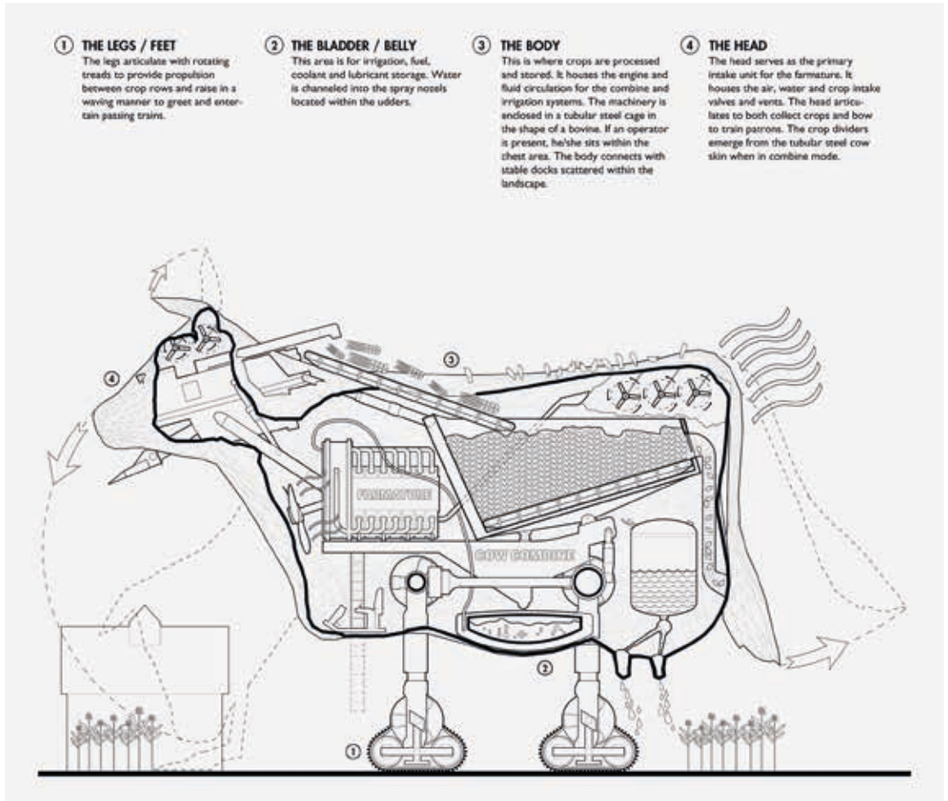


Fig. 1: Design With Company, *Animal Farmatures*, 2011. A section cut through the Cow Combine reinforces the familiar silhouette of the cow and delineates internal mechanisms with suggestive plausibility but without technical specificity.

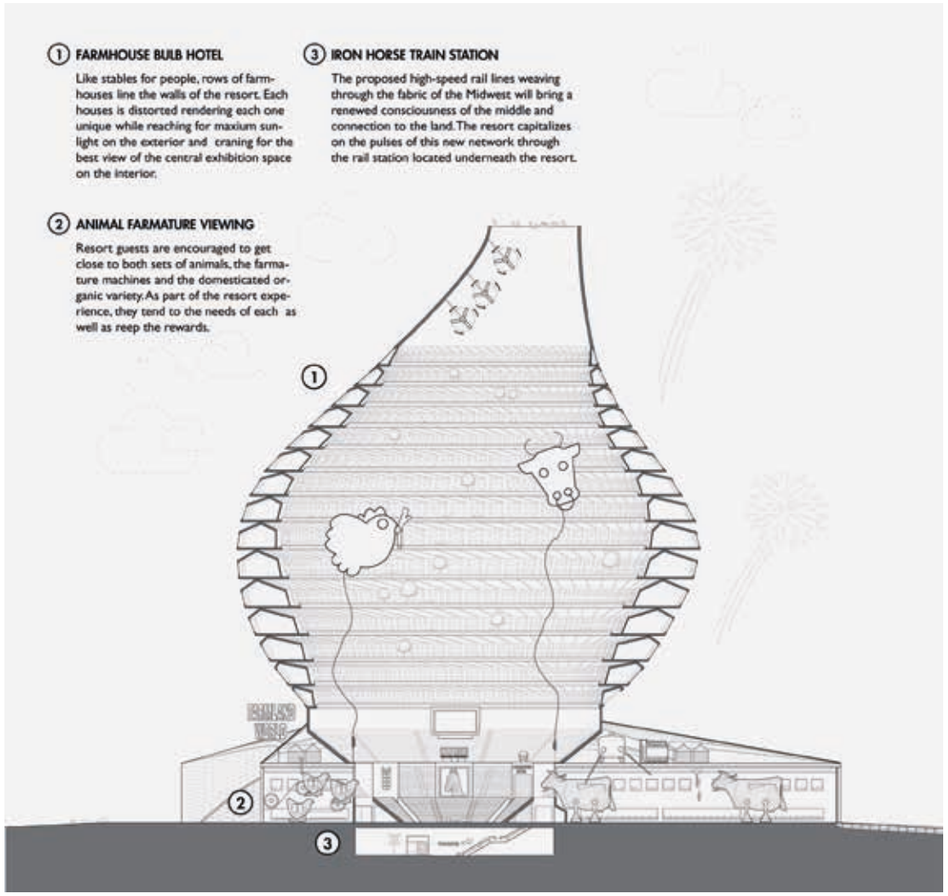


Fig. 2: Design With Company, *Farmland World*, 2011. While evoking Étienne-Louis Boullée's canonical drawing of the *Cenotaph for Newton*, the simple linework section through Farmland World includes details of human occupation, including an array of hotel rooms, stadium seating, jumbotrons and signage.

in the French theory of *architecture parlante* – buildings that use symbolism and pictorial reference to explain their function and identity. *Architecture parlante* is perhaps an ultimate manifestation of caricature in architecture: it exploits perspicuous visual likeness to communicate ('this building is for cows!'), it exaggerates the scale of familiar elements to produce laughter and surprise ('that cow is much too big for this pasture!') and it indulges in bodily and tumescent forms to insinuate sexuality and to project personality ('is that building coming on to me?').

While the Animal Farmatures benefit from all of these qualities of *parlante*, they also push the techniques of caricature in new ways. Lequeu's cowshed is rendered with charcoal shade and shadow, both to heighten its sublime setting and to convey a sense of depth and realism. While colour renderings are included in the suite of representations for the Farmatures, the primary architectural artefact is a cartoonish section drawn in hard-line black strokes (Fig. 1). The bold outline reinforces the familiar silhouette of the cow, and the unrendered technique liberates the architects to delineate the internal mechanisms with suggestive plausibility but without technical specificity. Like a diorama, the section reads in a kind of two-and-a-half dimensions, as the mechanical viscera are represented with both faux-illustrated depth and diagrammatic vitality (e.g. big arrows, air flow markings, drips of water and dashed lines indicating movement) atop an emphatically 2D animal outline and scenic backdrop. The drawing stages a truthy appeal: it instructs us how the architecture *might* work without explaining how it *really* works. Instead of the sublime realism conveyed in Lequeu's uncanny caricature, the Farmature's dioramatic caricature intentionally and humorously detains veracity and leaves elements of its realised identity open for interpretation and further intrigue.

The Farmatures facilitate new agricultural interactions between farmers and their implements, to be sure, and in turn they also suggest a new sense of subjectivity in the interactions between farmers and their livestock. And while the Farmatures contribute new possibilities for working farms, they also interact with the non-farming public via a franchised chain of agro-tourist resorts called Farmland World. 'Part theme park and part working farm', Farmland World invites people to interact directly with the Farmatures, as well as live farm animals, in ways that

transcend the visual spectacle provided by vehicular windows. Within *Farmland World*, humans enter the agricultural diorama.

As a slightly cheeky experiment in crowdsourced labour, guests to Farmland World perform farm tasks as a voluntary distraction from their humdrum urban lives, reconnecting non-farmers to the labour and mechanisms of their food production as a participatory alternative to ubiquitous factory farms. If in the dioramas of the American Museum of Natural History the detached public viewers are completely divorced from the killing of animals required to fabricate the myth of patriarchal human-animal relations, then in Farmland World humans participate fully in the slaughter of animals required to sustain the populace according to the American culture of meat-eating. Humans have entered the diorama, with blood on their shoes to boot.

Formally, the section drawn through the bulbous interior arena of Farmland World (Fig. 2) evokes the geometric elegance and clarity of Étienne-Louis Boullée's canonical drawing of the *Cenotaph for Newton*. Akin to the comparison with Lequeu, Boullée's section is sublimely rendered with caricaturised light, shade and shadow, while the spectacles of Farmland World, including fireworks, parade balloons and the Farmatures themselves, are drawn with simple single-stroke linework. More importantly though, while the transcendental scene depicted by Boullée is devoid of almost any human scale or reference, which heightens the sublimely autonomous effect, the Farmland World section is complete with details of human occupation, including an array of hotel rooms, stadium seating, jumbotrons and signage. Humans emphatically belong within Farmland World. Indeed, soliciting human participation and worldly enthusiasm is the dioramatic caricature's reason to be.

FAUNA FANS: *NONHUMAN AUTONOMOUS SPACE AGENCY*

Fred Scharmen's *Nonhuman Autonomous Space Agency* launches communities of live animals and robotic creatures into low-Earth orbit. The project leverages the communicative power of *charismatic megafauna*, "a species of animal that is well known and well liked, which serves as a stand-in and focal point for the complexities of the ecosystem in which it lives". For example, "Talking about manatees is a way to begin to talk about how we use the landscape of Florida and the Caribbean recreationally, and how to possibly change some careless habits associated with that use".[14] By invoking human empathy with their relatable anthropomorphic expressions and postures, manatees serve as a mascot for habitat conservation and responsible water use.

The Nonhuman Autonomous Space Agency continues the lineage of early experiments in space travel in which dogs, monkeys and rabbits successfully launched into orbit and subsequently returned to Earth. This time, however, a semi-aquatic habitat created within a hollow

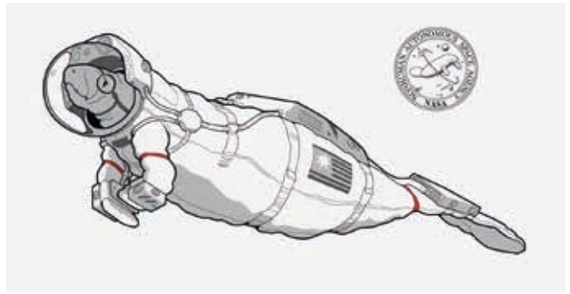


Fig. 3: Fred Scharmen, *Nonhuman Autonomous Space Agency*, 2015. A line drawing of NASA's astronaut manatee combines digitally precise line-weight articulation with an analogue, organic flow to produce a caricature that conveys the manatee's character with an expression of confidence, curiosity and wisdom.

asteroid is sent into orbit for manatees and chickens to inhabit and explore. The exploits and interactions of the space-bound animals is carefully monitored by autonomous robots, who digitally broadcast their activities to an emerging public of Earth-dwelling human fans. In this way, the Space Agency aims to amplify the subjectivity of these nonhuman astronauts (both animals and robots) by giving them a comprehensible and emotional voice, understood by humans via the likes of Twitter.

The project operates via two prominent drawings. The first caricature introduces us to the actor playing the leading role: the suited manatee performing extra-vehicular activity (Fig. 3). The composition leverages the familiar pose and uniform of a human astronaut floating in space. As the manatee already exhibits anthropomorphism in its physique, the subtle modifications to the human suit to accommodate the sea cow's fluke appear strangely natural. The drawing combines digitally precise line-weight articulation with an analogue, organic flow to the lines themselves. This overtly drawn quality of the caricature heightens the manatee's character; while no excess lines are used to do so, the carefully composed wrinkles and expression on its visible face through the helmet convey confidence, curiosity and even wisdom. This is a manatee with agency. It aspires to be a revamped Vitruvian nonhuman person for our time.

The second caricature depicts a cross-section of the hollow ovoid orbital habitat (Fig. 4). Because of the curved surface of the ovoid's low-gravity hollow interior, the familiar features of an Earth-like landscape transition from section to plan and back to section again, lending a wonky sense of vision to quotidian elements such as trees, shrubs and rocks. The drawing demonstrates how what would otherwise be an extremely warped or exaggerated caricaturising of reality as we know it can simultaneously act as a truthy vision of the world (or outer-world) as we imagine it. Unlike the more painterly renderings of space settlements that NASA commissioned in the 1970s,[15] the simple colour fills and cartoonish outlines of the flora and fauna flatten the scene and challenge its viewers to reconstruct its spatial possibilities within the unfettered bounds of their imagination.

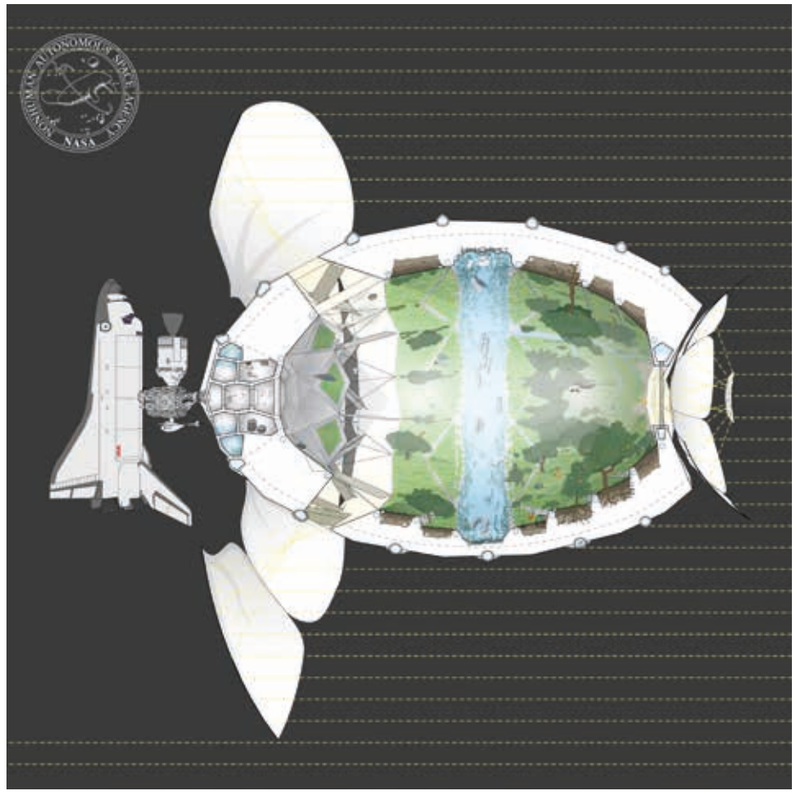


Fig. 4: Fred Scharmen, *Nonhuman Autonomous Space Agency*, 2015. The space station's cross-section cut through a hollowed-out asteroid features an Earth-like landscape illustrated by simple colour fills and cartoonish outlines of flora and fauna.

The extraterrestrial lazy river is itself a far-flung diorama. Unlike the dioramas of the American Museum of Natural History, this strange orbital diorama grants its resident creatures many new affordances of subjectivity and spatial (and outer-spacial) freedoms. Yet it also intentionally stops short of full human participation. Retweets and 'likes' notwithstanding, humans are limited to 'following' the activities from afar with almost no agency in their outcomes. In this way, the new 'NASA' is staging an anti-diorama. This model reminds human earthlings that they may not be the centre of the universe after all. This is not necessarily to rid humans of their burden of responsibility to 'save the planet', but rather to champion the agency of nonhuman actors in the complex ecological workings of our world(s). 'Liking' outer-space-exploring manatees on social media may just translate into a human cultural desire to 'like' and safeguard aquatic habitats on Earth.

SURROGATE SUBJECTS: *GULF COAST BESTIARY*

The *Gulf Coast Bestiary* positions an array of zoomorphic architectural 'characters' alongside a sanctuary for dolphins retired from entertainment captivity as well as other injured and recovering coastal animals. While many of the programmes of the sanctuary are not accessible to the public, the animal characters of its architecture provide image- and activity-based pavilions for visitor interaction with the back-of-house scientific activities. For example, one character houses a discussion forum with access to the zoological lab below, while another pairs an apartment for a biologist-in-residence with locker rooms for volunteers.

The primary representation for the project is a wide perspectival drawing, with hard-line black strokes and precisely articulated swathes of bright colour fill. Photographic scale figures of human occupants are montaged into the drawing. The logic of caricature operates here on multiple levels. First, the architectural 'characters' are themselves zoomorphic caricatures. The characters are conceived as three-dimensional Tangrams, where a finite series of elemental geometric blocks are assembled into multiple configurations that solicit animal imagery. While the forms are specifically inspired by local endangered fauna (e.g. the bottlenose dolphin, whooping crane, gulf sturgeon, sea turtle and West Indian manatee), the abstracted colourful volumes simplify, distort and exaggerate the prominent features of their representative species. Occasionally, these bodily features even provide humorous affordances to their human companions; for example, visitors are invited to bend down and stick their heads into the posterior cavity of the caricatured whooping crane character, which doubles as a recording booth to record and listen to stories about wildlife recovery efforts. By reconfiguring

the same set of blocks among the multiple characters, the architecture reads as a coherent cast with distinctively enhanced individual characteristics. While the characters are iconic in their imagery, they do not convey established meaning to an existing constituency, but rather rally new publics around a movement of environmental engagement.

Second, the drawing itself is a caricature of an architectural rendering. Rather than being saturated with photorealistic textures and illumination effects, the materiality of built and natural elements are articulated with layers of speckles, hatching and other drawn patterns that suggest character without defining specificity. Additionally, by exaggerating the curvature of the horizon line, the drawing suggests that the Bestiary occupies a miniature planet – a visual effect that implies an architecture that can transform its context and produce an autonomous world (or diorama) of its own making.

The Bestiary is indebted to the drawings of John Hejduk's various masquerades, his "tribe of architectural animals" on wheels that "invade and repopulate" the cities of Europe.[16] As drawn representations, the red steel frames that articulate the Bestiary characters' geometric parts echo the heavy black outlines that delineated Hejduk's masques in his watercolour renderings. As operative propositions for the city and landscape, the Bestiary characters might register as Hejdukian masques embedded in place along a fixed platform. But while they may be stationary, the Bestiary characters leverage their perceived vitality as animate creatures to project surrogate subjectivity for the live animals in and around the building – a surrogate that enacts a responsibly anthropocentric opportunity for interaction.

If the dioramas in the American Museum of Natural History directed an institutionally controlled gaze inward into the constructed exhibits, then the Gulf Coast Bestiary leverages its cast of caricatured creatures to enable a bi-directional gaze inward and outward as the public peers into the privileged activities of the zoologists and out at the families of coastal species beyond.

AN OBLIQUE (BUT NOT BLEAK) CONCLUSION

If we use social media as a litmus test for contemporary human desire, then the animal memes, GIFs and videos that frequent the average Facebook feed indicate a craving for connection with the non-human world that is expansive and illuminating. Not only does this impulse to see and understand the social, cultural and emotional life of animals cut across demographic boundaries, but it points us towards our most aspirational shared qualities of affection, humility and humour. While the caricature is commonly considered a disparaging medium, intended to make fun of or amplify faults and weakness, we see in its origins a more profound desire to extract a legible truthiness from an otherwise complex and contradictory world, often with an air of absurdity or humour. Not unlike these omnipresent internet novelty items, the architectural caricatures discussed above deploy a selective amplification to highlight and manipulate qualities of the world that we would like to imagine and cultivate as the basis for our near-future reality.

Letting lively and literary creatures loose into our cities, hinterlands and beyond may not solve environmental problems directly, but it offers an oblique enactment of 'anthropocentrically responsible' agency in the world. Creatures connect us to something bigger; they give us license to suspend our inhibitions and disbelief in order to participate in the real-time myth-making that their fabulist subjecthood makes real. The Sustainment will not be televised (no form of technology will solve its problems or spread solutions), but its performance will be enacted by companion subjects of humans and creatures within an expanded cultural environment.

1 Neyran Turan, "Measure for the Anthropocene" in *Climates: Architecture and the Planetary Imaginary* ed. James Graham (Zurich: Lars Muller Publishers, 2016), 120.
2 Tony Frye, "The Sustainment and its dialectic" in *Design Philosophy Papers One* (Ravensbourne, Qld: Team D/E/S Publications, 2004), 37.
3 Sam Jacob, *Make it Real: Architecture as Enactment* (Moscow: Strelka Press, 2012).
4 Turan, 127.
5 Donna Haraway, "Teddy Bear Patriarchy" *Social Text*, No. 11 (Winter, 1984–85), 54.
6 Ibid., 53.
7 Anthony Vidler, "Vagabond Architecture" in *The Architectural Uncanny* (Cambridge: MIT Press, 1992), 209.
8 E. H. Gombrich with Ernst Kris, 'The Principles of Caricature,' *British Journal of Medical Psychology*, Vol. 17 (1938): 319–342.
9 Ibid.
10 Stephen Colbert, *The Colbert Report*. Television programme. 17 October 2005.
11 Joseph Altshuler, 'Animate Architecture: 12 Reasons to Get in Character,' ed. Cynthia Davidson. *Log*, #33 (New York: Anyone Corporation, 2015).
12 Mike Kelley, "Foul Perfection: Notes on Caricature" in *Foul Perfection: Essays and Criticism* (Cambridge: MIT Press, 2002), 20–38.
13 Stewart Hicks and Allison Newmeyer, "Animal Farmatures" in Life at the Speed of Rail Competition (New York: Van Alen Institute, 2011).
14 Fred Scharmen, "The Nonhuman Autonomous Space Agency", 103rd ACSA Annual Meeting Proceedings, The Expanding Periphery and the Migrating Centre (2015), 500.
15 Fred Scharmen, "The High Frontier, the Megastructure, and the Big Dumb Object", 101st ACSA Annual Meeting Proceedings, New Constellations, New Ecologies (2013), 540–547.
16 Vidler, 207, 209.

The Digital Renaissance

Anna Andronova

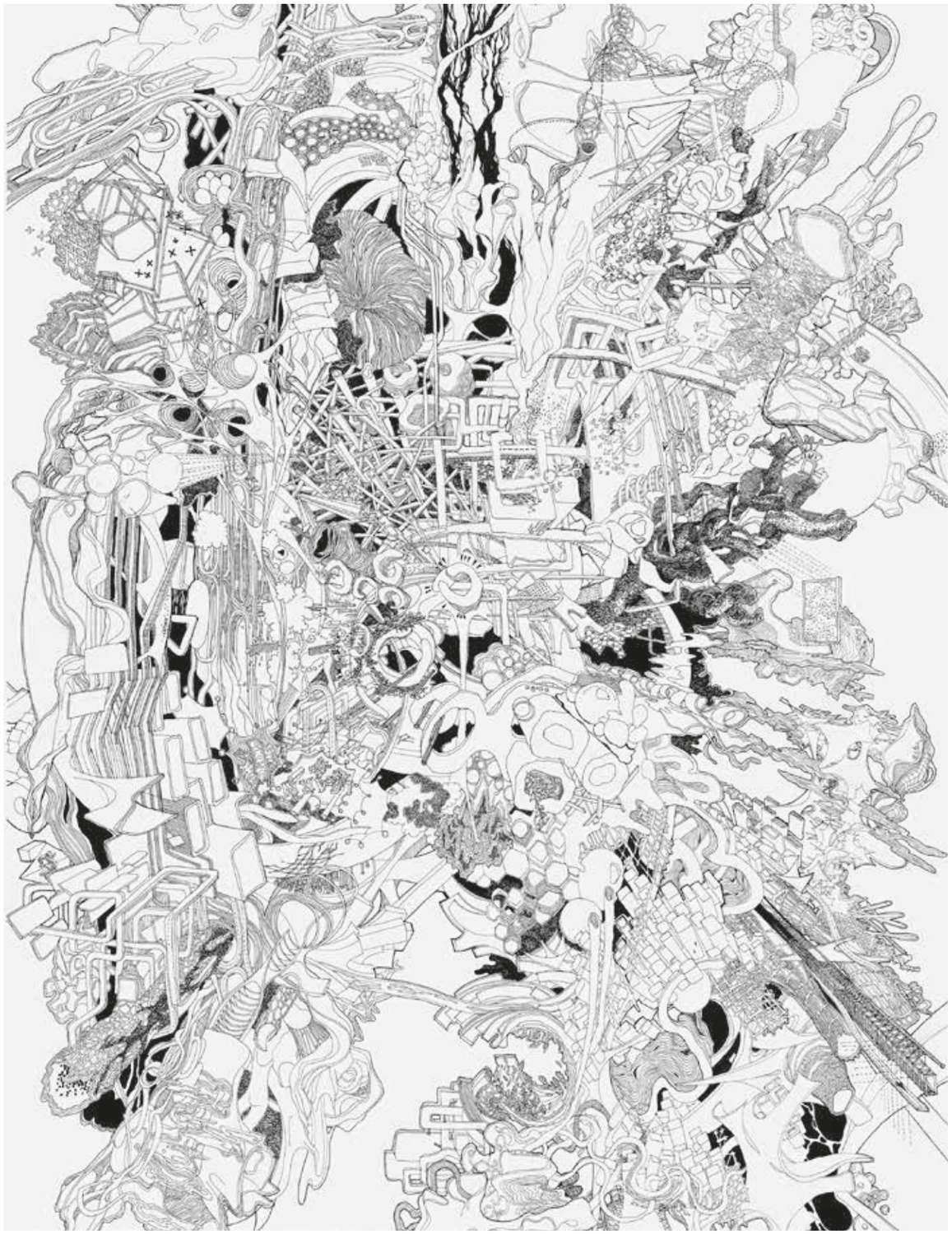


Fig. 1: Anna Andronova, collage.

With virtual reality gaming technologies, which lead both children and adults far, far away from actual reality; with the internet of things, which blurs the notion of distance; and with the rise of artificial intelligence, which can process infinitely faster than a mere human, how can we be confident that a future of architecture will still include bricks and mortar? This 'Digital Renaissance' project aims to reinvent how city spaces should be inhabited and explored in the future and how people should perceive themselves in this new reality. It aims to resurrect the lost harmony between nature and culture, alongside the feel of community and mutuality in a city.

It might seem contradictory to rely on analogue techniques while the project itself is purely about the digital. However, its intricacy of ideas and spatial complexity are only realisable by hand.

The project is split into five stages, from analysis to synthesis.

The first stage is an 'explosion', where drawing acts as a conductor for the flow of ideas and forms, both conscious and subconscious, resulting from one's inner experience. Collage is a perfect approach for finding images for a future city. The key principle is not to be restricted to any existing typology, but instead to be spontaneous.

The second stage is 'autopsy'. By referring to the first drawing, certain nodes are distinguished and captured in detail. Relationships between the biosocial fabric, an artificial transportation framework and an informational field are carefully studied using layers of drawing. Through this, the organism of a city is dissected to its 'flesh,' 'blood' and 'bones'.

The third stage is a 'fragmentation'. The overall urban landscape is studied carefully atom by atom; elements are depicted on separate pieces of paper and then arranged by dimensional qualities: point, line, surface and volume.

In the fourth 'alchemy' stage, all the systemised information is grasped, recombined into the full model and represented in sections. This perfect cube (figuratively speaking) is a 'womb' of a speculative utopia, to later be expanded.

The final stage is the 'renaissance' statement – a comprehensive model, encompassing the later stages of evolution. The large scale of the drawing allows the exploration of the landscape both in detail and in relation to the wider environment. The final step takes the drawing from a self-sufficient utopian vision to a living biosocial city system developed through representation.

Fig. 2: Anna Andronova, *Alchemy*, a set of three principal model sections (front view).

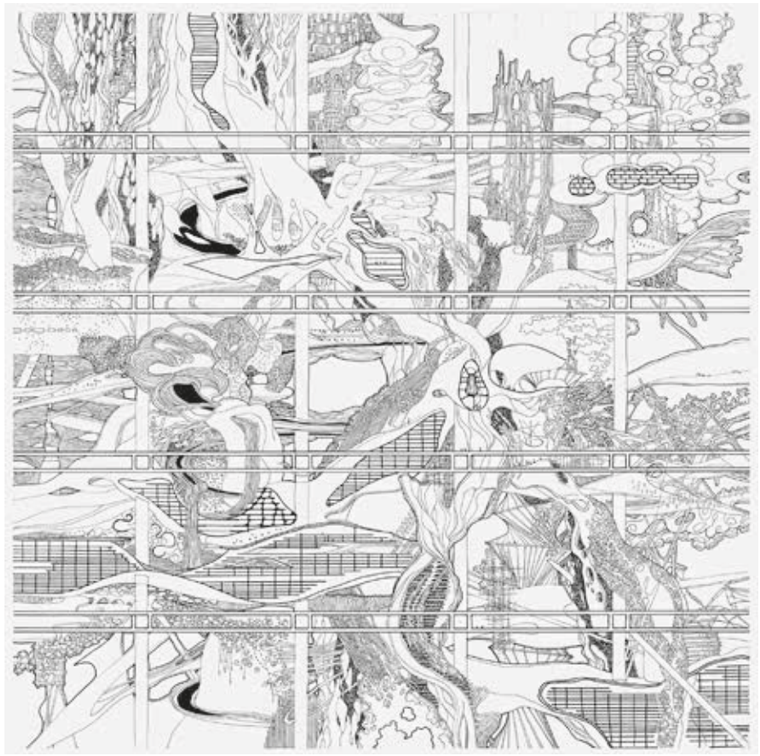


Fig. 3: Anna Andronova, *Alchemy*, a set of three principal model sections (side view).

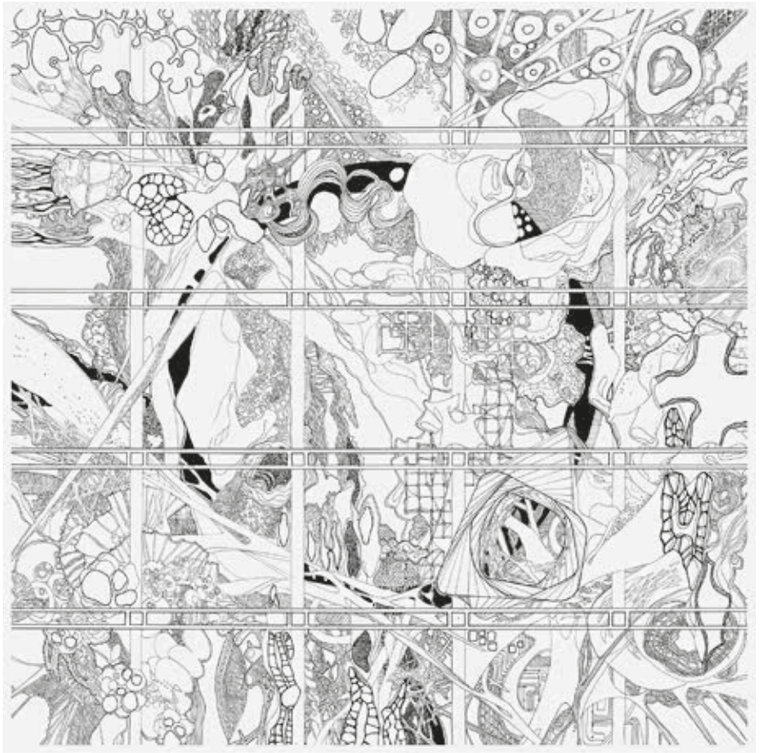


Fig. 4: Anna Andronova, *Alchemy*, a set of three principal model sections (top view).

New Lohachara

Kirsty Badenoch

New Lohachara explores an architecture of wonder and the miraculous, weaving a fantastical future narrative through an imagined hand-drawn world. Within a context of increasingly hyper-digitalised representation, in which the architect is progressively further removed from the physical design and building process, analogue methods retain a physicality, an awareness of time and process and an engagement with poetic narrative that is lacking today more than ever. Through re-engaging with hand-drawing, New Lohachara looks to re-instil a lost wonder back into architecture, a wonder associated with the bygone narrative architectures of metaphor, motif and folly, a wonder that challenges possibilities and ignites the imagination.

New Lohachara is centred around the preservation of disappearing lands and cultures in the face of rising sea levels. It explores an architecture of wonder through the augmentation of nature: an architecture of [Super] Nature. Speculating on future potentials for the embrace of water, as opposed to defence against it, the narrative of the project constructs a new city that re-engineers the water cycle – a great water-processing well. The project is sited in Venice as a context for the extraordinary and the miraculous, a city historically both born from and doomed by water, taking inspiration from Italo Calvino's Invisible City, 'Isaura' – City of 1,000 Wells.

Piranesi's eighteenth-century etchings of Venice depicted the city through the eyes of the Age of Enlightenment – glorious architectural recordings of a grandiose ancient world. But through them he also challenged convention and extended his depictions to his own design – utilising representation as opportunity for his own personal imagination, romanticism and speculation on the past and future. The etchings become both historical records and future possibilities, depicting half-imagined, half-ruined places and incorporating mythologies within the fabric of their imagery. They were driven by – but not bound by – buildability, thus liberating the imagination towards early ideas of science fiction.

Jumping ahead to the 1980s, the Russian 'Paper Architects' Brodsky and Utkin employed a similar expressive technique and historical language in the visualisations of their dream landscapes. Operating between the worlds of architecture and fine art, they designed dense cities that intertwined invention, memory and possibility, cities laden with mythology, critique and literary and political allusion within the context of Soviet control.

The drawings of New Lohachara draw heavily on such inspirations that explore, invent and criticise through the creation of romantic, illusionary worlds based within our own. Pen-and-ink rendering is by nature playful, appealing to an innate childlike sense of curiosity, allowing respite from reality for speculative thought and engagement through the imagination. It is visually reminiscent of times of narrative antiquity – and forgiven its exaggerations and inaccuracies due to its inherent human nature.

Compositionally, the drawings are in many ways traditional – constructed as dioramas or layered milieus and grounded within the genus of preservation – exploring a futuristic vision that is sensitive to the old. But unexpected perspectives explore abstracted and surprising angles, challenging the narrative through play and delight.
The project was driven by an intent to critically explore the role of hand-drawing in contemporary architectural representation – and to challenge the architect's convention of plan-section-elevation alongside the neo-classicist painter's frame. The drawings were developed through studying, layering, 3D modelling, redrawing and collaged composition. In this way, they were constructed over time in a dialogue between research and design, between invention and accident and between pen and paper.

As architects working within a hyper-digitalised age, our toolset for the imagining and realising of spaces is vast and fast. We are like never before able to sketch, distort, morph and throw away ideas often faster than we can think them up. We can photo-visualise indistinguishably lifelike imagery, produce dizzying fly-throughs and even four-dimensionally occupy the virtual spaces we dream up years before the site has even been prepared.

To draw by hand requires slowness. It requires a physical presence of body and of mind to dwell within the spaces they imagine and construct. It requires patience, frustration and a certain number of accidents, the traces of which become bound within the final work. It allows space and time for occupation throughout its creation. Unlike photoreal renders, it is forgiven for its mistakes; it is allowed the space to breathe and be interpreted by the individual. It is allowed to exist simultaneously in the past, present and future. It is allowed the space to dream.

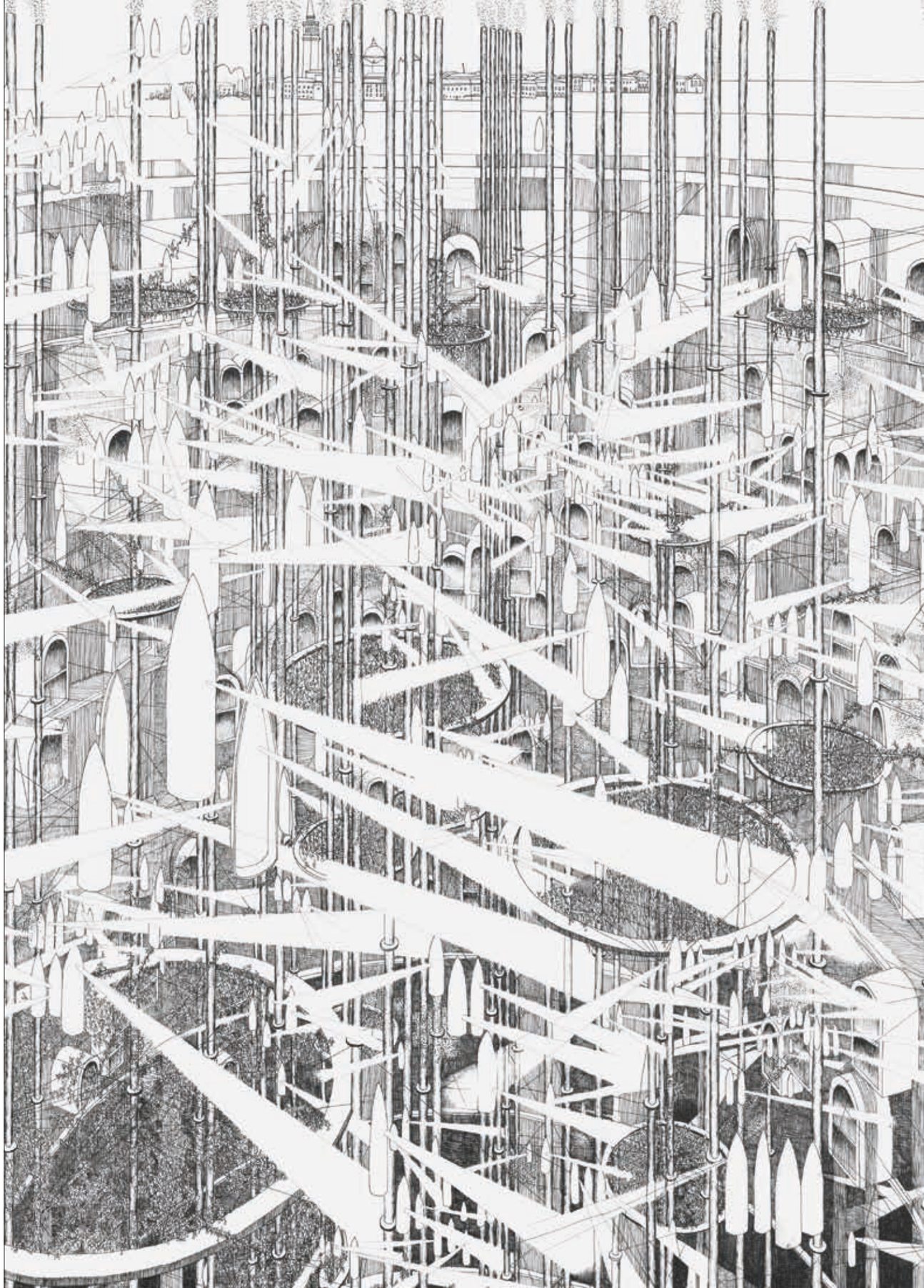


Fig. 1 (opposite): Challenges the vertical and horizontal planes of living below the water's surface, inside the great well. Boats are upended to become mirrored elevators, reflecting sunlight downwards as they move vertically through the city. Hot water processing pipes become tropical tree trunks from which hydroponic plantations are suspended, cultivating tropical flora in a [Super]Natural rainforest.

Fig. 2: *Super[Nature] I – Preserving Venice* takes on an abstracted cosmic perspective, a conceptual fish-eye blueprint for the re-engineering of the water cycle. Floodwater is drained from the Venetian lagoon into the great well below, in cycle with the lunar tides and the dancing of boats upon the water's surface. Venice hovers precariously just above the waterline, its magic amplified by the shrouding mist exhaled by the water-processing. With reference to Calvino, "an invisible landscape conditions the visible one".

Fig. 3 (opposite): Pulls the narrative into Venice, looking up at the sky from inside a Venetian well in reinterpretation of the Venetian Baroque painted ceiling. A rainwater-collecting chandelier hangs suspended delicately above the public square, while clouds gather overhead in celebration of water.

The Restored Commonwealth Club

Adam Bell

The drawing form of the Restored Commonwealth Club (RCC) took a number of months to come together, initially by experimenting with digital collage techniques and fusions of digital and hand-drawing before choosing hand-drawing as the primary technique.

The evolution of the hand-drawing technique was in line with the complexity of the subject. This ranged from an elevation such as the Empire Clock – which integrates the dymaxion (Buckminster Fuller map) time zones of the immersive realm – through to the spaces of the British Empire and Commonwealth that are fluctuating between time and scale.

The drawings consist of a series of plans, views and details that give a short glimpse into an alternative realm. The drawings were crucial to support the approach and execution of the project, providing a brief insight with a great amount of detail while allowing for ambiguity and interpretation, enabling viewers to form their own ideas of the RCC within the collective gaze.

The key sets of drawings were the mnemonic details of the Club. Prior to this, only spaces in plan and perspective were developed.

The details were manipulated in such a way by using the drawing technique to break the connections of time, space and scale. This provided the opportunity to form large-scale mechanisms, landscapes and specific periods of time significant to the British Empire, while still being contained within the mnemonic details housed in the Club.

This led to the analysis and representation of material reactions and interactions within the realm. Standard materials and objects distort, fracture and at times regenerate according to the movement of the Empire Clock.

Materials that could cope with the strains of gravity, time, space and scale were developed while referring to muscle tissue, bone and tendons.

This again re-investigated the spaces and the architectural details of the Club in an anatomical manner. The details at this stage were considered members of the Club, and this influenced the approach of the examination of particular studies. The drawings partly sliced and opened up certain details to reveal the inner workings, always considering the impact of the fluctuating environment. They also considered how future details might be installed and at times the possibility of infection, should the detail be rejected.

The drawings had to demonstrate shifts of time, distortions of space and manipulations of scale, while also respecting the society, Club and details that exist in the physical realm. In doing so, the drawings also represent the Commonwealth Club's vulnerability to extinction, something which it has experienced repeatedly.

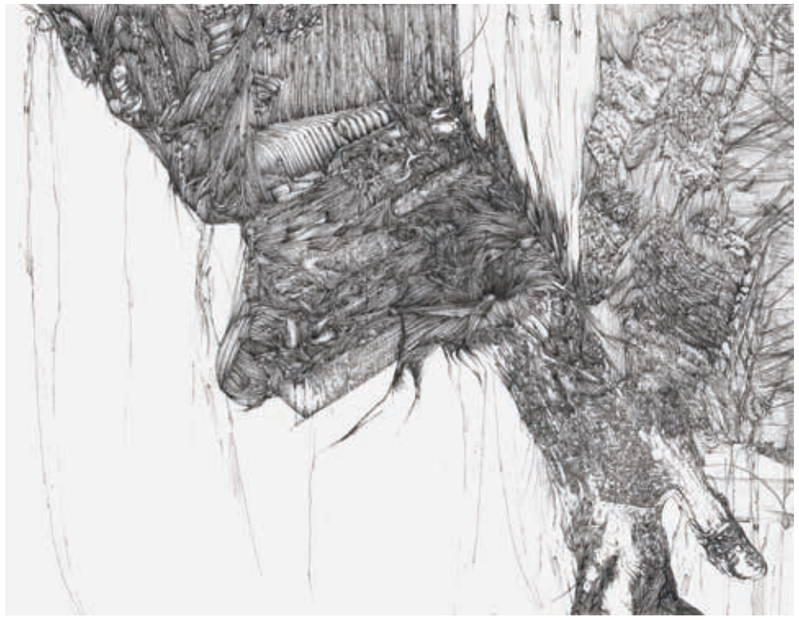


Fig. 1: Adam Bell, *Detailed Evaluation – Door Push Plate*. Mnemonic detail reveals the formation of the Club following the demise of the British Empire.

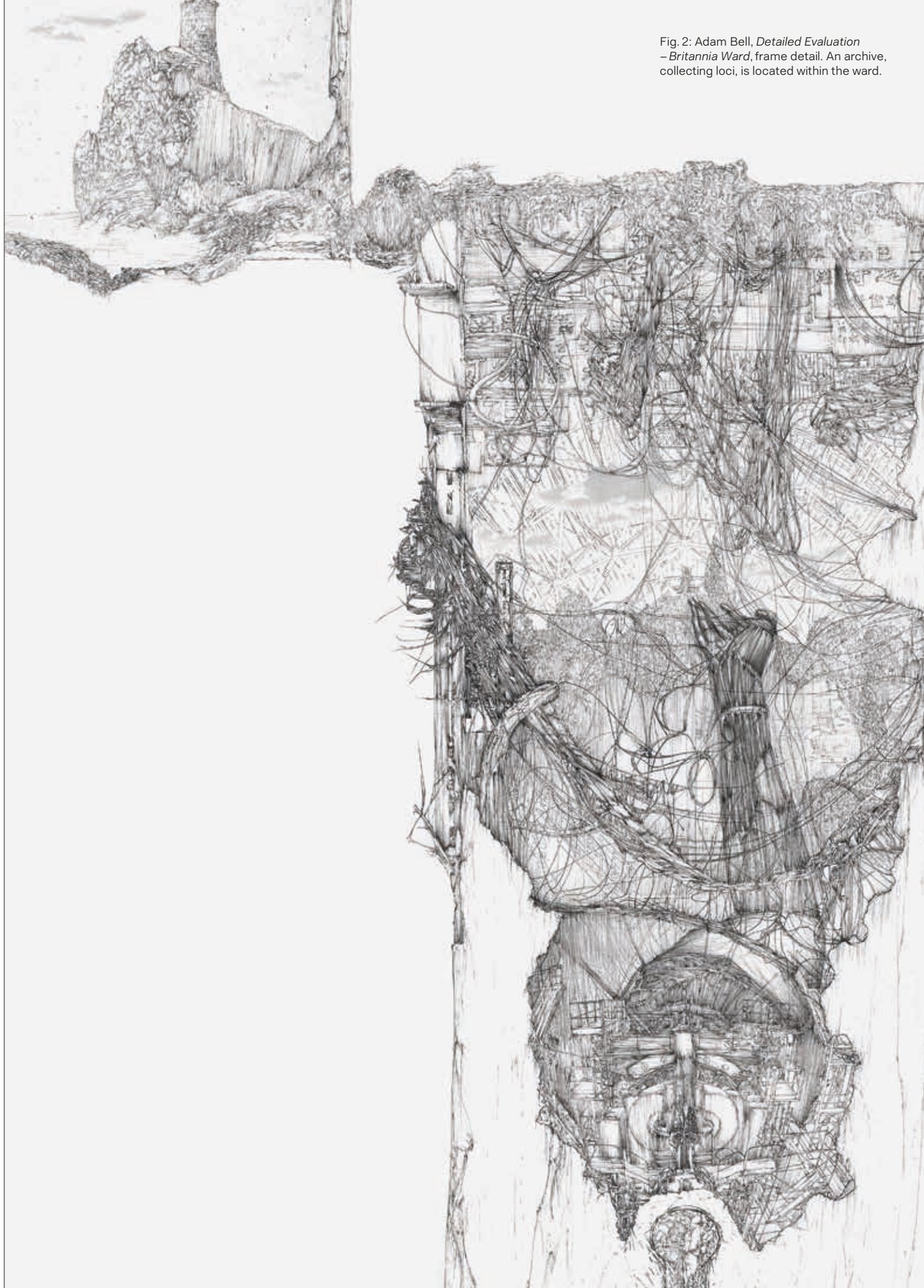


Fig. 2: Adam Bell, *Detailed Evaluation – Britannia Ward*, frame detail. An archive, collecting loci, is located within the ward.

SCALEFULNESS

Kyle Branchesi

The city, as we have come to know any city, is a homogeneous soup. Bound, gagged and gasping for air, it no longer represents us, it no longer represents our thinking, but it lives with us and some say we are stuck with it. The qualities of its buildings are designed but are of no importance. They are so minutely different; they might as well not be different at all.

SCALEFULNESS is an attempt to undermine the conditions laid out by those who gave the twentieth-century city its shape. SCALEFULNESS produces an architecture at a scale beyond their scope. To place architecture back in the city, one must avoid the ground altogether. It must develop away, above and around the city, but never in the city.

SCALEFULNESS plays with colossal differences: of scales, of morphologies, of effects, of legibilities and of indices within its territory.

SCALEFULNESS is aware of the conditions below and laughs at them. The streets that make up the city below are built with cowardice. SCALEFULNESS doesn't know that it is arbitrary; the city above takes pride in knowing that it is.

Allergic to the ground, SCALEFULNESS is ambivalent about the ambivalent. The city above derives its character from objects taken from the city below. Generic objects are redeployed to become newly unfamiliar environments: the soda bottle house, the watch gear office complex, the ballerina tchotchke cul-de-sac, the tea kettle neighbourhood, the pistol grip district. SCALEFULNESS is the City of The Cold Press Juicer.

The city below is present only through a vague glimpse under one's feet. Duck boats span between lakes of grids, mountains are bound by radii, as stacks of suburbia are separated by motor grills.

Arrogant it is, and inconceivable it must appear. SCALEFULNESS believes it could not care less about context, it believes it demonstrates no awareness of siting. It believes it doesn't give a fuck about scale. But SCALEFULNESS does, because an awareness of ambivalence is just as important as ambivalence itself.

SCALEFULNESS acts selfishly, only investing in its own qualities, in its own relationships and in its own nonsense. SCALEFULNESS is unaware of its misgivings; it sees itself as an edifice, but behaves like a city.

SCALEFULNESS is represented within five panes, in a forced perspective that gives depth while never showing the full depth, size or limitations of itself. The colour used within the drawings removes the reality of the city above and forces its juxtaposition with the redundant, grey city below.

Fig. 1 (opposite): SCALEFULNESS, 2015.

Figs. 2–5: SCALEFULNESS, 2015.

The Silt House

Matthew Butcher

The Silt House project is a series of speculative structures that act as a practical and poetic investigation into the inhabitation of a future flooded Thames Estuary; a place in which the environment and the weather alter the material fabric of the architecture. These architectures are sited in and around Cliff Marshes on the south side of the river near the mouth of the Thames. They reside where the existing sea wall would be removed to allow water to splay during a flood.

The project primarily exists as a series of drawings in a variety of media. They are projections, intended to provide provocative visions of new ways of living with the increased threat from flooding caused by increasing global temperatures. The works aim to resonate with certain historic drawn and speculative designs that were produced in the 1960s and 1970s, such as those by Raimund Abraham and Superstudio. Here, the project seeks to draw from the ambitions of this earlier work, particularly to produce architecture removed from the problematic of building so as to explore the artistic, poetic and philosophical ambitions of the discipline.[1] In order to embody this legacy, the work utilises certain methodologies of drawing that seek to sample, then reappropriate, this earlier work to generate new architecture in a new context. Methodologies of drawing are also used to create images that are analogous to the character of the architecture and its relationship to the landscape.

THREE ARCHITECTURES

Within the project, there are three main buildings: the Silt House, the Filter House and the Chapel. The Silt House, a communal residence, uses tidal processes to change the levels of comfort in the building. During the flood season, nets around the structure are set up to slow down the water in the estuary, which in turn allows sediment to fall and build up on top of the house when it is submerged by high tides. This build-up of sediment acts as insulation for the building during the winter months. Secondly, during a high tide, water is allowed into the house, washing out sewage that is then ejected through a pipe in the back of the building. This process clears the building of its waste – essentially, when the land floods, the building buries itself and shits itself. The Filter House operates as a house and saltwater filtration plant. Here, the filtration process, driven by tidal movement, alters the internal spaces and form of the building. As part of the process to purify the salt water, glass chambers fill up with steam, obscuring views through the house and back across the landscape. The third and last of the buildings is the Chapel, which acts a place of refuge and sanctuary within the landscape. Its floor takes the form of an undulating surface that can also provide places to sit or sleep. The building can only be accessed at the lowest tide and is often completely submerged by water.

Fig. 1: Matthew Butcher, *Axonometric of Silt House*. The building form is developed by identifying, then synthesising, key formal tropes used by Raimund Abraham.

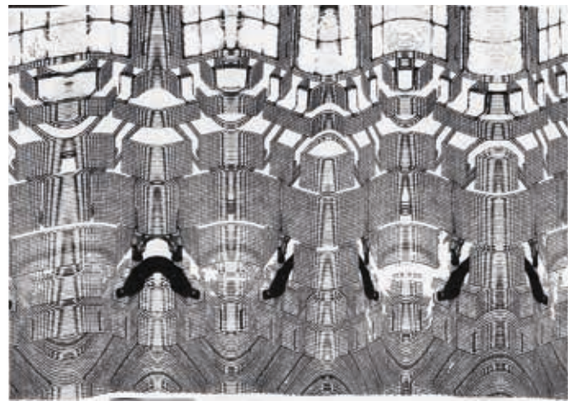


Fig. 2: Matthew Butcher. Texture for formal invention created by dragging a copy of a Superstudio drawing across the surface of a scanner while it is scanning.

The operation of these buildings in relation to the flood plain aims to create architecture that is explicitly *of* the ecology and the landscape in which it sits. It can be seen as a conduit attempting to channel the poetic characteristics of natural processes, including the very floods that wash over it. Where architecture traditionally sets out to protect its occupants from the unpredictable nature of the environment, the Silt House merges the flood into and through the building.[2]

DRAWING FORTH AN ESSENCE

During the development of the project, there were two main design methodologies that sought to appropriate existing avant-garde architectures, in order to ensure that the Silt House maintained reciprocity to these early designs.

The first of these was an analysis of the work of avant-garde architect and poet Raimund Abraham, and in particular his *10 Houses* project (1970–73).[3] In *10 Houses*, Abraham presents us with a series of poetic and drawn explorations of architectures existing in a non-specific landscape. These designs contain a series of motifs, including specific materials, burial mounds and formal components, which mimic natural forms. Together, these were understood to comprise a kind of topological key – a grammar of sorts – which was then developed to shape the spatial and formal logics within the Silt House. For instance, we can see the undulating cloud-like forms present in the basement of the *Earth-Cloud House* (1970) carried over to the Silt House, not as stratus-forming vapour but as wave-like forms that echo the way sediment and mud settles after the tide has withdrawn. The semi-burial motif seen in most of the *10 Houses* series works its way into aspects of the Silt House as the building is slowly buried beneath the sediment of the estuary mud flats. Finally, the presentation of spaces seen in the *House with Three Rooms* (1972), that appear to be carved from solid matter (rock), reappears in the Chapel. Also present is the idea that Abraham's architecture, within *10 Houses*, is formed as much from materials such as concrete and glass as the landscape itself. In the *House with Curtains* (1972), we see the billowing fabrics rise up, deforming the house's gridded structure. This motif is then seen in the desalination chambers, which, when in operation, fill up with steam that distorts and blocks the views through the building.

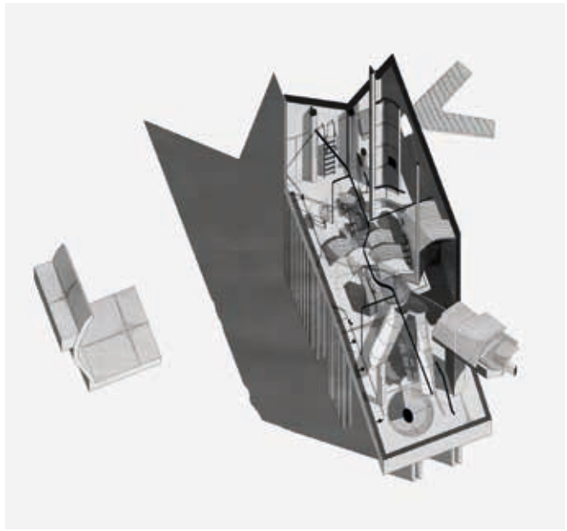


Fig. 3: Matthew Butcher, *Axonometric of the Chapel*.
Forms were created by using the texture seen in Fig. 2.

Fig. 4: Matthew Butcher, Interior of water filtration plant within the Silt House project. Drawing created by scanning and photocopying a photograph of a project model.

The second drawing methodology applied is mostly seen in the truncated cone-like forms of the interior of the Chapel. The modulations of these forms were created through the reappropriation of a drawing by the architectural practice Superstudio. A reproduction of the drawing was dragged across the surface of an image scanner while it was in the process of being scanned. The result is a direct mapping of the action and the scanning process (Fig. 2) – a physical imprint of the drawing as it moves through time and space. The process acts as an attempt to capture the shift between the material of the drawing and its eventual digitisation within the scan, from material print to immaterial data.

Out of this new materialisation or abstraction of the original Superstudio image, a series of forms were then identified in the image and spliced out of it using Photoshop. This was achieved by tracing various contours and lines within the new image. This process could be linked to sampling in music, where a digital copy is taken from an existing audio recording and can then be manipulated and reproduced in different ways. Although a clear distortion of the original image, this action could be seen as an attempt to draw out an essence of the original sampled architectures; an intrinsic formal and aesthetic logic from the original source that can be carried forward to another time and place. In this case, the reimagining of the Superstudio grid is open to different constellations of meanings.

IMAGE IN FLUX

Drawing is intrinsic to the project, as it can seek to embody and represent buildings that otherwise would exist in a constant state of flux. This is demonstrable in Fig. 4, where the original drawing was photocopied and re-photocopied, creating a distinct grain, contrast and distortion. By activating the drawing in this manner, the image becomes degraded and, if the process is repeated over time, becomes fainter and fainter. Here, the drawing can be seen as an analogy for the dynamic relationship of the Silt House building to the flood, emerging and disappearing within the silt and sediment of the estuary.

THE FLOODED FUTURE

Paramount within the Silt House project is the use of distinct processes of drawing as a methodology for the development of the work, as well for as instigating and communicating its meaning. The drawing, in this way, aims to be part of the legacy of certain figures in the avant-garde, such as Raimund Abraham, as well as acceding to a sense within present architecture of operating in a constant state of flux. Here, the reciprocity between past and present and the movement between a stable and an unstable facsimile can be seen as analogous to the fluctuation of the proposed architecture and its reciprocal relationship with the environment. This provides us with a unique series of spatial and formal representations for the future flooded Thames Estuary.

1 For further exploration of an architecture that prioritises philosophical and artistic exploration over building, please see: K. Michael Hays, *Architecture's Desire, Reading the Late Avant-Garde* (Cambridge, MA: MIT Press, 2010), 2 and Neil Spiller, *Visionary Architecture : Blueprints of the Modern Imagination* (London, Thames & Hudson, 2006). In both books, the authors explore certain canons and histories of theoretical or 'paper' architecture and its meaning as part of the discipline. Critical to their theses is the work of the avant-garde from the 1960s and 1970s.

2 The ideas expressed in this paragraph, in particular the idea that architecture is traditionally seen as stable, and that by questioning this we can develop a more creative relationship towards the environment through architecture, is influenced by the writing of Jonathan Hill, specifically *Immaterial Architecture* (London: Routledge, 2006).

3 Raimund Abraham's *10 Houses* project existed as a series of ten theoretical projects developed between 1970–73. The drawings are particular in their use of coloured pencil and graphite and all show isolated dwellings in unspecified landscapes. An extensive catalogue of reproductions of the projects can be found in Raimund Abraham, *[Un]built*, ed. Brigitte Groihofer (Vienna: Springer-Verlag, 1996), 53–67.

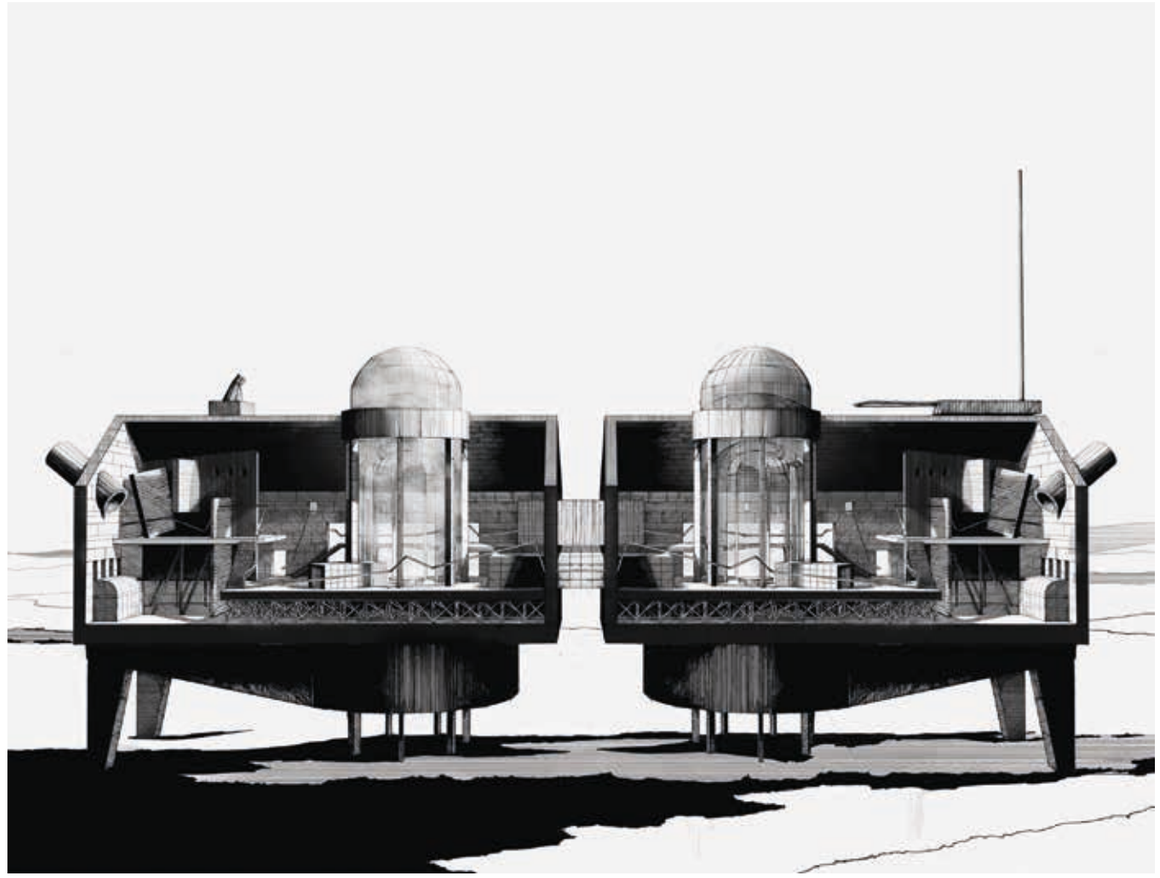


Fig. 5: Matthew Butcher, *Water Filtration Plant*.
Section drawing by Tom Noonan and Matthew Butcher.

Deviated Futures and Fantastical Histories

Bryan Cantley

The architectural drawing: a set of instructions, a legal document, a reductive artefact.

*IN*STRUCTION(S) FOR *CON*STRUCTION...

The history of (draw) has become a set of status quo commands given for the production of *building*. As part of this discourse, *the draw* has furthermore integrated written instruction; notations for the assemblies, chronologies and materiality of a desired conclusion. A product (*building*) other than itself (*drawing*).

Let us consider a new permission, where drawings might produce artificial mythologies. Since architectural drawing has traditionally referred to the reduction of information, or the creation of 'absolute truth(s)', my initial posture was to obfuscate that initial role of the *truth-maker*, and to challenge the typical relationship of occupant/viewer to the subject matter.

I suggest that the drawing could be the thing itself, in the nature of the '*Dasein*' – being there, as opposed to being elsewhere. This condition requires a recognition and perhaps occupancy of the liminal space between *there* and *elsewhere*. One might be aware of the space linking drawing and building and ultimately drawing and subject/object. The '(t)here' is where the drawing resides... where the occupant probes deeply in order to locate themselves, ironically distanced from any potential physical *conclusion*. Traditionally, the viewer and the suggested occupant have had a degree of separation, setting up a voyeuristic mapping. This type of document collapses the binary condition of 'watching' vs. 'performing' within suggested architectural invention. We might assume that the future of architecture would be based on the a *posteriori* condition of allowing the drawing to remain in its current role.

DRAWING (@LTERED) FUTURES

The premise suggests that *the draw* locates the *history* of itself instead of disclosing the *future* of its building/result. If we suspend the idea that *the draw* must develop in the future into a building, then we alter its histories. Therefore forecasts taking place after this suspension might arguably produce an alternative condition of possibilities. The notion of projection suggests a set of known data that inform a calculation/realisation implied by the observation: *drawing* (verb) suggests *building* (noun).

A trajectory that erases and refabricates its path as it moves, therefore eradicating typical *predetermined* policy. Speculation over calculation... investigation above representation... and amalgamation over segregation.

The termination of the drawing suggests that there is a spatial cessation. Nothing more is to be generated other than its specific objective. However, these drawing instructions suggest potentials for increasing expansion of the drawing, and therefore the potentials of the *thing*.

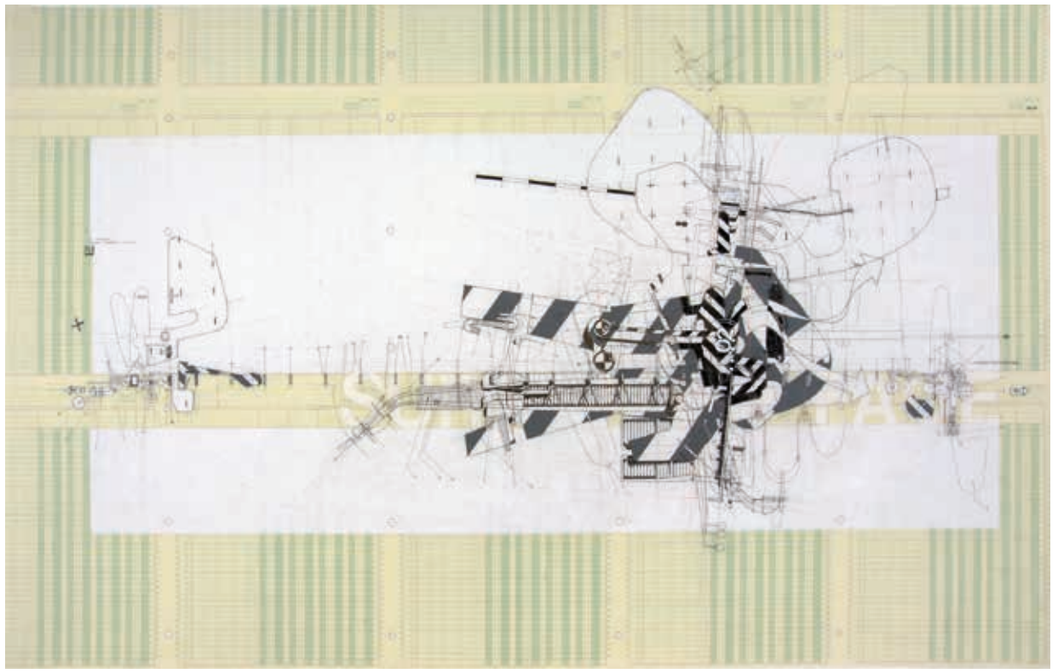


Fig. 1: Bryan Cantley, *SurFace Excavator[s]*. Photograph by Matt Gush.

Fig. 2: Bryan Cantley, *Native Topography 05/Series 02*.

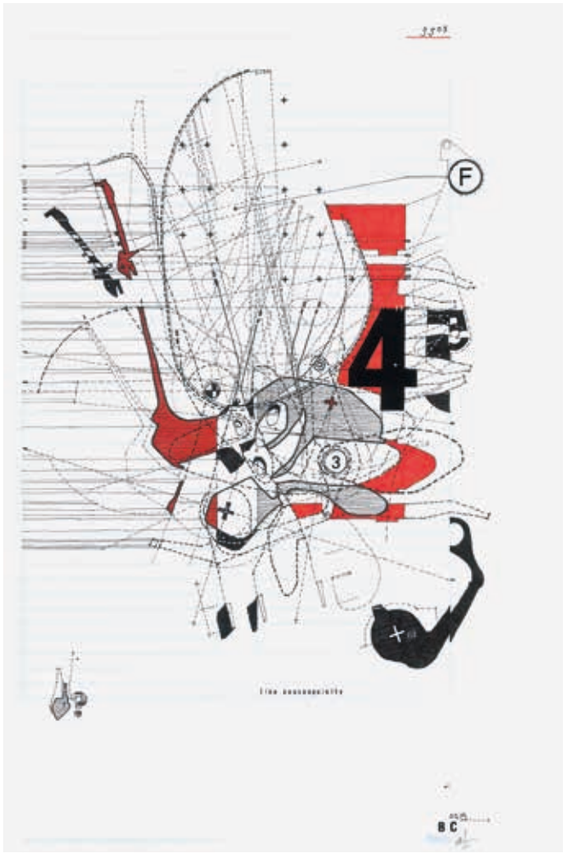


Fig. 3: Bryan Cantley, *Native Topography 04/Series 02*.

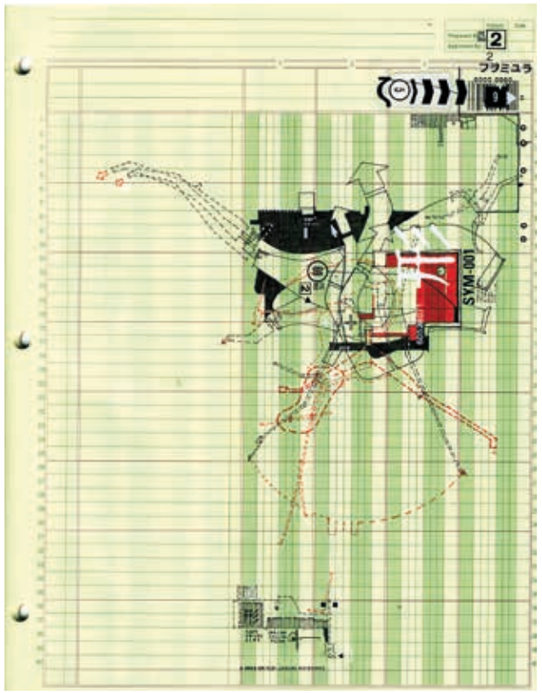
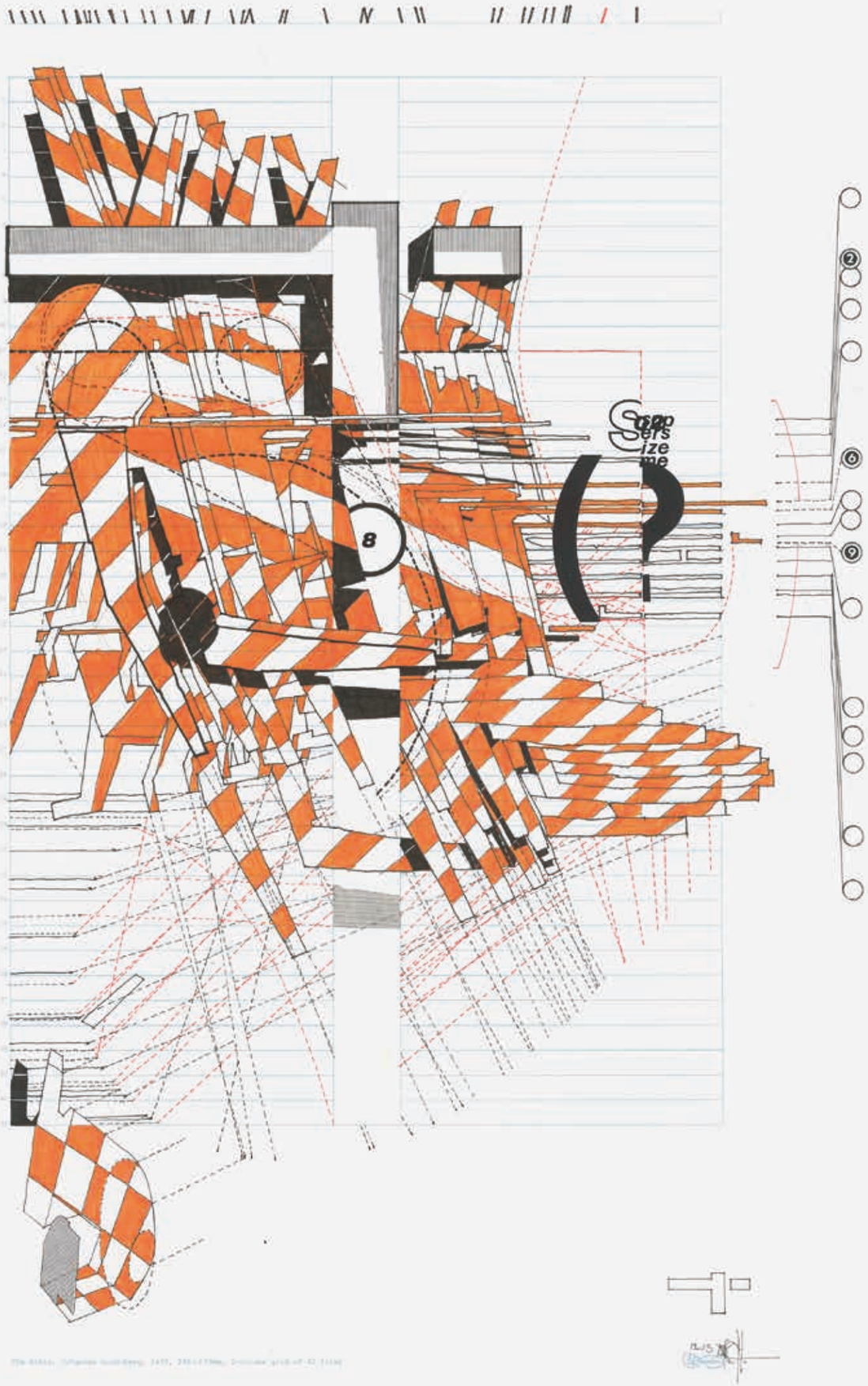


Fig. 4: Bryan Cantley, *Native Topography 06/Series 01*.

Fig. 5: Bryan Cantley, *Native Topography 07/Series 2*.



In human physiology, the interstitial space between organs and skin membrane is referred to as *thirdspace*. Fluid often collects here when the body is in a state of malfunction. The hollowness is designed to house internal organs, but serves as an overflow container for breakdowns of these entities. Interstitial space is not a new term in architecture and is quite common in drawing, yet most of the time we are encouraged to ignore or erase its presence. This is the *thirdspace* of drawing. When we define the architectural drawing as a documentation of *elsewhere* – of a thing's representation – then this covert zone becomes supportive at best, dismissed to clarify the object's definition. Construction drawings are meant as highly specific instructions for understanding, and have gone through the stage of reduction in order to make them clear without interpretation. When we define the drawing as a condition of the *here* (the entity itself), then the *thirdspace* becomes an active occupant in the construct.

This understanding allows for the generation of historical/contextual information that might be found on the drawing surface predating impregnation by the architect's hand/input. These particular drawings were fabricated using the imprinted graphic data, *Native Topographies*, to apprise and distort developing architectural data. Just as site influences structure and building distorts site, these broadcasted excavations initiate a call and response scenario that utilises a previously unrecognised (or dismissed) condition of the history of the page/surface. This allows for a most interesting deviation and eventual inclusion/acceptance of a context that emerges from the union of surface data and drawing.

FANTASTICAL HISTORIES

The white space of any paper meant for the insertion of input information is at question – it is the pure space of unlimited innovation. It has no expressed history or context – it is an open system devoid of any internal/external reference except for its fixed dimension.

Enter the infected... the paper embedded with its own history of graphic impregnation. This information, the pre-printed forms meant for data insertion, is intended to be the static information of prototypical variation. They are merely placeholders of generic data.

We may, however, make an analogy, in the sense that these printed histories convey a similar adjacency in concept to that of the building site/context. That condition comes to us as accepted truths – with their own terminus and finite value. My suggestion is that these artefacts may be utilised to inform *experimental* drawing, and therefore it can be argued that they offer potentials of discovery of unorthodox spatial prototypes. The chronicle and artefact of the printer evolves into part of the dialogue of architectural language.

> We make a move from:
> Paper Architecture
> to:
> *Paper > Architecture*

This is a condition that I have labelled 'postliminal fuzz' – a circumstance of the recognition of liminal space, the physical and conceptual properties of the drawing surface and the production of new policies based on their collision(s).

DEVIATED FUTURES

The context of the drawing evolves as the drawing progresses. The chronological references of *that which is fixed* and *that which emerges* are shifted to the extreme background. In this threshold region, the concurrent progressions of the two situations are foreground subjects. Information derived from the drawing begets additional drawing on top of the existing – its start-shape ever-evolving. It is convention to establish rule sets and standards prior to the launch of a drawing. With these constructs, the initial rules serve as a base upon which a second set of evolving and responsive rules are added, looking to discover the performance logics of how the ideas/drawings behave as opposed to their pure visual characteristics.

When we suspend the history of the history of (a) drawing to pursue itself, we, by definition, alter the aforementioned trajectory of spatial production and what it *might become*.

Fig. 6 (opposite): Bryan Cantley, *Native Topography 08/Series 2*.

The Living Tableau

Pablo Gil Martínez

This set of drawings explores an architecture that could potentially behave as a numinous animal. The drawings show robotised units that operate as artificial animal organs, producing a series of effects – thermodynamic, behavioural, formal and functional – that will be later coordinated in a composition in the form of two variations of a building which are represented in axonometric projection. The buildings, composed as an aggregation of 'artificial organs', are to be perceived as a choreographed herd of intelligent organisms that is able to communicate fear, familiarity, divergence and understanding. The buildings form an ecosystem and also a performative living tableau that moves beyond our control.

This exploration uses different approaches to drawing. The first drawing (Fig. 2), aims to represent the exterior form of the different organs selected, understood as volumes seen from the outside and put together to attempt a first compositional result of the idea behind this exploration. It is a sketch of what could be the architectural result of this approach applied on a ceiling. It is certainly limited in its representational qualities. The representation does not even show changes of form, movement, texture, colour, light or shadow. The action of the different parts, if it were to be represented, would require other drawing techniques. Instead, the role of this drawing is to fix the agenda of exploration that is being developed. It is a small confirmation for me that things are going in the right direction towards my vision, which is obviously changing throughout the process. But at this stage I was not interested in the truthful representation of a reality, but rather in discovering and developing my vision though various means. This involved prototypes on 1:1 scale, material experiments with students, developing the means to control and generate behaviour through robotic systems, producing construction drawings and making models. All these knowledge acquisition processes, running in parallel with the drawings, may appear only vaguely apparent for others, but the author sees all the behaviour, applied technology, materials, colour and shadows in them as they unlock the projected visions that Fig. 2 was helping to fix.

The second type of drawings are construction drawings (not shown) that mix reverse engineering, understood as a direct conversion from animal organs to artificial technology, and the repertoire of architectural technologies I have developed. They are sketches that are not there to represent to others how these parts should be built, but to make me understand how to build

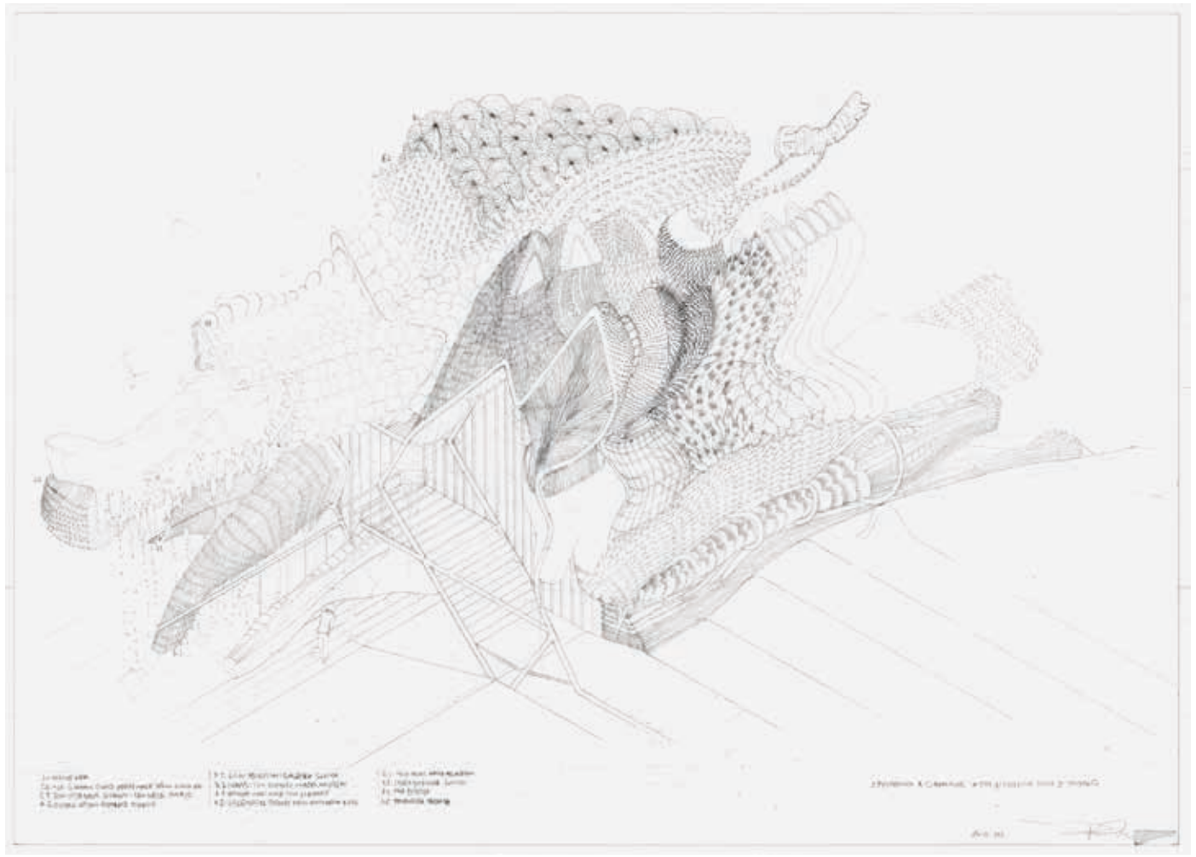


Fig. 1: Pablo Gil Martínez, *Building test*, 2013, pencil drawing, 840 × 597 mm. Collection of the author.

them, as I progress, with the help of sketches, back and forth from one technology to another, exploring the implications on the different levels of architecture – technique, experience, tradition, scale and so on. In this exploration, I have produced 120 Din-A1 drawings drawn in parallel with other means of experimentation that feed back into the drawings. The drawings here play the role of testing the necessary technology for my vision and are partial accounts of it, but are adequate to progress to further stages of knowledge needed to one day be able to execute one's vision.

Thirdly, Figure 1 applies the previous knowledge into the design of two buildings. These are tests of the feasibility of the different aspects that have evolved and are a definition of what is, or was, my vision of the architecture at that point. Again, they might be vaguely indicative to others of what I was after, but for me they mark a very important point in this journey and were a great joy to make, too. They confirm the growth of, and power gained over, the original ideas, and I see them as a demonstration that a building like this could be realised.

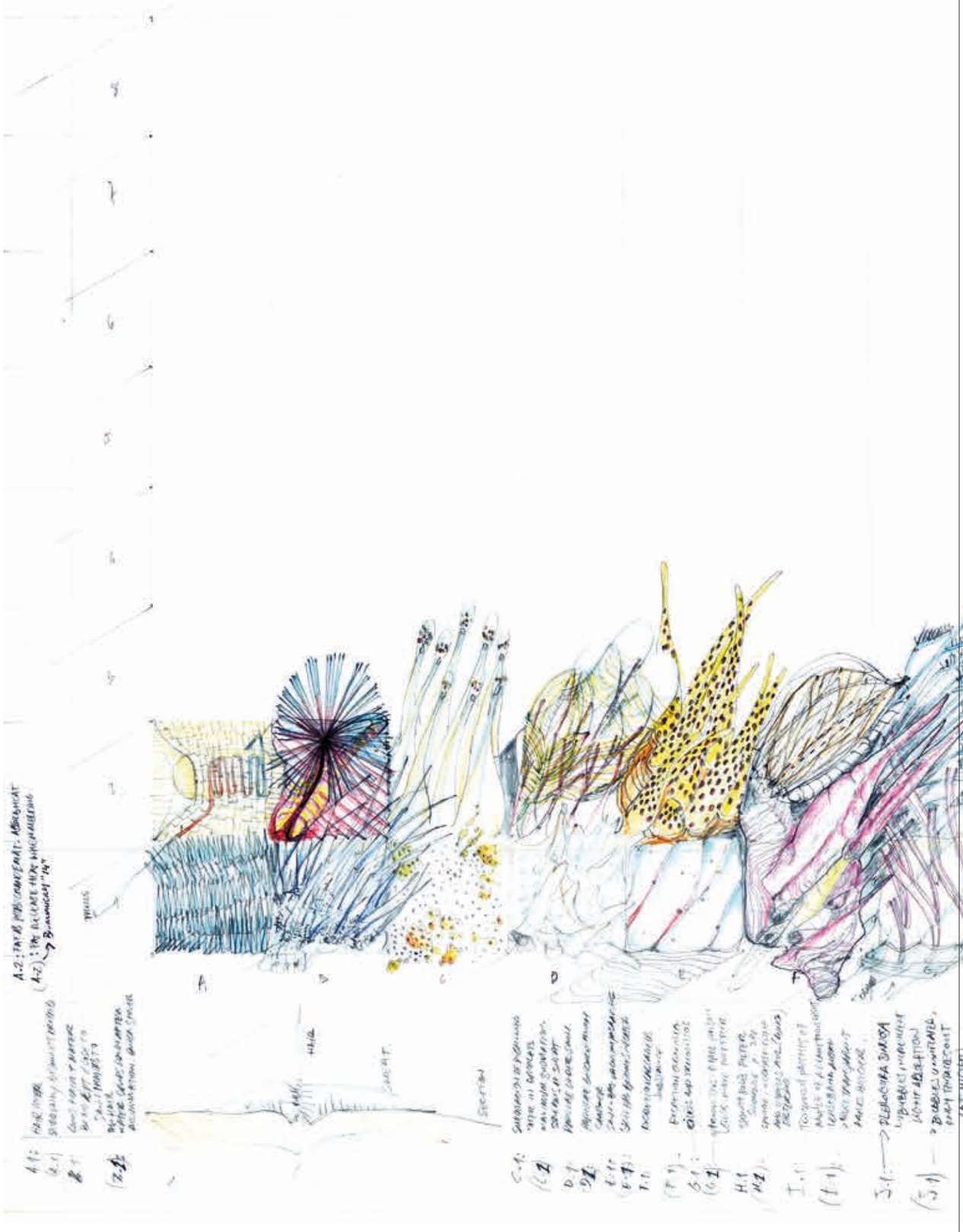
What these types of drawings share is that they are iterations of a projection that could require a whole lifetime to explore. Architecture as a living organism is an idea that first provoked me 14 years ago. It is potentially achievable with our present technology, but I have not mastered it yet. My understanding is that building is the only great objective that the field of architecture can offer me. From this point of view, I am not interested in thinking about representation as a theme, neither I have found, when I have tried, that drawings done in another way were more helpful or had more of an impact on the design that I was after.

I mean that shifts in drawing technique, augmentation, excursion, collage, mixing media, not even changing the diameter or hardness of the lead, which for me it is often 0.35 B, have no added value and in fact feel like delays in my process.

Instead, I see drawing as a tool for inquiry, with a great potential to think with objects in the same way that ideas or concepts rely on words, text and arguments. The joining of objects or the composing and organising of future spatial situations has a great ally in drawing. But drawings do not always need to be 'readable' to others. It is possible to conceive of codes that are only obvious for those who makes them; and maybe this would connect with the idea of style, a particular code linked to a particular individual. In the world of words, this happens, too: mumbling, speaking out, going through ideas mentally, extracting ideas or concepts from visual representations or memory or using metaphors or analogies to describe situations. These can all take place in an individual's mind, on their tongue or with their pen. They may be not yet ready for communication to others, as they do not operate yet in common code – phrases, books, lectures or other forms of communications that have become historically institutionalised. This idea was culturally retrieved in works such as *Finnegans Wake* – although no one can ever think of that text as the preparatory mumblings of Joyce; instead, it is a finished piece of writing in the form of a book, an institutionalised object with a particular structure.

We might use the analogy of practicing the piano to understand drawing. A music student spends hours going through fragments, exercising scales and arpeggios, getting ready for performance. That music is not to be heard publicly, but serves as necessary preparation for the musician him/herself. Drawing operates as a tool to envision all the complex dimensions involved in the design of a building. In this sense, a building could be understood as the result of the art of fixing into reality what you have been practicing to get built.

Fig. 2: Pablo Gil Martínez, *Building test*, 2013, pencil drawing, 840 × 597 mm.
Collection of the author.



Speculative Morphology of Recurring Terrains

Ryota Matsumoto

Fig. 1: Ryota Matsumoto, *Imaginary Echo Chamber*, 2016, mixed media on paper, 68 × 74 cm. The biomorphic structures begin to merge into each other to form urban agglomerations.

My work speculates on the morphological transformations of ever-evolving urban and ecological milieus that are influenced by the eco-political reality of the Anthropocene epoch, emerging technologies of genetic modification, the advancement of biomaterial technologies, a socially constructed value system and rapid environmental transformation accelerated by the dynamic interplay of socio-economic, institutional and technological activities.

A background in architecture and visual art has led to exploring a hybrid approach in drawings, combining and merging both traditional and digital media in his working process. The various constituent methods of architectural, graphic and mixed media conventions are synthesised seamlessly in this approach. The drawing process involves base images that are composed by 3D software incorporating generative algorithms and then overlaid with traditional media such as acrylic, ink and graphite, as well as scanned images of found objects. These are then further processed and looped through stochastic and recursive operations by image-editing programmes and plugins.

Some of the works cycle through phases and take a long time to complete. In such cases, the completed work is then disassembled and reconfigured by implementing iterative algorithms. I repeat this process until I find unpredictable dialogues among newly assembled pieces. This almost autonomous, exquisite corpse-like approach generates a dozen versions of completely new compositions.

The hybrid technique allows for a certain degree of unpredictability of visual dynamics. Painterly, organic sentiments reveal themselves amidst the otherwise detached precision of digital drawings. By employing this specific method, the degrees of depth, spatial dimensionality and scalability vary, distort and warp the finer details and overall composition. The drawings are effectively liberated from the restrictive traditions of the Cartesian coordinate system.

The application of this method allows the work to bridge the gap between analogue and digital media as well as between two- and multi-dimensional domains. Compositional techniques imbue the work with the very essence of post-digital constructs beyond the conventional protocol of architectural and artistic formalities. They conjure up synthetic possibilities within which the temporal variations of spatial semiotics emerge as the potential products of alchemical procedures.

Recent work revolves around common themes that are built on the mythology of future cities, with emphasis on the socio-cultural aspects of innovation, resources and planning processes. The wide range of compositional techniques embrace varying scales and juxtapose amorphous and structural forms. They intertwine textures/patterns, oblique projections and visual metamorphoses and are employed to envision the potential scenarios of post-smart cities of the transhuman age. The clusters of bio-based phase-shifting cellular structures enveloped in tactile membranes with tentacle-like sensory systems are dominant components of urban tissues that constantly

Fig. 2: Ryota Matsumoto, *Rapid Gaze Polynomials Embedded in Infinite Variables*, 2016, mixed media on paper, 64 × 70 cm. The self-organisation process of semi-organic urban clusters with their layers of infrastructures.

Fig. 3 (opposite): Ryota Matsumoto, *Those Who Affirm the Spontaneity of Every Event*, 2015, mixed media on paper, 84 × 119 cm. The whirlpool of primordial chaos before the beginning of bio-organic systematisation.

self-organise and cross-fertilise to replicate semi-living urban agglomerations in perpetual motion. They are autonomous, organic entities that regulate their internal environments through the combination of artificial photosynthesis and biofuels. They maintain homeostasis within their own adapted ecosystems, while simultaneously living in symbiosis with pre-existing nature. These biomorphic structures can reconfigure and expand through preprogrammed mutation and somatic cell division in order to meet ever-changing programmatic and economic needs. As time passes, they outgrow the ravaged cities of the past and replace abandoned and dilapidated buildings with their biologically driven multiplying structures. Consequently, the myriad emerging biotechnologies blur and undermine the fundamental distinction between the natural and the artificial in the visionary cityscape of speculative urbanism.

The paradox, contradiction and distortion of an alternate perception towards time and space have been a constant subject of interest in my drawings, manifested in the visual narratives on conjectural possibilities of urban futures. Furthermore, most of the work is a personal expression meant to merge and transcend the boundaries between architecture and art, two cultural realms that both reflect on and create contemporary society.

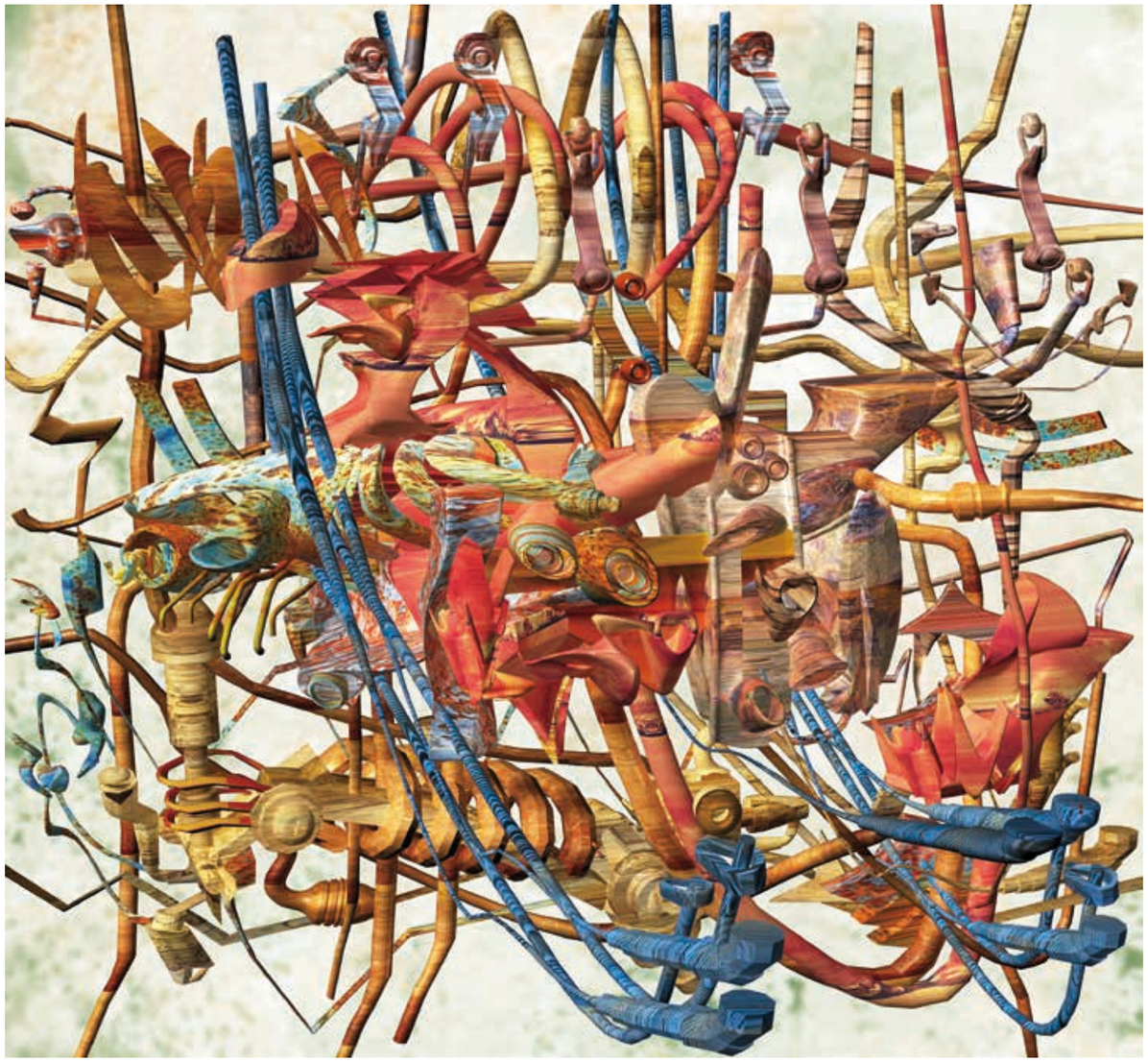


Fig. 4: Ryota Matsumoto, *Swirling Effects and Their Wayside Phenomena*, 2016, mixed media on paper, 67 × 72 cm.
The hybrid cellular unit comprised of mechanical and organic elements.

Fig. 5: Ryota Matsumoto, *The Indistinct Notion of an Object Trajectory*, 2015, mixed media on paper, 75 × 56 cm. The stacks of biologically enhanced urban farm towers embedded with multi-functional components.

Rowhouse

Tom Ngo

When asked the difference between art and architecture during an interview with Charlie Rose in 2001, Richard Serra responded that art was "purposefully useless". Elaborating further, he clarified that architecture could never be art because it was inherently functional, while art, on the other hand, could be freely made without constraint. The crux of his argument lay in the idea that function acted as a hindrance to an architect's ability to create.

In my work, I challenge the idea that art and architecture are mutually exclusive by proposing *function as the architect's medium*. My work attempts to blur the boundaries between utility and purposelessness within architecture. In my drawings, I ask viewers to ignore the operations that occur within spaces and encourage them to consider whether architecture can have as much freedom as art does. The resulting structures attempt to straddle both disciplines, subverting the idea that architecture must be purposeful and proposing, instead, that it can simply be art.

This is illustrated in first project, *Dimhouse*. The aim of this project was to represent the concept of absurdity. Two houses have been stretched and pulled like pieces of dough and doubled over – and the project is named *Dimhouse* as a nod towards this idea. The repetition of the stretching, pulling and doubling gestures should be emphasized here. Firstly, this reinforces the idea that they are intentional; secondly, it creates an artificial compositional balance, both visually and architecturally; and finally, it obscures programme and presents a level hierarchy of space. As a result, this duplication of spaces represents an intentional blurring of architectural purpose.

This is built upon in the second project, Rowhouse. This project reinterprets a rowhouse and situates it within eight rentable units of a self-storage garage. The duplicate structures play off the symmetry of the row house typology, but the rooms within the structure are presented as unprogrammed vessels. However, the aim of this project was not only to present a purposeless space, but to examine it through the rigour of a set of construction documents. Every aspect of the building is annotated and detailed, from general construction notes to building detail sections to door schedules. This brings up several questions. Does the architectural reading of the space change? Does CAD alter the artistic reading of the image? By presenting it as a construction set, does this make the space imaginary or real? Finally, the drawings are screen printed by hand and framed in such a way as to ask the viewer to accept them as art. Rowhouse therefore proposes to shift the artful intent away from the presentation of drawings and towards the construction set. This act reinforces the idea of reclaiming functionality as a medium, as well as embracing architecture's own capacity for creating art.

Fig. 1: *Dimhouse 1*, 2013, Coloured pencil and graphite on paper, 28 × 22 in.

Fig. 2: *Dimhouse 2*, 2013, Coloured pencil and graphite on paper, 28 × 22 in

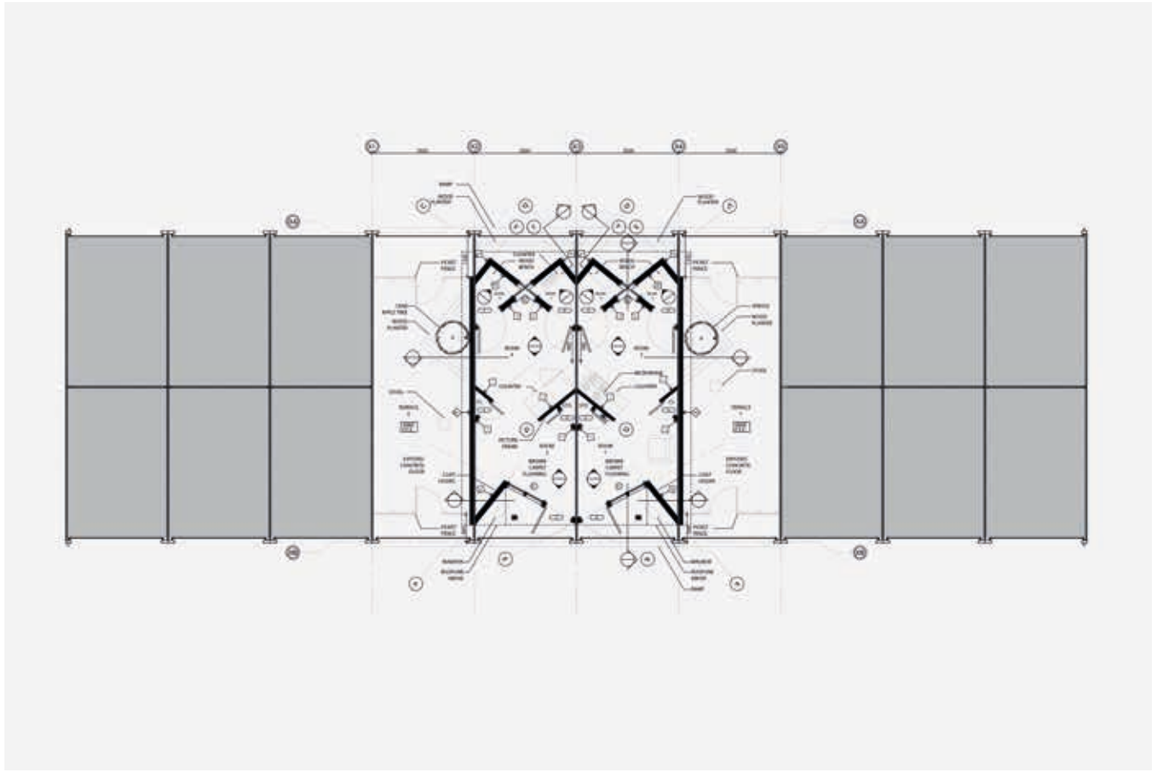


Fig. 3: *Rowhouse – Plan*, 2015, Screen print on paper, 24 × 28 in.

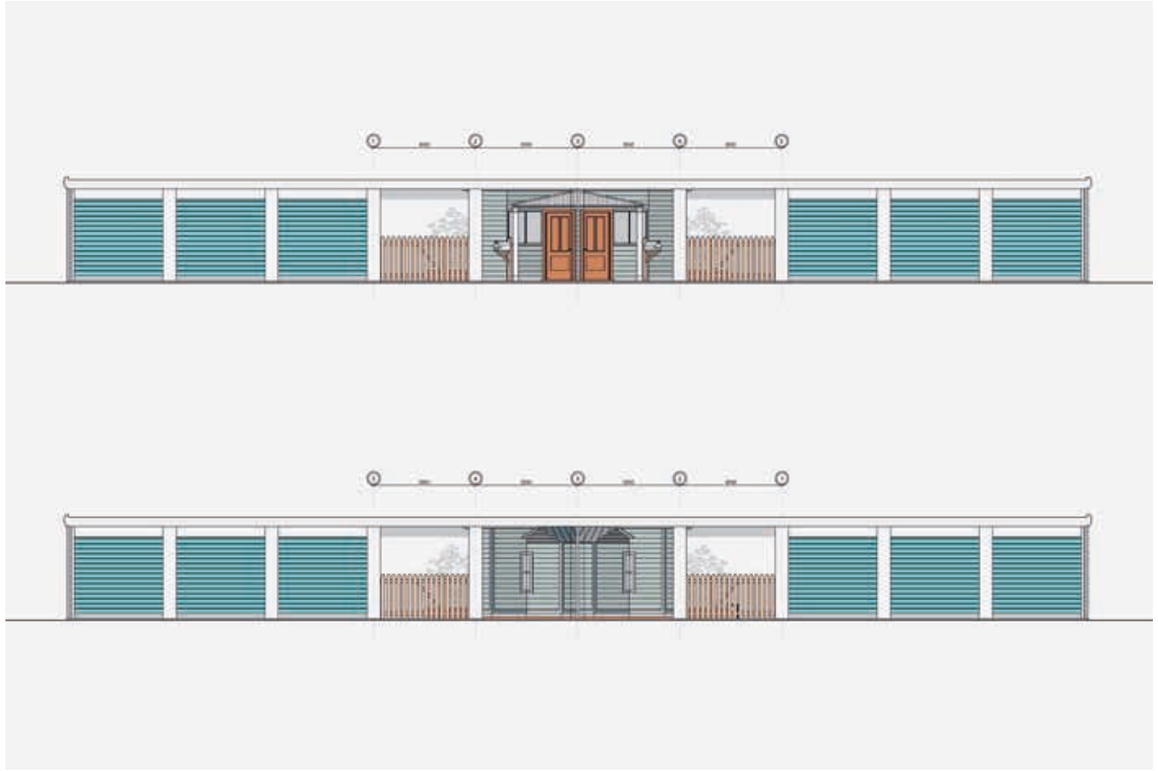


Fig. 4: *Rowhouse – Elevation*, 2015, Screen print on paper, 24 × 28 in.

Tokyo Backup City IRTBBC

You + Pea

Tokyo IRTBBC was a plan first proposed in 2011 by Hajime Ishii of the Japanese Democratic Party, addressing concerns that Tokyo's current density puts it at mortal risk from natural disasters following the tsunami (of March 2011) and subsequent damage to the Fukushima 1 Power Plant. A group of high-ranking officials proposed a new 'backup city' for Tokyo that would keep the nation running even if its capital stopped.[1] Our 'Tokyo Backup City' proposal is drawn in response to Ishii's 'NEMIC Initiative' (National Emergency Management International City), which floated the Tokyo IRTBBC scheme as a new emergency seat of power. The project would be located in Osaka at a site suggested by Ishii's committee – currently occupied by the domestic Osaka Itami Airport.

The NEMIC proposal calls for construction under the logics of the acronym IRTBBC: *Integrated Resort Tourism Business and Backup City*.[2] Alongside business zones and special amusement areas such as *American Sporty Stadium* and *Euro Healing Palace*, the 'IR' of the project would also introduce American-style gambling 'integrated resorts' to Japan, which are currently illegal.[3] Under this initiative, an ersatz backup Tokyo would be subjugated to the economic and symbolic models of other cultures.

Far from backing-up the characteristics of Tokyo, the NEMIC proposal would sneak in spatial typologies that would profoundly affect the future of Japan both economically and socially. It would be funded by a public-private partnership of the type not currently common in Japan, hurling the country into a new legal turmoil concerning gambling and new financial relationships with the gaming powerhouses of the USA and Asia.

Our project proposes an alternative vision of a backup city for Tokyo that antagonises the gambling resort as a model by utilising the distinctive aesthetics of Japan's own gambling (and religious) culture of 'tokens'.

The drawings are inspired by the luminous colours and hypersaturated landscapes of Japanese arcade 'medal games'. Due to legal restrictions on betting with money, Japanese gamblers exchange currency for tokens (also called medals) that are fed into elaborate miniature architectures, rolling, spinning and cascading through their tiny infrastructures – hopefully towards a prize. Medal games are the mutant cousins of 'coin-pusher' games found in any British seaside arcade; car-sized cabinets holding games of chance where the token tends to do all the real work (Fig. 1).

These games are ubiquitous in Japanese arcades, yet are rather rare to encounter abroad – strange worlds of arcane rules and symbols, as impenetrable as pachinko but with even more booming sounds and lights. To wander through a contemporary gaming arcade in Japan is to experience a sensorial overload at a number of architectural scales, from the glowing exterior of the building to the repetitious units of game cabinets with their cacophony of light and noise to the tiny spaces and territories within which gambling transactions are enacted through surrogate objects.

In response, our methodology for representing our proposals operates on two levels. Firstly, they are propositions for gamifying the urban realm through gigantic 'medals' that tie together the backup city into a series of interactions between workers commuting to the city and their movement through space. The drawing becomes a way of testing the cause and effect relationship that comes from using the urban realm itself (and the people within it) as a form of *sport* – data footprints and biometrics collapsing the city into a landscape of information.

Secondly, the drawings also represent a critical transcription of arcade medal game cabinets, encoding their language of symbolic elements, ball runs and user-operated mechanisms into a series of full-scale architectural elements. Having observed and recorded

Fig. 1: You + Pea, photo of *Hyozaaan!!,* medal game by Sega Japan, 2015. A view into the miniature world of the medal game, photographed at the equally bizarre *Anato No Warehouse* arcade in Kawasaki, Japan.

Fig. 2: You + Pea, *Tokyo IRTBBC: Backup City Birds-eye (detail).* A detail from the drawing, showing the layering and compositional techniques used to pull the eye across the page of the drawing.

Fig.3: You + Pea, *Tokyo IRTBBC: Backup City Birds-eye.* Overall view of the Tokyo IRTBBC project, showing the various medal structures as luminous points of interest surrounded by the integrated *zone*.

medal games during research trips to Japan, our drawings frame these miniature structures as an architectural typology at a different order of magnitude. The intricate mechanisms of games such as Sega's *Hyozaaan!!, Galileo Factory* and *Medal Tower of Babel* are revealed and reconstituted through drawing.

Our work juxtaposes drawings and 3D models inspired by recordings of Japanese medal games combined with hand-drawn digital painting. The process involves the overlaying of multiple views and scales and the unusual framing of architectural features to draw the eye across the page in patterns like the token spiralling through the arcade cabinet. As a result, the drawing becomes an intimate reflection of the supersaturated locomotive world of the medal, as well as a schematic for its function as a public building in a backup Tokyo.

We first draw a series of 'medals' woven together into a gamified landscape sited at Itami Airport (Fig. 2). They test the collisions of arcade aesthetics with a condensed version of the Tokyo metropolis. Notable architectures from the metropolis take on new functions in the backup city. A rescaled version of Tange's Tokyo Metropolitan Government Building becomes a data centre for administrative legislation that forms an architectural 'cloud' backup. Shinjuku's infamous 'Piss Alley' of bars and yakitori joints is arrayed into a series of irrigation systems to provide water for the city, and supernatural landscapes such as a reconstructed Mount Takao are punctured with geothermal boreholes that produce hot springs. These moments of architectural archiving are enmeshed into the space of the drawing, woven into the aesthetics of the game (Fig. 3).

Between medals and other significant buildings is the *integrated zone* – residential and commercial structures growing into the gaps of the site, their angular shells articulated by Tokyo's shadow planning laws. The 'colour burn' of Tokyo's neon surfaces is encoded into the drawing to suggest a new city of intensity and friction rather than preconceived zones. In the same way the medal game overwhelms the player to distract them, the drawing overloads the viewer to emphasise a spatial alternative to the NEMIC proposal of anodyne, clearly divided zones of commerce that would define the backup city. Drawing is a zone to test the medal game as an urban planning prototype.

The drawn surface is used as a tool to enmesh speculative ideas, remodellings of typologies, photographic recordings and sketches. These combine together

Fig. 4 (overleaf): You + Pea, *Tokyo IRTBBC: Exploded Medal*, 2016. An exploded view of a sports medal, where the four legalised gambling sports are combined with the infrastructure of the subway station into a pillar of symbolic transactions.

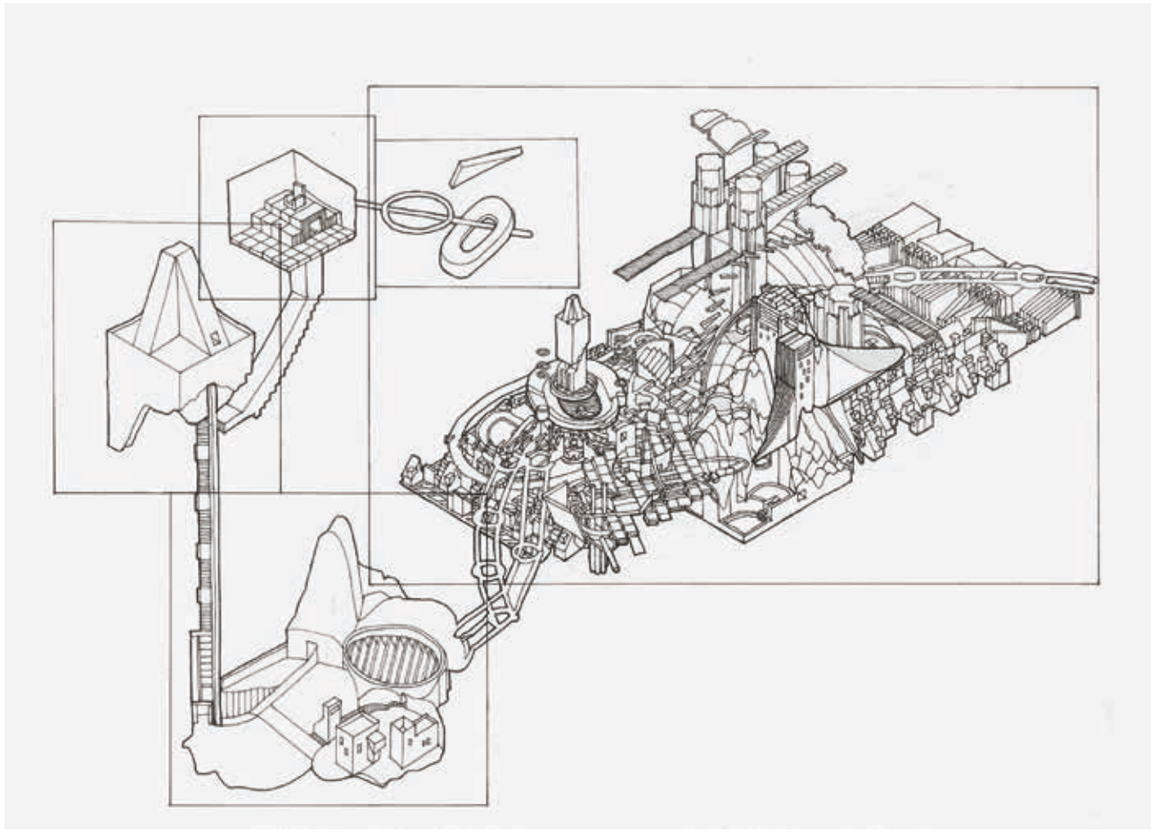


Fig. 5: You + Pea, *Tokyo IRTBBC: Sketch studies*, 2016. A sketch through space and time within the Backup City, showing the moments encountered by workers and residents at different scales.

into an architectural language that embraces the collisions of traditional tokenism with super-plastic arcade cabinetry. Sketches such as (Fig. 5) explore the landscape at multiple scales, conceiving of the architecture as a journey. Medal games typically work on complex schedules of 'random' events, which are nearly impossible to understand for a novice player, with tokens driven on a tortuous passage through the system by miniature infrastructures. The drawing is a method to explore how people encounter this new form of gamified urbanism as a journey through architectural space.

In Fig. 4, we show a view exploring the inner workings of a skyscraper-scale medal. The structure accommodates the only four legalised gambling sports in Japan: powerboat racing, speedway, keirin cycling and horse racing, extending them by gamifying the interchange of people within the metro station at the heart of the building. People become tokens cascading through the miniscule monuments of the arcade game. Inspired by schematic drawings of arcade cabinets and pinball tables, we explode the medal, revealing logics and speculative mechanisms within the structure.

For all their flashing lights, chutes and spinning roulette wheels, there is something inscrutable about medal games – an internalised logic held away from the player. One often gets a similar feeling walking the streets of Tokyo. By exposing this and using it as a strategy within our drawings, we attempt to reinforce the idea of a backup city that celebrates the inconsistencies and manias of the modern metropolis. The drawings, like medal games – like Tokyo itself – become spaces of bewilderment through their layers of information: a representational riposte to Ishii's idea of a business park backup city trapped in the 24-hour mood lighting of the American casino floor.

[1] "Plug and play… Japan looks at creating world's first backup city", World Architecture News.com, accessed 16 February 2016, http://www.worldarchitecturenews.com/project/2011/17908/wan-editorial/irtbbc-in-irtbbc.html.
[2] "NEMIC National Emergency Management International City", NEMIC, accessed 16 February 2016, http://nemic.org/index.html.
[3] "NEMIC Park Casino" (translated), NEMIC, accessed 16 February 2016, http://nemic.org/amusement.html.

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.

What's the Difference?

Hsinming Fung

We can agree that it is possible to be enthralled, even moved, by drawings made by hand. This is true whether they are from the caves of Lascaux or our contemporaries in the world of architecture. Sought by collectors and museums, bearing the hand and thoughts of the artist, original drawings offer invaluable insights into the era, the culture and ultimately the mind of the artist. It is this last category – in which the mind is revealed – that interests me.

Every stroke, every correction, every pause represents a transaction between the hand, the eye, the imagination and the chosen medium, measuring the intention against the result. An incredible algorithm judges instant by instant whether that last stroke achieved its objective, and prompts the next to take corrective measures. All this while the artist conspires with the vision that provoked her to put pencil to paper in the first place.

This may seem like a great deal of effort, but in fact it can be a source of intense pleasure. To observe the progression of detail as the image matures and to observe finally the moment when the hand relinquishes the instrument is to observe the creative process in one of its most revealing guises.

Yet today, one might be hard-pressed to find architects and designers who rely on such a skill. Instead, skeins of spiderweb lines with volumetric overtones defy tradition to create new, luminous forms generated by algorithms and strategic conditions set by their authors. The physical act of drawing has largely been replaced by a kind of poetic scripting. The search for *the* one line among many has become a command for a new layer. The sigh of recognition has been replaced by clicking *Save*.

It can be argued that, as a design tool, drawing reigns supreme. Media constraining the immediacy of the act inhibit the linkage between imagination and the image, inspiration and the napkin sketch. That is not to say that drawing is the most effective way to communicate an idea nor to delineate it in formal terms. For that labour-intensive and often drawn-out process, one must be grateful to digital media.

This is not to suggest that the importance of drawing has been eroded or sidelined; but it marks a shift in the balance of design intelligence. A shift in the relative investment in, perhaps even utility of, drawing as a discipline requisite for pursuing a product such as a building, a hoover or a subterranean pipeline. It is here that one must pause and sift Drawing, with a capital 'D', from drawing, with a lower-case 'd'. For the expanding, data-driven realm of production documents – those one might call small 'd' drawings – there is no substitute for digital media. In fact, when inspecting the small 'd' drawings of Gustave Eiffel or Mies van der Rohe, one

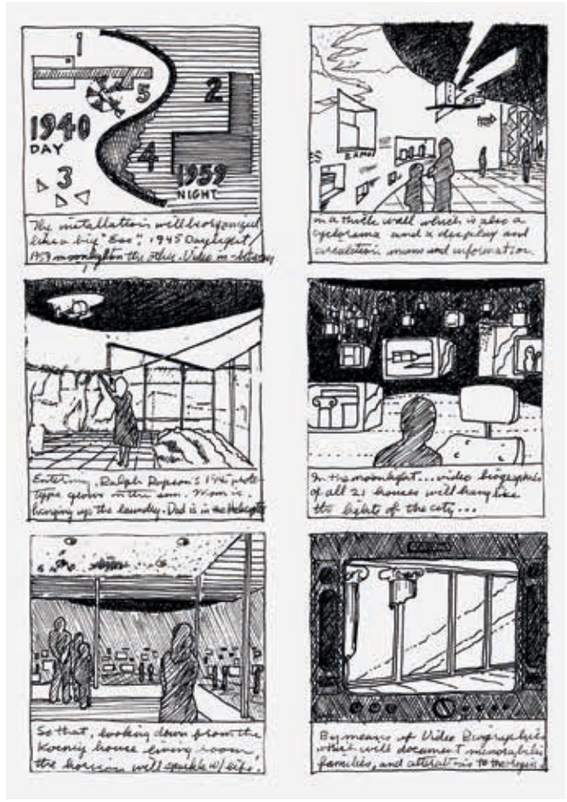


Fig. 1: *Sketch for the timeline*: Interior graphics for the exhibition, 'Blueprints for Modern Living: History and Legacy of the Case Study Houses' at The Museum of Contemporary Art, Los Angeles, by Hodgetts + Fung, 1989 © Property of Hodgetts + Fung. All Rights Reserved. 2016. 210 × 297 mm, pen and ink drawing on paper.

cannot help but marvel that they were possible at all without some sort of digital apparatus. Therefore, given the widening gyre, given that purposeful, speculative drawing is no longer tethered to the expectation of explicit communication, should we not celebrate the role of Drawing as a purified and rarified tool for exploration and speculation?

Applying this lens to our practice may offer some examples of the role of drawing, from which more generalised observations might be drawn. Such a practice came of age when James Stirling upended the way architects visualised their work. Beginning with that notable freehand sketch of the patent glazing for the Leicester Laboratory, Stirling perfected the axonometric view as a comprehensive, dimensionally accurate manner to visualise the complex forms he had in mind. For many, this represented a far more engaging way to approach architectural design than the beautiful and evocative but vague charcoal studies then in vogue. These Drawings from *Cookie Express* demonstrate the power of the axonometric to organise volumes and materials while avoiding any hint of the 'picturesque'. This approach to drawing is not without empathy or visual appeal but, in its minimalist way, is simply stripped of non-essential flourishes, avoiding appeals to craft and surface embellishment.

The Drawings are calculated to emphasise meaningful features. While minimal in terms of tactile details, they are rich in rhetoric.

Often imbued with narrative devices, whether to describe an assembly process or to point to the manner in which one might occupy a space, the stripped-down 'storyboard' approach fills the space commonly assigned to detail with anecdotal content. The conceptual organisation of 'Blueprints for Modern Living', an exhibition covering the Case Study programme in Los Angeles, took the form of a 'combine' sketch that compressed planimetric ideas with visitor experiences. With references to the cycloramas gleaned from motion picture sound stages and a cinematic organisation, these sketches gave priority to the narrative milestones expected to structure the exhibition (Fig. 1).

Other Drawings, such as these for a housing competition (Fig. 2), specify the narrative potential of the design, and underscore the variety of interactions to a degree that typical architectural drawings do not exercise. Simple devices – a straw hat and wooden clogs, a skateboard and a pair of dogs – give an impression of the activities of the tenants. The *realpolitik* of one such drawing in fact exposed the project to unfounded criticism aimed at the lifestyle of the occupants, which doomed the project while also unveiling the implicit covenant between architects and their clientele.

This was the case with the invited competition entry for Vesey Park. Situated in a dense urban triangle and squeezed between gigantic corporate towers and a neighbourhood of deteriorating nineteenth-century townhouses, the design seeks to provide a common destination for workers and residents alike. Again, Drawing was the medium populating the design with activities for runners who might take a break there or for vendors who might use the stall for an ice cream truck or for children who, in this sketch, are playing with a model of the play area in which they find themselves. In this way, Drawings are also a 'literary' form, able to accommodate parenthetical comments, in-jokes and even political manifestos. One remembers the desk on the penultimate floor of Stirling's Siemens project and the nearly invisible but ominously present Luger lying upon it, or the dog

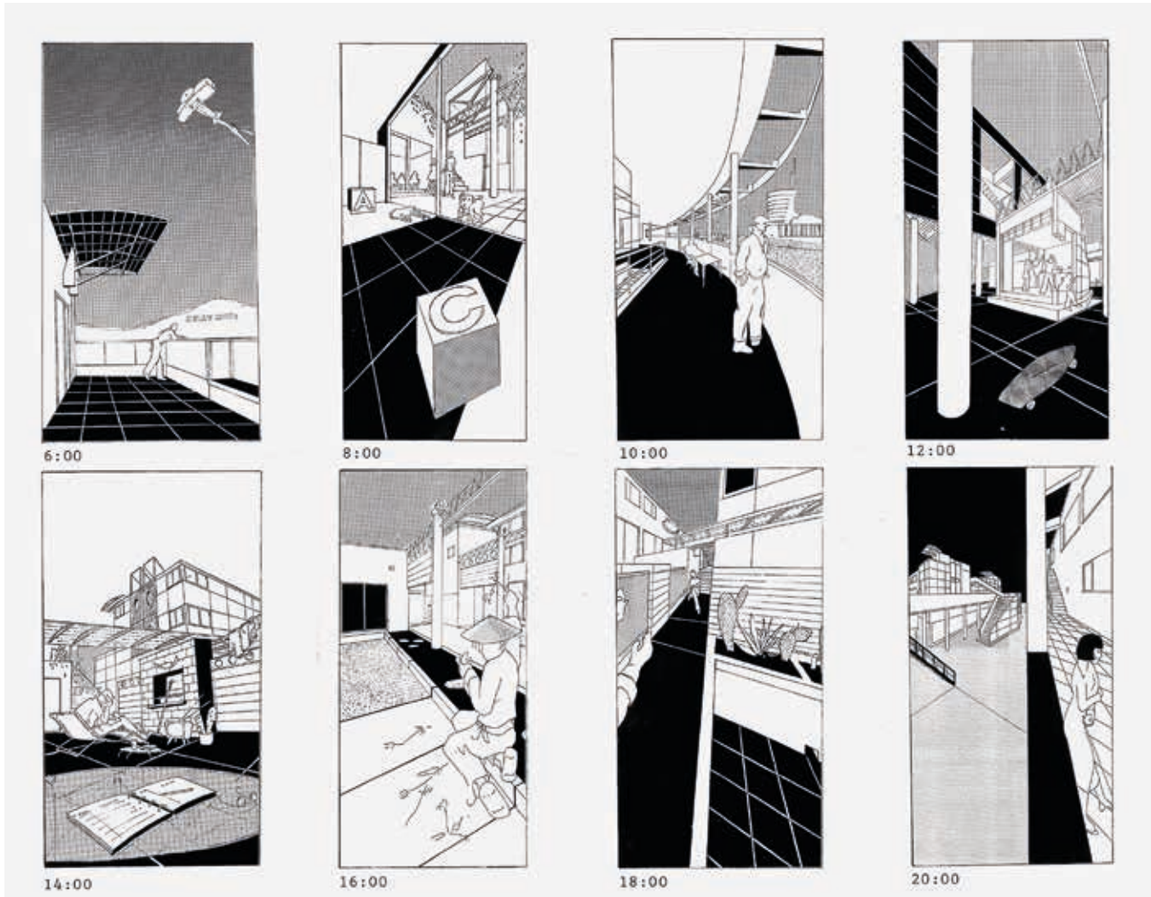


Fig. 2: Drawing for Franklin/La Brea low income invited housing competition, The Museum of Contemporary Art, Los Angeles, by Hodgetts + Fung, 1988. © Property of Hodgetts + Fung. All Rights Reserved, 2016. 210 × 297 mm, pen & ink drawing on paper.

Fig. 3: *Cyberville*, 'La Citta Pulpa', by Hodgetts + Fung, XIX Milan Triennale, 1996.
 914 × 206 mm. Composite.

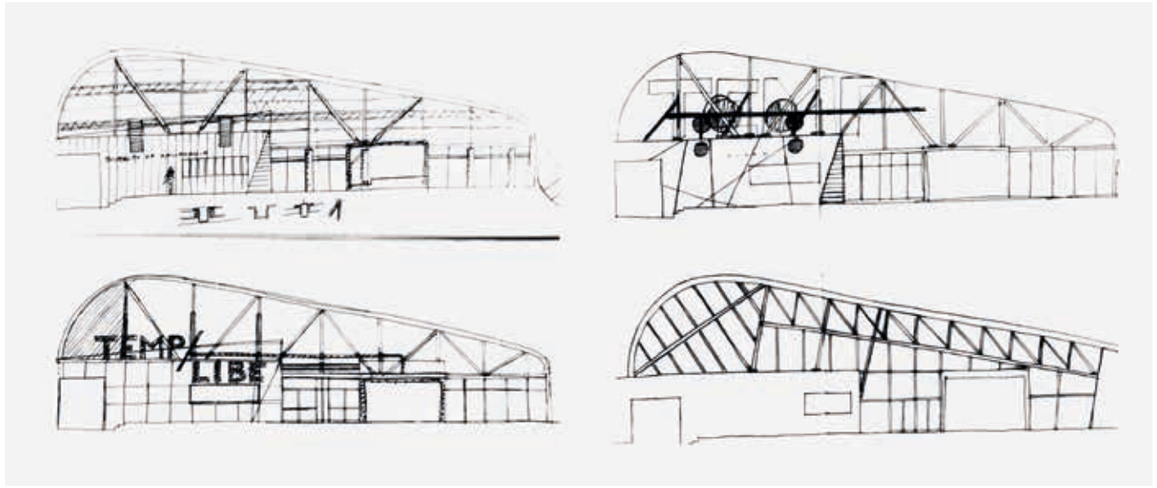


Fig. 4: Elevation sketch series of Towell Library, by Hodgetts + Fung, 1997. © Property of Hodgetts + Fung.
All Rights Reserved. 2016. 269 × 51 mm each, pen and ink drawing on paper.

lounging in a cluttered kitchen in Le Corbusier's workers' housing. In the present idiom of digitally rendered, seamless environments, it is difficult to imagine such content, just as it is difficult to picture such intimate detail within the contemporary fetish for high-resolution digital renderings. The beauty of a Drawing is the ability to emphasise significant features through composition, rather than acting as a passive bystander as a digital maestro sorts through its algorithms.

Drawings can also be impetuous, rapidly exploring variants within the premise of the design. Sketches for the façade of the Towell Library explore the patterns created by different plastic glazing materials: polygal, corrugated fibreglass, sheet polycarbonate and so forth. Again, here, in studies for the seismic bracing for a church, it is apparent that religious symbols begin to take form (Fig. 4).

Of course, Drawings reach their maximum potential as a vehicle for speculation and experimentation. Since the practice evolved from earlier adventures in the world of film and exhibition design, it applied cinematic storytelling devices to projects such as 'La Citta Pulpa', which was commissioned for the XIX Milan Triennale under the challenging rubric of 'Identity and Difference'. The basic concept required a new kind of urban framework, for which diverse lifestyles were the object of planning, meaning in this case the creation of various enclaves that celebrated and enhanced differences. After rejecting conventional planning tools, with their diagrams and statistics, the decision was made to create a narrative in the form of a comic book, which offered an opportunity to portray the novel conditions that might arise in a quasi-realistic narrative with speech bubbles and a manga-type picture frame (Fig. 3). Reproduced at super-scale and mounted in a spatially complex configuration, this was intended to create an immersive environment to envelop the visitor in the narrative.

Prior to that, images of devices and environments were created for an installation based on novelist William Gibson's 'Skinner's Room', which takes place in a colony of creative bohemians who occupy the San Francisco Bay Bridge. Juxtaposed with the bridge, which is festooned with all manner of jerry-built dwellings, and marching through San Francisco's dilapidated core, is a phalanx of towers crowned by rotating solar collectors. This improbable but possible blueprint hovers disarmingly close to the pulp science fiction magazines of the 1950s, yet presages many of today's mega-hit motion pictures with its dark portrayal of the conflict between elites and the underclass. A more gestural style was adopted for the competition entry for the Los Angeles Art Park, in part to convey the contrasting, scenographic settings of this most public of urban environments and in part to suggest that elements of mystery, drama and anticipation expected to define the visitor's experience of the park as well as the architectural manifestation. These Drawings were accompanied by a suite of disciplined, pragmatic exposés in the form of axonometric drawings on the mechanics of the attendant water treatment plant, subterranean exhibit halls and the iconic 'wing' to house exhibits on future ecologies.

At this point, it may be worthwhile to discuss the intentions of this work. As our practice is looking at the techniques and the craft of building, we find that Drawings such as these lie somewhat beyond the usual boundaries of the discipline. Yet, given an approach grounded in a plausible physical reality, much of our effort is devoted to teasing out those aspects of a project that are uniquely amenable to the laws of graphic description. Thus, to articulate structurally complex conditions, such as the moment that the limbs of the twin columns at the Menlo Centre for the Performing Arts penetrate the slanted window wall, or to elucidate the operation of the pivoting spiders opening the glass clerestory above the open doors of the Wildbeast Pavilion, or to describe the assembly of the acoustic armature within the cavity of the Egyptian Theater, the studio has often selected the axonometric. Such Drawings, elemental yet surgically precise, foreground the subject while suppressing or eliminating background 'noise', and in the process celebrate what may ultimately be overshadowed by the project as a whole (Fig. 5).

While this selection is by no means exhaustive, it is intended to underscore the diverse roles that Drawing has played in architectural practice. Always purposeful, at times at risk and constantly seeking an appropriate voice for the task at hand, the Drawings of the practice remain an invaluable tool.

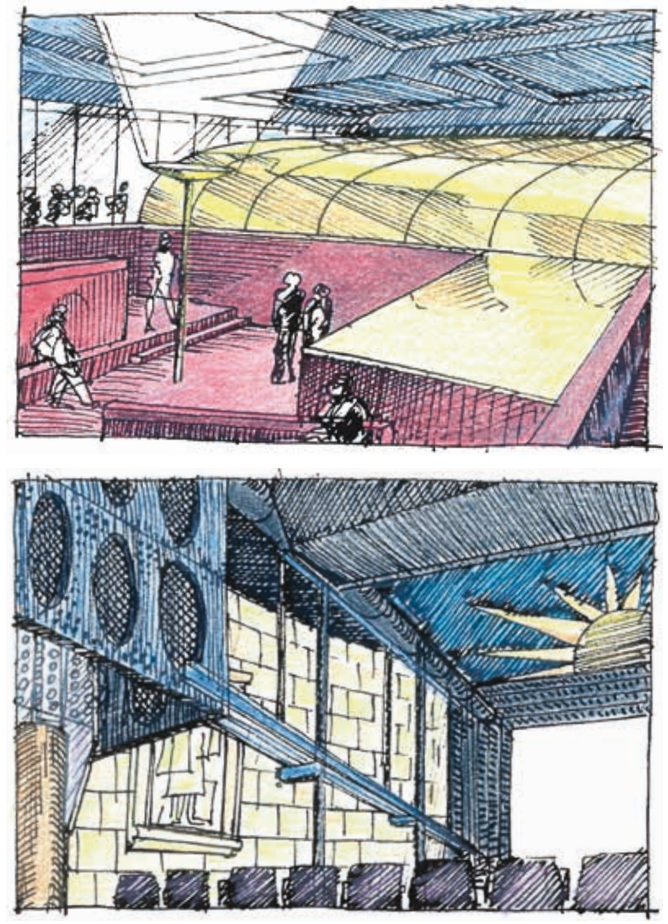


Fig. 5: *American Cinematheque Narrative Sketches, Egyptian Theatre*,
by Hodgetts + Fung, 1997. © Property of Hodgetts + Fung.
All Rights Reserved, 2016. 100 × 65 mm each, pen and ink drawing on paper.

Tandem: Human Art in Collaboration with Machine Intelligence

Harshit Agrawal
Arnav Kapur

Expression through art is core to our very being. From cave paintings that date back 40,000 years to modern digital media, we have explored an enormous variety of means of expression via the canvas. As much as art is about the internal drives and the expression of desire (and the desire for expression), it is equally about the tools used to create it and the media through which it is delivered. Art has always existed in a complex, continuously evolving relationship with the technological capabilities of a time. While some artists seek benefits from its advancements, others abstain from it to maintain traditional practices. Nevertheless, the inclusion of ever-changing technologies among the representative tools of successive generations is an inevitability.

Both artists and technologists have continuously experimented with their tools to amplify and explore the ideas they want to bring forth, be it creating chemical experiments on paint pigments or using code as a means of generating art. Also, the role that art plays in society has changed over time. With documentation as a primary purpose in earlier times, today's works of art could be said to exist predominantly to offer a plurality of lenses through which to view the conditions of modern life. In recent decades, it has evolved into a critical medium to generate discussions around how new technologies should be used and what potential impact they might have.

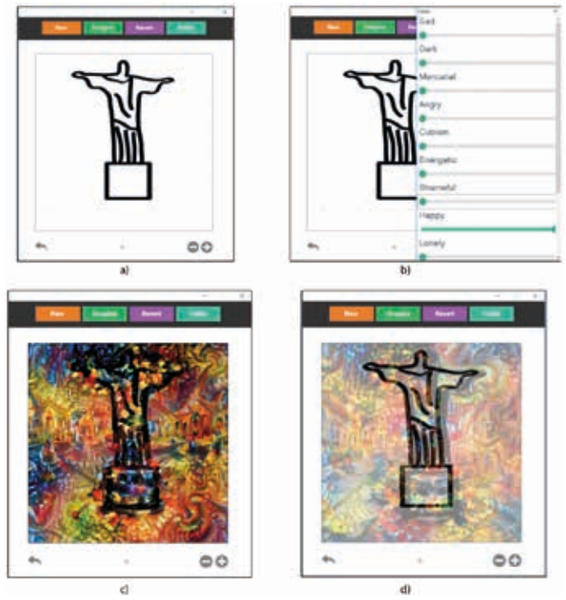


Fig. 1: Walk-through of the Tandem drawing tool. (A) The user sketches an input (top left). (B) The user can then choose the personality of the computer collaborator (CC) – 'happy' in this case. (C) The computer produces an output they imagine from the input sketch, as an analogue to collaboration with a real artist. Here the computer imagines a city surrounding the Christ the Redeemer statue, with the statue positioned at the centre of the setting (bottom left). (D) The user can then iterate over the initial sketch input based on what she/he perceives from this output.

Artificial intelligence (AI) itself is one area of research that has always been a rich source of discussion, reflection and prognostication about the future of humanity. It has acted as fodder for numerous filmmakers, writers and philosophers, most likely because the question of what it would be like to live alongside artificially intelligent beings is one which captures the imagination in both its uncanniness and its strong possibility. It is a deeply intriguing question, one which when thought about for any length of time leaves us inevitably trying to understand what it means to be human in the first place. Is it our irrationality, our sudden, unpredictable bursts of emotion, our ingenious creativity that cannot (yet?) be explained as a logical sequence of steps but rather feels magical – or really is it nothing special after all and in fact only a matter of time before its essence is captured and reduced to mere mathematical equations? From the earliest days of computing, there has always been this hope – in some sense, this greater purpose – among computer scientists to use computers to help understand ourselves better. Artificial intelligence has been seen as the path to this goal. AI itself as an area of research is as old as the first computers, if not older, and has had its peaks and valleys. However, possibly due to its dramatic appeal, AI has stayed firmly within the popular imagination.

The recent wave of AI advances shows tremendous potential. It is slowly and steadily becoming an integral part of our lives, with many exciting technologies – such as self-driving cars – just around the corner. As computers become equipped to perform relatively more complex tasks, the bigger questions around AI surface again – can computers be creative after all? Can they produce works of art like we do? In some sense, we have always held on to creativity as the last frontier of something uniquely human. Such questions have also emerged through various research breakthroughs that hint at the creative possibilities of AI. With AlphaGo beating the world master at the game of Go, these claims are growing stronger by the day. As computers became eerily good at identifying images, researchers at Google moved a step further from identification to creation, asking the computer to create images as well.[1] This gave birth to an internet sensation that caught everyone's attention: deep dream images. References to art, and to computers becoming creative or hallucinatory, started doing the rounds. These images looked wonderful and, as researchers from Google explained, they exploited the relationship between perception and creation – flipping the former to result in the latter.

When thinking about creating art with artificial intelligence, it becomes important to address what passes as art and what does not. Various philosophers have debated this within the context of machine-created art.

O'Hear dismisses the idea of machines originating art entirely, because art "in the full sense is based in human experience" and requires a communication between artist and audience drawn from that shared experience.[2] Similarly, d'Inverno et al. argue that "perhaps one way to identify what we mean by human creativity is precisely that which automation cannot do, so whenever AI systems improve it shifts our interpretation to whatever is not currently possible by machine". They suggest two broad AI directions for creativity, Heroic (fully autonomous) and Collaborative, arguing that art can benefit from the use of AI as a collaborative agent rather than it as a heroic one.[3] This understanding highlights the importance of designing collaborative and interactive systems for human-machine art processes, rather than designing a machine as an autonomous art agent. After all, tools are something that let us do what we are motivated to do in better ways, and that is precisely what AI's power can be. It is something that can vastly expand the spectrum of human art, allowing for creation of art that wouldn't be possible otherwise. The motivation for the artwork therefore remains human.

TANDEM

We explore this theme by building a system called *Tandem*, where a person's drawing or painting input is 'imagined' upon by a computer to suggest an outcome (Fig. 1). The human iterates over the sketch and the machine re-imagines, thereby indulging the two in a creative dialogue. This sort of relationship goes beyond the traditional use of a computer in an art process as an assistant. Here, the computer plays a deterministic role by 'imagining' what it sees within a human input and drawing along with it (Figs. 2–4). Therefore the user nudges the computer towards a direction and, owing to the vastness and non-deterministic nature of the deep neural network algorithm, the computer produces varied – sometimes unexpected – results. What is critical is that the motivation for the artwork is provided by the human(s), and this acts as a basis for the computer to offer its own interpretation and input. The user can tweak the personality of his creative collaborator as well, with access to a range of recognisable traits, such as angry, dark or energetic, as well as to artistic styles, such as cubism or impressionism, with the possibility of combining them to form different personalities. This personality assignment affects the outcome produced by the computer. In some sense, the AI engine Tandem therefore seeks to help humans explore different kinds of painting styles and personalities, creating room for serendipity and innovation.

SOFTWARE IMPLEMENTATION

Tandem's software implementation can be elucidated as sequential steps. The system is built as a series of modular deep learning methods superimposed upon human art in order to creatively combine them in an iterative manner (Fig. 5).

Fig. 2: Flower drawn using Tandem. The user drew an arrangement resembling a flower in the centre with bolder lines around the corners. The right image is the completed artistic output based on a 'happy' personality, built upon the user's initial sketch.

Fig. 3: Leaping wolf. A user's abstract drawing of a bold and stretched shape was imagined as a leaping wolf by the computer collaborator, demonstrating the capacity of unique additions by a CC to the creative artistic process.

Fig. 4: Trees imagined as dogs by Tandem. The initial intention of drawing trees was imagined to be dogs with large ears by the CC. In this collaboration, the direction of the final output was changed by the CC.

The first step in the pipeline is to find an approximate inverse of the image representation provided by the human artistic input. This is the first interaction between the human and computer, which captures the semantic comprehension of the human art. In our tool, we use the GoogLeNet model,[4] trained on ImageNet,[5] as our base convolutional neural network (CNN) that accepts human art as its input. These networks are comprised of a hierarchy of consecutive layers. The lower layers capture simple features like corners and oriented edges, while higher layers encode meaningful complex features like whole objects. The computer contributes new content to the input by amplifying the neurons in a specific layer that were activated most strongly by the input. We empirically chose a layer higher in the network to give object visualisations that were meaningfully complete with

respect to human inputs. This is the 'imagination' step, where the software creates its own contributions to the artwork. Because the system adopts its own persona based on initial human art inputs, bright colours will elicit a jovial response; amorphous shapes and a lack of human effort would make the computer contribute in a sombre manner; and rough strokes, for example, would signal hostility and the computer artist would in turn become aggressive.

To give the computer different personalities, we created a labelled dataset of images corresponding to different human emotions and artistic aesthetics. This repository acts as a source of artistic motivation for Tandem, so that the system takes up personality traits based on the inceptive human art or as determined by the human. The output of the 'imagination' step is passed through a CNN-based system,[6] modifying image inputs based on different emotions to create the output.

CONCLUSION

Tandem tries to challenge and tackle a different kind of artistry, expression and communication between the audience and the machine, mixing algorithm with affection, interweaving intentions with imaginations. With the rise of artificial intelligence and the general notion of machines taking over human activities prevalent throughout science fiction discourses and increasingly in mainstream culture, through Tandem we hope to give the audience a more utopian view of the future by engaging them with something that comes as naturally as drawing juxtaposed with the ultimate in artificiality: artificial intelligence.

1 "Google research inceptionism", accessed 12 July 2016, http://googleresearch.blogspot.com/2015/06/inceptionism-going-deeper-into-neural.html.
2 Anthony O'Hear, "Art and technology: An old tension" in *Royal Institute of Philosophy Supplement* (1995), 38, 143–158.
3 Mark d'Inverno & Jon McCormack, "Heroic versus Collaborative AI for the Arts" in *Proceedings of the 24th International Conference on Artificial Intelligence* (AAAI Press, 2015), 2438–2444.
4 Christian Szegedy, Wei Liu, Yangqing Jia, Pierre Sermanet, Scott Reed, Dragomir Anguelov [...] & Andrew Rabinovich, "Going Deeper with Convolutions", *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition* (2015) 1–9.
5 Alex Krizhevsky, Ilya Sutskever & Geoffrey E. Hinton, "Imagenet classification with deep convolutional neural networks", *Advances in Neural Information Processing Systems* (2012), 1097–1105.
6 Leon A. Gatys, Alexander S. Ecker & Matthias Bethge, "Image Style Transfer Using Convolutional Neural Networks", in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition* (2016), 2414–2423.

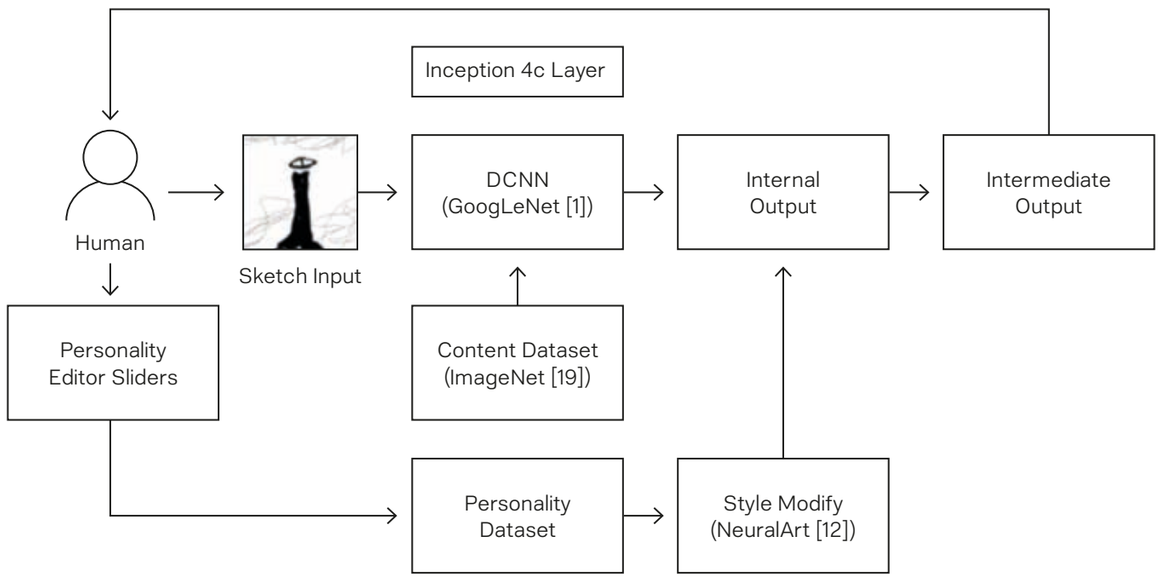


Fig. 5: Schematic. Tandem's software implementation can be elucidated as sequential steps. The system is built as modular deep learning methods.

Inscriptive Practice as Gesture

Ray Lucas

A PROVISIONAL TAXONOMY OF GESTURES

Modelling my argument after Flusser's collection of *Gestures* (2014), I propose to add a number of accounts that elaborate the gestures involved in various types of drawing. It is often unspoken or unnoticed that the role of the hand is quite different according to the various technologies used; in this instance, the definition of technology remains broad: pencil and paper constitutes a technology every bit as much as the latest PC running the latest software.

The exercise of cataloguing or producing a taxonomy is not a neutral one, of course – it consists of a series of judgments and decisions, an editing and selection. Like the archive, not everything is kept: some things are weeded out and discarded.

What is interesting in the technology of architectural drawing, however, is that each earlier iteration has an afterlife, an impact on the development of inscriptive practices where good solutions can be seen to persist. Iterative development is the order of the day, and revolutionary attempts to reimagine architectural representation are often held up as noble failures, as stable or curious forms of diagramming and notation which do not usurp the dominant conventions. The function of the drawing convention is, after all, that it is a common language, a shared understanding of what each line or combination of lines means. I should note here that drawing consists of more than lines, however much the literature might celebrate the line.

Elsewhere, I have asserted that the drawing is not an image.[1] If drawings are not images, then what are they? One answer is to understand the drawing as a record of a gesture. Not all gestures have the same aim, though, and it falls to media theorist Vilém Flusser to describe a great many human movements in his collection on gestures.

Flusser, writing on the gesture of painting, describes gestures as enigmas rather than problems:

> "One analyses problems to be able to see through them, and so to get them out of the way. Problems solved are no longer problems. One analyses enigmas to enter into them. Enigmas solved remain enigmas. The goal of an analysis of the gesture of painting is not to clear painting out of the way. Rather, it consists of entering into the *enigma* of painting more deeply so as to be able to draw a richer experience from it."[2]

Contrast this with his account of photographing (notably not photography):

> "A photograph is a kind of 'fingerprint' that the subject leaves on a surface, and not a depiction, as in painting. The subject is the cause of the photograph and the meaning of painting. The photographic revolution reverses the traditional relationship between a concrete phenomenon and our idea of the phenomenon. In painting, according to this tradition, we ourselves form an 'idea' to fix the phenomenon on the surface. In photography, by contrast, the phenomenon itself generates its own idea for use on the surface. In fact, the invention of photography is a delayed technical resolution of the theoretical conflict between rationalist and empirical idealism."[3]

The gesture of drawing is different again, offering greater precision at times than the enigmatic painterly gesture – while some of the best architectural drawing maintains this uncertainty and lack of prescription, offering a palimpsest of lines drawn, undrawn and suggested: dividing surfaces into those to be perceived as figure and those that are ground.

Further nuance in this definition of 'cause' and 'meaning' from Flusser helps with this discussion. Take, for example, the act of making a copy by using tracing paper. The drawing in this case has more in common with Flusser's description of the gesture of photographing: the source is copied selectively by placing tracing paper over the top of it and picking out lines. Sometimes all the lines are replicated, other times only some of them. The gestures involved in tracing are quite different to those of an original drawing. The trace is more definite, more assured, as there is a line to follow. The traced line is akin to Bergson's speculative problem.

THE GESTURE OF RULING

The ruler, the T-square, the set square and other tools allow us to produce certain kinds of lines. The manner of drawing with a ruler is significantly different to a freehand line. Too often this is results-driven, the apparent perfection of the ruled line compared with the imperfections and autographic nature of the unruly freehand line. To an extent, the origins of such tools can be traced to the medieval stonemason's templates, where knowledge of arches and complex geometry was jealously guarded. Turnbull (1993) and Shelby (1971, 1972) document the use of templates by stonemasons in the construction of these grand pieces of architecture, used both for inscribing into surfaces in a drawing action and for guiding the hand when cutting stone.

Practically, the ruling of a line necessitates a certain stability in the drawing surface. In the twentieth-century model, this would consist of a drawing board with parallel motion, T-square or drawing head. The mechanical drawing board is a large item, a tool requiring skilled operation in conjunction with the paper, pencils, pens and so on: it is simultaneously a *tool* and a *context* for drawing which generates a set of gestures.

Those trained in mechanical drawing will remember the difficulty in coordinating these movements at first, but eventually a fluidity is achieved. The gesture I would like to focus upon here is the gesture of making a mark according to a template, such as a ruler. The steadiness of hand is focused on maintaining a stable angle for the drawing instrument against the template; the speed of the mark is also steady, as is the pressure applied. The character of the ruled mark is evenness and consistency; altering the angle part-way through will cause imperfections in the line and applying greater pressure might cause brittle mechanical pencil lead to snap or a drafting pen to apply an unintentional spot of ink. The beginning and ending of such lines is therefore fraught and risky: some opt for a gradually increasing pressure, feathering the line at the beginning, and a corresponding decrease at the end; others might place the instrument definitely – a dot at the termini of the line; a convention which emerged was the extension of the line, a deliberate additional length to each line, giving corners a characteristic crossing of lines. An argument is made for the precision of such practices, but this is somewhat contentious.

Other forms of guide could fall into a similar category were the focus not on gestures. Graph and gridded paper, for example, are forms of template applied directly to the support, the paper. My own preferred drawing practice uses a dot-grid which effectively disappears from vision once there is something more interesting on the paper to look at. The gesture here is quite different from the ruled drawing, however, and is more akin to the freehand drawing despite the assistance in achieving accurate lengths, angles and straight lines.

THE GESTURE OF TRACING

Tracing is a related drawing practice, of course, owing much of its existence to the technologies noted for the gesture of ruling above. As an operation, tracing demands more attention, as it is a particular and notable set of gestures which help us to unpack that drawing is about *intention* as much as it is about the embodied action. One of the earliest references to tracing paper is about its preparation, in Cennino Cennini's *Craftsman's Handbook* (from the mid-fifteenth century), which instructs the reader to copy the artists with the best reputations, lest you pick up the bad habits of lesser artists by copying them.

The aim of tracing is to copy – in architecture, this is often used to select and edit, but all with direct reference to an existing drawing or other source. By reproducing the drawing, iterative alterations can be introduced, and it is in this feature that tracing finds its great utility within the design process.

Gesturally, tracing can involve more manipulation of the paper. It is essential to tape the paper to the board securely, with the tension in the paper ensuring that the layers beneath can be seen. With the appropriate weight of paper, one can see several layers down: paper is no longer a singular condition but something multiple, with depth and temporality embedded into it. Finding lines to follow is the first task of the gesture of tracing, followed by the decisions about which lines to keep and which to discard: again the metaphor of the archive, where only the essential elements are kept.

The key gesture is the drawing itself, following the line rather than determining it. By tracing blurs, for instance, the manner of the inscriptive practice is complicated, so that a traced drawing shifts constantly between speculative and creative acts.

When I draw observationally, I am selecting and editing, focusing on some qualities over others. Sometimes innovating and sometimes following a path, I move from Bergson's speculative problems to creative ones and back again throughout the course of a drawing. When I am not drawing, I am often thinking about drawing, constructing ideas for drawings I would like to do: planning or even dreaming them ahead of time without producing a fixed image or plan of work.

> "But the truth is that in philosophy and even elsewhere, it is a question of finding the problem and consequently of positing it, even more than of solving it. For a speculative problem is solved as soon as it is properly stated. By this I mean that its solution exists then, although it may remain hidden and, so to speak, covered up – the only thing left to do is to uncover it."[4]

The truth of Bergson's statement of speculative and creative problems is more nuanced when tested against an established practice such as drawing. One frequently moves from one mode to another, fluidly following and driving the process.[5]

Following is an important aspect of the gesture of tracing, and a key distinction drawn by Ingold with reference to navigation and wayfaring:

> "The maze-walker, we could say, is a navigator; the labyrinthine path-follower is a wayfarer. In the carrying on of the wayfarer, every destination is by the way; his path runs always in between. The movements of the navigator, by contrast, are point-to-point, and every point has been arrived at, by calculation, even before setting off towards it."

It is important to refute, once and for all, the commonplace fallacy that observation is a practice exclusively dedicated

Fig. 1: Photograph of tracing workshop held at the 'Knowing From the Inside Kitchen' event at Comrie Croft, Perthshire. Participants are tracing drawings by other workshop participants, varying the media used in order to interrogate the original drawings.

to the objectification of the beings and things that command our attention and their removal from the sphere of our sentient involvement with consociates. As should be clear from the foregoing, to observe is not to objectify; it is to attend to persons and things, to learn from them, and to follow in precept and practice."[6]

While in some instances Ingold uses 'wayfarer' as a pejorative here, rather than 'navigator', I argue that these modes co-exist much more happily within drawing practices, offering two poles for a spectrum of responses. Each mode of inscriptive practice occupies multiple positions within this overall territory, shifting according to the phase of practice engaged in at any given point (Fig. 1).

THE GESTURE OF INKING

A footnote to the gesture of tracing is the gesture of inking. Another *following* practice, the gesture of inking still has some flexibility and possibility for editing. Simply stated, inking is the selection of which lines drawn in a lighter medium such as pencil are to be retained. Additional prominence and permanence is given by the application of ink to the surface (Fig. 2).

THE GESTURE OF SKETCHING

Sketching fulfils a range of purposes from collection[7] to preparatory work for a more substantial piece. The writer Nelson Goodman tackles the topic of sketching within a tripartite framework of score, sketch and script in his work in *Languages of Art*.

> "Because a painter's sketch, like a composer's score, may be used as a working guide, the crucial difference in their status may go unnoticed. The sketch, unlike the score, is not in a language or notation at all, but in a system without either syntactic or semantic differentiation."[8]

This linguistic analogy runs through Goodman's work on art and the graphic practices used in the production of artworks. Here, he notes that sketching has a more confused relationship to this language-based structure, and that – unlike notations, which have a clarity of communication – sketches are internal processes: intended largely for the sketcher themselves rather than an external audience. That sketches can sometimes be understood by others is interesting, and something to be discussed, but the original intention of many sketches is to understand something, develop an idea and otherwise to think.

Sketching is not a standardised activity with rules common from one practitioner to another.

> "In short, the sketch – as a sketch – differs from the score not in functioning as a character in a language of a different kind but in not functioning as a character in a language at all. The notational language of musical scores has no parallel in a language (notational or not) of sketches."[9]

Goodman, as an aside, exhibits a useful way of considering any form of representation you might want to analyse. That is, to form a comparison between that kind of drawing or mapping or whatever else, and some stable form of practice you know well and can understand the qualities of. By comparing sketching to musical notation,[10]

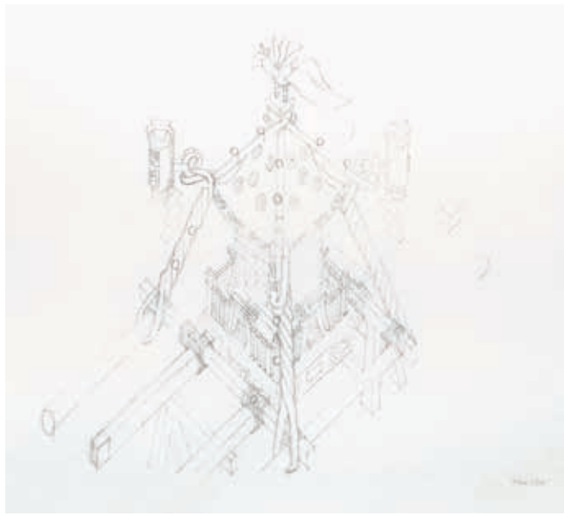


Fig. 2: As yet uninked drawing from the *Graphic Anthropology of Sanja Matsuri* series.

we instantly form an understanding about something we might easily take for granted. Sketching is so familiar to us that we do not question it, but it is interesting to really consider what it is that we do when we decide to take a pencil or other inscribing tool and make marks on a surface. This act, where we can translate something observed into a series of lines and tones on a piece of paper, is a complex activity requiring a vast apparatus of understanding, artifice and transfiguration from a lively scene of real life to a captured image.

The differences in Goodman's thinking between these inscriptive practices can be expressed as belonging to either the autographic arts or the allographic. Autographic arts are simply those where the work of the original hand is necessary, where an exact replica of the work does not stand for the work in any way and is considered a forgery. This is a complex issue, but is further illuminated by Goodman's example:

> "Let us speak of a work of art as autographic if and only if the distinction between original and forgery of it is significant; or better, if and only if even the most exact duplication of it does not thereby count as genuine. If a work of art is autographic, we may also call that art autographic. Thus painting is autographic, music nonautographic, or allographic."[11]

This distinction is not used to make a judgment on the relative merits of one form of art over the other; the performance-based arts represented by Goodman's allographic arts are every bit as valid as the autographic arts. The manner in which the distinction is measured by Goodman is, however, curious, and throws up one of the interesting inconsistencies in his argument. This inconsistency far from invalidates his argument, but rather complicates and makes it interesting.

The case of the architectural drawing can be considered as both/either allographic and/or autographic in nature. An original drawing by the hand of a famous or influential architect is inherently valuable in a way that a reproduction of it is not. The autograph: the quality of that individual's handiwork is present in the drawing. This aura of the original persists despite the intention behind that drawing, which is often allographic. The allographic nature of the drawing relates to it being a set of instructions for the construction of a building.

What of the gestures inherent to sketching? These are open and varied, arguably to a greater degree than other modes of inscriptive practice, but an internal consistency remains important. A family of marks and gestures are used in the sketch as a form of internalised communication. The sketch is often produced without the implied audience of other drawings, allowing for shortcuts and efficiencies that might render it impossible for others to read. The internal consistency allows each sketch to compose its own logic, a logic that might not necessarily apply to the next sketch in a series.

THE GESTURE OF ERASURE

Often overlooked in treatises on drawing and related to the elision of lines within tracing practices is the process of erasing lines. Tools for this include the eraser – various types of which can be used for different media – and also the scalpel blade to scratch inked lines from paper. It is not until digital drawing becomes widespread that erasure becomes complete: the erased line leaves no trace or mark; even the chain of 'undo' actions is limited to a certain number of actions once another branch of decisions are taken.

Related to erasure is masking. More common in painting practices such as watercolour, the eraser becomes a tool of the drawing itself here, removing a shaded ground through a mask or shield in order to produce a mark: a negative mark, but a mark nonetheless. As such, the gesture of erasure here refers to the intention to remove marks rather than the production of a mark by using an eraser.

In practical terms, the erasing instrument is rarely as accurate as the drawing instrument – and more than intended might be erased, leading to repair work on the lines that were unintentionally removed. Erasing a mark denies its existence and validity within the overall scheme, representing everything from a simple mistake or slip of the hand through to changed plans and altered intentions. This reinforces the idea of drawing as a process of selection, as a temporal and spatial more than a visual phenomenon.

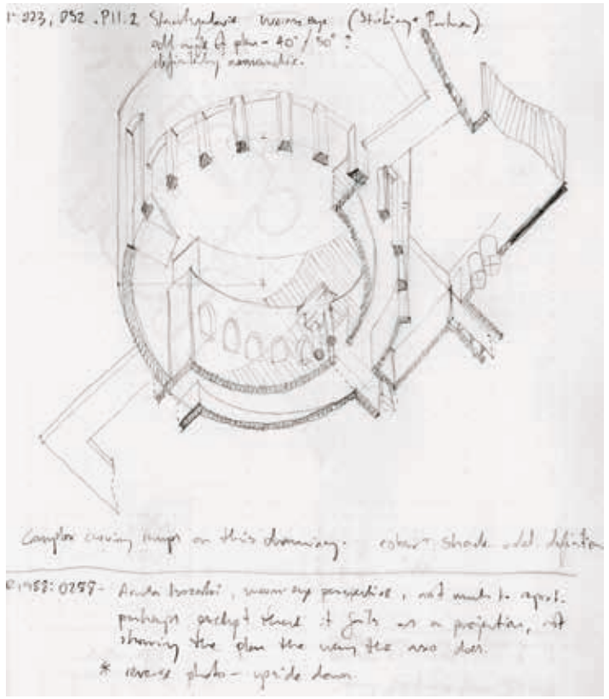


Fig. 3: Drawing from *Drawing Parallels: Knowledge Production in Axonometric, Isometric and Oblique Drawing*.

CONCLUSION: DRAWING AS PERFORMANCE

If a drawing is a record of a gesture, then that set of gestures can be understood as a performance. Whether in public, for an audience, or the architect drawing in front of their client as a way of communicating and describing an intention, the sequence of acts that constitute a drawing are performed.

Where a score is present (and performance suggests a script of some sort), this can give instructions which govern the performance, allowing variations within a set of parameters. This could be Ruskin's exercises for drawing, my own notations describing a drawing or any number of fine art practices. This could include drawings I copied at the CCA[12] or the artefacts I drew in a visit to the British Museum.[13]

Performance can suggest dance, particularly the professionalised dance designed for an audience to appreciate within a theatrical setting. The Russian filmmaker Sergei Eisenstein himself makes this connection in his essay 'How I Learned to Draw (an essay on my dancing lessons)'. Published by the NY Drawing Centre in a collection of Eisenstein's sensuous and mystical drawings, he describes drawing and dancing as being "branches of the same tree".[14] The gradual transformation from learning steps in order towards learning the response and interaction involved in dancing are most instructive here.

In many ways, a parallel practice can found in the practice of improvisational dance described by Maxine Sheets-Johnstone:

> "In view of its unique appearance, it is not surprising that a dance improvisation is commonly described as an unrehearsed and spontaneous form of dance. What is not commonly recognised, however, is that that description hinges on the more fundamental characteristic suggested above, namely, that in a dance improvisation, the process of creating is not the means of realising a dance; it is the dance itself. A dance improvisation is the incarnation of creativity as a process."[15]

Sheets-Johnstone's concept of thinking in movement is crucial to any study of drawing and, as a result, the design process itself. The description of improvisational dance given above could easily refer to the close integration of drawing with the architectural design process. Thus, the process of creating is not the means of realising a design; it is the process of design itself – to draw is to design. In this way, thinking in movement is understood not as the transcription of a pre-formed mental image, but instead "thinking is itself, by its nature, kinetic"[16]

Further work in this field brings the argument back to actual human bodies rather than the kind of theory that finds presence, movement and actual people too messy, preferring to abstract us out of the picture entirely. A call to arms on this is made in strong terms by Brenda Farnell:

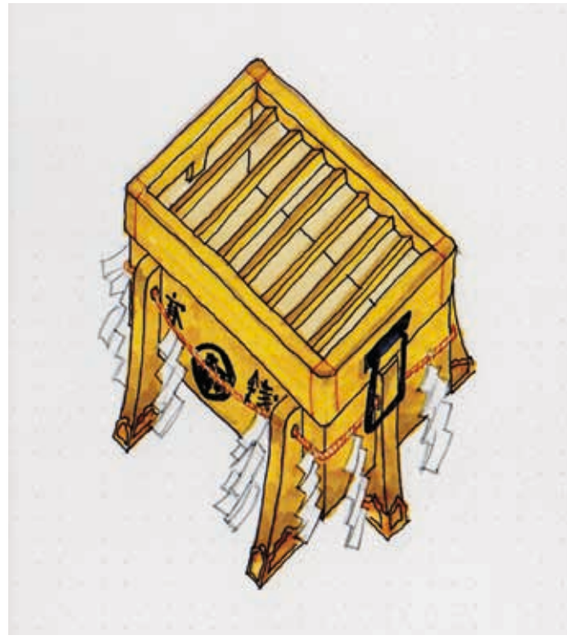


Fig. 4: Drawing from *Graphic Anthropology of Namdaemun Market, Seoul*.

> "Central here is the idea that the way human agency works is in terms of the signifying enactments of moving persons. This position is commensurate with Ingold's dwelling perspective (2000) and his use of Gibson's environmental theory of perception (1966, 1979). The varied discursive practices that constitute meaning-making processes (semiosis) are performatively grounded in, and conventionally a structuring of, a suitable region of the mindful body that serves the purposes of socio-cultural living – such regions as the mouth and lips in speech, the hands in sign languages, and the whole body in forms of dance, ceremony, or practical skills of various kinds (Farnell, 1999). The human actions that constitute speech-act systems, action-sign systems, and any other form of semiosis are the creative outcome of a primary generative act – signifying enactments from the body (Farnell, 1999; Williams, 2003). While Csordas proposed a paradigm of the experienced body, for the 1990s, Williams, Varela and I are proposing a paradigm of the moving body for the beginning of the twenty-first century."[17]

Defining what drawing is or can be is a more fruitful way to proceed. Institutions from London's V&A Museum to the Drawing Centre in New York struggle with pinning this down, of course, veering from the vagueness of 'works on paper' to a wide-ranging discussion of the various intentions which lie behind an assemblage of lines.

My research agenda addresses one possible approach. Dealing with a range of inscriptive practices, I discuss the idea of what qualities each practice possesses at length. Nelson Goodman is increasingly important as I continue to work in this area: his clear-minded descriptions of

scripts and scores, allographic and autographic marks serve as a model for how to describe, rather than as stable categories which I would subscribe to unswervingly. The conclusion is that any given inscription can simultaneously possess a range of qualities, speaking to different audiences according to their knowledge and ability to understand each quality. Thus, an architectural drawing can have an aesthetically pleasing pictorial quality at the same time as being a set of instructions: a notation for the construction of a building.

Recent projects have brought me back to drawing more consistently.

Most of the attention in architectural drawing literature is spent on the emergence of perspective or the dominant modes of orthographic projection of plan, section and elevation. Axonometric, isometric and other forms of oblique or parallel projections are the poor relations, however. My mode of inquiry is to copy and to redraw. Spending several weeks in the Canadian Centre for Architecture's library and drawing collection, I selected works by twentieth-century architects who had made distinctive uses of parallel projection. Through careful copying, redrawing, retracing the steps, I found that my understanding was enhanced enormously through this act of retracing, re-enacting. That is not to say that I could place myself entirely into the context in which each drawing was made, but a deeper understanding is possible through practising the relevant form of knowledge production: drawing.

I am also producing drawings as forms of *graphic anthropology*, a deliberate play on visual anthropology that prefers lens-based media to the neglect of drawing, diagramming, mapping and notation. Recent visits to Tokyo have been timed to coincide with the Sanja Matsuri, a three-day festival in May which involves a vast disturbance to the everyday life of the Asakusa district of the city. The festival involves a constellation of temporary and mobile structures, the most celebrated being the *mikoshi* – portable shrines which are boisterously carried through the streets; the effort and weight involved giving a real practical presence to this radical and traditional architecture. Drawing is an important way of understanding the spatial implications of this event and its various stages, so the project will include a series of axonometric drawings, long sections and Laban movement notations.

A similar *graphic anthropology* is also underway to describe Namdaemun Market in central Seoul: another socially produced space with a great many lessons for architects.

Fig. 5: Drawing from *Graphic Anthropology of Sanja Matsuri, Tokyo.*

[1] Ray Lucas, "Why a Drawing is not an Image (and why that might not be a problem)" in *Beyond Perception*, edited by Peter Loovers et al. (London: Routledge, publication forthcoming).
[2] Vilém Flusser, *Gestures*. Translated by Nancy Ann Roth (Minneapolis: University of Minnesota Press, 2014), 65.
[3] Ibid., 72.
[4] Henri Bergson, *The Creative Mind: An Introduction to Metaphysics*. Translated by Mabelle L. Andison (New York: Citadel Press, 1992), 51.
[5] Ray Lucas, "Towards a Theory of Notation as a Thinking Tool" (PhD diss. University of Aberdeen, 2006), 169.
[6] Tim Ingold, *The Life of Lines* (London: Routledge, 2015), 133 and 157.
[7] Ray Lucas, "The Sketchbook as Collection: a Phenomenology of Sketching" in *Recto-Verso: Redefining the Sketchbook*, edited by Angela Bartram, Nader El-Bizri and Douglas Gittens (Farnham: Ashgate, 2014).
[8] Nelson Goodman, *Languages of Art*. (Indianapolis: Hackett Publishing Company, 1976), 192.
[9] Ibid., 194.
[10] In Ray Lucas, "Taking a Line for a Walk: Flânerie, Drifts, and the Artistic Potential of Urban Wandering" in *Ways of Walking: Ethnography and Practice on Foot,* edited by Tim Ingold & Jo Lee Vergunst (Farnham: Ashgate, 2008); and Ray Lucas,"Gestural Artefacts: Notations of a Daruma Doll" in *Fieldnotes and Sketchbooks: Challenging the Boundaries Between Descriptions and Processes of Describing,* edited by Wendy Gunn (Oxford: Peter Lang Publishers, 2009).
[11] Nelson Goodman, *Languages of Art* (1976), 113.
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[13] Ray Lucas, "The Sketchbook as Collection: a Phenomenology of Sketching", 2014.
[14] Catherine De Zegher (Ed.), *Drawing Papers 4: The Body of the Line: Eisenstein's Drawings* (New York: The Drawing Centre, 2000), 26.
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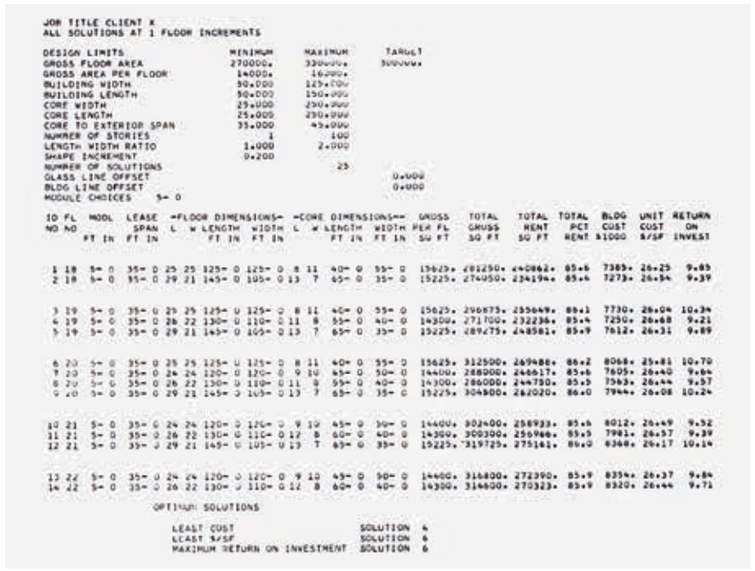
Data Dreams: The Computer Group and Architecture by Spreadsheet, 1967–84

Ann Lui

In 1967, Skidmore, Owings & Merrill's Chicago office was asked to design an office building near the city's international airport.[1] "A client came [...] with a funny request," said David Sides, an architect who worked there at the time.[2] "He had just bought a piece of property near O'Hare airfield. His requirement was a building that could be built on that site to give a maximum return on [his] investment. He had no other requirements." Restricted only in height because of the airport's fly zone, the project was otherwise a blank slate: the client had no opinions on architectural form, only on his financial return. SOM took this almost unexpectedly simplistic problem to its in-house architects-turned-programmers, a team nicknamed 'the Computer Group' that Sides led in the San Francisco office. Was it possible to design a building on cost parameters alone? "We [...] quizzed architects in the Chicago office," Sides said about the Computer Group's response to the O'Hare problem, "on how they went about estimating usage, estimating return. How did they go about deciding what a building was worth, what they could build on the lot, what clients wanted, and what [would] it cost?"

The Computer Group's solution to the problem, after a four-week research blitz, was a 'crude'[3] computer application that they called the Building Optimization Programme (BOP).[4] Text-based, without graphic interface, run on IBMs the size of refrigerators, BOP operated on a simple premise. "The practical problem of building design can be formulated, in a general way, *as an optimization programme*," wrote G. Neil Harper, who collaborated with Sides on the project, in a conference paper on the programme.[5] BOP's authors drew from SOM's tall building expertise and developed a programme that hinged on four key financial factors: structure, exterior wall, mechanical system and elevators. For any given site and project, the cost relationship of these four variables could be explored through automatically generated alternatives. For example, in-house architects estimated that the increasing size of window wall openings resulted in higher HVAC costs. BOP codified this relationship, and others, into its algorithms. The programme would return a range of results, including a literal bottom line: 'Optimum Solutions' listed options for the lowest overall cost and the maximum return on investment (Fig. 1).

BOP is a quintessential example showing the significance of these early computational research programmes at SOM, both for its holistic aspirations as well as for its impact on the office's production. The Computer Group, a team which spanned across SOM's offices but focused in Chicago, was the name given to a studio of architects and systems engineers working intermittently between 1963 to 1986, with different leaders and members through the years.[6] In this period, before the widespread commercial availability of drafting software, large architectural firms, including SOM, undertook their own research on computer integration.



JOB TITLE CLIENT X
ALL SOLUTIONS AT 1 FLOOR INCREMENTS

DESIGN LIMITS	MINIMUM	MAXIMUM	TARGET
GROSS FLOOR AREA	270000.	330000.	300000.
GROSS AREA PER FLOOR	14000.	16000.	
BUILDING WIDTH	90.000	125.000	
BUILDING LENGTH	90.000	150.000	
CORE WIDTH	25.000	290.000	
CORE LENGTH	25.000	290.000	
CORE TO EXTERIOR SPAN	35.000	45.000	
NUMBER OF STORIES	1	100	
LENGTH WIDTH RATIO	1.000	2.000	
SHAPE INCREMENT	0.200		
NUMBER OF SOLUTIONS		25	
GLASS LINE OFFSET			0.000
BLDG LINE OFFSET			0.000
MODULE CHOICES 5= 0			

ID NO	FL NO	MOD FT	IN	LEASE SPAN FT	IN	FLOOR DIMENSIONS L	W	LENGTH FT	IN	WIDTH FT	IN	CORE DIMENSIONS L	W	LENGTH FT	IN	WIDTH FT	IN	GROSS PER FL SQ FT	TOTAL GROSS SQ FT	TOTAL RENT SQ FT	TOTAL PCT RENT	BLDG COST $1000	UNIT COST $/SF	RETURN ON INVEST
1	18	5=	0	35=	0	25	25	125=	0	125=	0	8	11	40=	0	55=	0	15625.	281250.	440862.	85.6	7385.	26.25	9.65
2	18	5=	0	35=	0	29	21	145=	0	105=	0	13	7	65=	0	35=	0	15225.	274050.	234194.	85.6	7273.	26.54	9.39
3	19	5=	0	35=	0	25	25	125=	0	125=	0	8	11	40=	0	55=	0	15625.	296875.	259649.	86.1	7730.	26.04	10.34
4	19	5=	0	35=	0	26	22	130=	0	110=	0	11	8	55=	0	40=	0	14300.	271700.	232236.	85.4	7250.	26.68	9.21
5	19	5=	0	35=	0	29	21	145=	0	105=	0	13	7	65=	0	35=	0	15225.	289275.	248581.	85.9	7612.	26.31	9.89
6	20	5=	0	35=	0	25	25	125=	0	125=	0	8	11	40=	0	55=	0	15625.	312500.	269488.	86.2	8068.	25.81	10.70
7	20	5=	0	35=	0	24	24	120=	0	120=	0	9	10	45=	0	50=	0	14400.	288000.	246617.	85.6	7605.	26.40	9.84
8	20	5=	0	35=	0	26	22	130=	0	110=	0	11	8	55=	0	40=	0	14300.	286000.	244750.	85.5	7563.	26.44	9.67
9	20	5=	0	35=	0	29	21	145=	0	105=	0	13	7	65=	0	35=	0	15225.	304800.	262020.	86.0	7944.	26.08	10.24
10	21	5=	0	35=	0	24	24	120=	0	120=	0	9	10	45=	0	50=	0	14400.	302400.	258933.	85.6	8012.	26.49	9.52
11	21	5=	0	35=	0	26	22	130=	0	110=	0	12	8	60=	0	40=	0	14300.	300300.	256966.	85.5	7981.	26.57	9.39
12	21	5=	0	35=	0	29	21	145=	0	105=	0	13	7	65=	0	35=	0	15225.	319725.	275161.	86.0	8366.	26.17	10.14
13	22	5=	0	35=	0	24	24	120=	0	120=	0	9	10	45=	0	50=	0	14400.	316800.	272390.	85.9	8354.	26.37	9.84
14	22	5=	0	35=	0	26	22	130=	0	110=	0	12	8	60=	0	40=	0	14300.	314600.	270323.	85.9	8320.	26.44	9.71

OPTIMUM SOLUTIONS

LEAST COST	SOLUTION 4
LEAST $/SF	SOLUTION 6
MAXIMUM RETURN ON INVESTMENT	SOLUTION 6

Fig. 1: *Overall Summary of Computer-Generated Solutions, Building Optimization Programme,* from G. Neil Harper, 'BOP – An Approach to Building Optimization.' Credit: G. Neil Harper, 'BOP – An Approach to Building Optimization', ACM Press, 575–83. doi:10.1145/800186.810621.

Fig. 2: O'Hare Plaza seen from the highway.

The potent dreams for computation in this moment reflected SOM's emergence as a logistics-driven corporate practice and its hopes for a future that would be optimised and bolstered by computer automation. "A building is a 3D spreadsheet," posited the Computer Group.[7] O'Hare Plaza, completed in 1970, manifested as a group of three stark concrete structure buildings, one 10-storey and two 4-storey, with regular openings. This first building executed with BOP, for a client whose sole interest was in the figurative bottom line represented SOM's first foray into a dream of architecture by bits. When passing the building on the highway to the airport from Chicago, it is easy to overlook, its form almost a caricature of the mundane office building (Fig. 2). Yet it is in fact the epitome of such projects – O'Hare Plaza's calculated shape, facade and floor plan was the first output of BOP, a seemingly innocuous text-based computer programme developed in search of the most cost-effective commercial architecture.

Of course, BOP's authors and users were aware of its limitations – of its reduction of architectural design to four numerical variables. Nonetheless, the reach of BOP in the Chicago office of SOM was wide. Any office building designed by SOM's Chicago office between 1968 and 1990 included a BOP analysis,[8] including projects as outwardly dissimilar as the iconic Hancock Centre (1965) and One Shell Plaza (1971) (Fig. 3).[9] Yet what they both share is the efficient layout of the central core, the window wall and the regular structure: features grounded in BOP's variables. Throughout this period, rising in the city centres of dozens of large cities in America and abroad were structures of glass and steel, elevated off ground level by a tall lobby, then unrolling as a repetitive orthogonal grid of disappearing curtain wall modules, fading into the sky. SOM's commercial office buildings became the firm's calling card, drawing both praise and critique for their ubiquity. What drove the shape, form and organisation of these buildings?

During this period, SOM went through a profound internal change within the office as it integrated computers into the drafting room. This change manifested itself in the outside world in the buildings the office designed; O'Hare Plaza's stark form that was authored, in part, by a digital application is a visible case. The effect of this early, experimental integration of computers into SOM also went beyond BOP and the office building: in terms of the internal changes it initiated, pioneering and also heralding changes across the industry in the years to come. The research-driven work of the Computer Group at SOM during this period is a unique case study into the firm, one which is often marked by historians as the quintessential corporate office – a relatively new type of practice at the time that has now come to dominate the contemporary landscape. The emergent logistics-driven architectural practice of SOM was, in a way, both indexed and formed by the work of the Computer Group, including these designers-turned-programmers' attendant hopes for a prosthetically enhanced architect; total building simulation and evaluation; and the potential for interdisciplinary synthesis aided by computation.

"A WILLING AND CAPABLE PARTNER": SOM AND THE COMPUTER

In 1968 and 1969, two significant conferences took place on computer integration in architecture: the first broadly attended, the second behind closed doors. The first, in April 1968, was a public gathering at Yale University on the topic of 'Computer Graphics in Architecture and Design' and represented a cross-section of industry leaders in research, industry and practice. The second conference, a year later in March 1969, was a private, invite-only affair: a strategic planning meeting held by SOM leadership. Originally called the 'Sterling Forest Meeting', this SOM meeting became jokingly known by its attendees as the 'Appalachian Conference' after the eponymous scandalous summit of the American Mafia, revealed to the FBI a few years previously.[10] In attendance at both Yale and Sterling Forest was SOM's design partner Bruce Graham, who first supported the development of new applications for architectural use at the office. The Yale presentation was a public proclamation of Graham's

intentions for computer integration at SOM; the Appalachian Conference a moment that represented an internal reckoning with the tumultuous transformation. These two conferences set the backdrop against which the Computer Group rose in prominence.

The 1968 Yale Conference was organised by Murray Milne, an architect and professor, to discuss a "potential [...] fantastic"[11] future at hand. The discussion of this future included promises of speedier, more cost-effective production of architecture and also 'softer' topics like the role of automation in design, its democratisation and the benefits to the city. Invited to speak at the conference were those who in the following two decades would have a crucial role in the development of computer graphics. From its origins in a back room at the Lincoln Lab, computer graphics would travel into a host of adaptations and applications used in a variety of fields, and ultimately land squarely in the centre of the architect's office. A sense of excited anticipation pervaded Milne's introductory text to the conference proceedings. "The computer," he wrote, "is a [...] potentially willing and capable partner."

The conference in the "creaking lecture hall"[12] at Yale represented broader shifts outside its walls. Soon-to-be-giant corporations like Digital Equipment Corporation (DEC), Tektronix and IBM were mobilising to develop commercial applications of military technologies to be more suitable and desirable for office use. Nicholas Negroponte and his team at MIT were finishing *The Architecture Machine,* exploring the consequences of human-computer interaction.[13] Outside the US, the engineering firm of Ove Arup was using computer programmes to process structural calculations for Jorn Utzon on the Sydney Opera House's curving shells. Massive early computers were carted into the drafting room to perform tasks that ranged from personnel management to heavy-duty structural calculations to the design of architectural forms. Large architectural practices with fiscal resources to make long-term investments were going through a similar period of computational experimentation.

In the 1960s and 1970s, computer applications for architectural practice as we know them now – massively available, commercially priced and available for personal computers – did not yet exist. Yet architecture firms, especially those large enough to take financial risks, were beginning to independently investigate their possible use. Caudill Rowlett Scott (CRS), a Houston-based firm, began by using computers for management and accounting in 1965, taking advantage of systems developed for general office use.[14] The office also formed the 'Computing Research Systems 2' (CRS2) that developed a suite of applications for in-house use and for sale, including streamlining cost analysis, project scheduling and equipment specifications. Hellmuth, Obata + Kassabaum (HOK) also developed a range of applications for internal use and for sale.[15] Other large firms also produced applications for their own use: this included Jung/Brannen, DMJM, TAC and Albert C. Martin & Associates. Employees with computer expertise cross-pollinated information and ideas: informally – such as over drinks[16] – and when, as valuable assets, they switched employers and moved between these offices.[17]

SOM was unique, however, in its development of software like BOP that drew from its existing expertise in commercial office buildings and then transformed that knowledge base through computing. In 1968, when the Yale Conference took place, SOM was already underway with its own research. Bruce Graham's presentation at the conference gave the audience a background for SOM's involvement with computers. Work was up, Graham said, pushing the office to the size of 450 people, not just employing architects but also diversifying through the hiring of specialists like "'planners', 'traffic analysts', 'hospital and equipment specialists' and 'furniture designers'".[18] The size of contracts and the scale of projects themselves had been increasing as well, and the firm was responsible for $500 million in yearly construction costs. Yet the office was wrestling with this exponential growth. Graham found that his search for a more highly trained and educated workforce was not enough; consequently, the office turned to a new worker: the computer. SOM was ready to "make the transition from the traditional practice of architecture to the methodology of the future".[19]

In practice, this meant the acquisition of new key people at the office who shared Graham and Fazlur Khan's vision, as well as early testing of how the computer could be integrated into existing processes. G. Neil Harper, hired in 1964, had previously worked at IBM as a liaison to SOM. In the mid-1960s, E. Alfred Picardi, the head of the Structures group in the Chicago office, and Khan led the deployment of computers for structural engineering, including on the Brunswick Building, Chicago (constructed 1965), where it was used for checking manual calculations.[20] Picardi and Khan worked to advance the use of computers in-house in their calculations for the structure of the tapering John Hancock Centre in 1965.[21] The computer was integral to Khan's structural design for Hancock; consequently, its potential grew. When Harper left in 1968, Lavette Teague was hired, who had a background in systems engineering at Rust Engineering, as well as degrees from MIT in related fields.

However, despite Graham's show of a united front at Yale, within the office the path towards computer integration was not so clear. Walter Netsch, a design partner in the Chicago office, had tried to deploy computers in the design of the Air Force Academy in Colorado Springs (1963), but found them lacking. "I sort of hemmed and hawed," Netsch said about computer integration, "because after the Academy – and it didn't work for me then – I didn't see any relevance to spending a million dollars for the work I was doing."[22] A faction within the office was skeptical about the pay-off for computer integration: notes from SOM at the time suggest resistance was based in concerns about the economic return of such a venture, and also a more vague

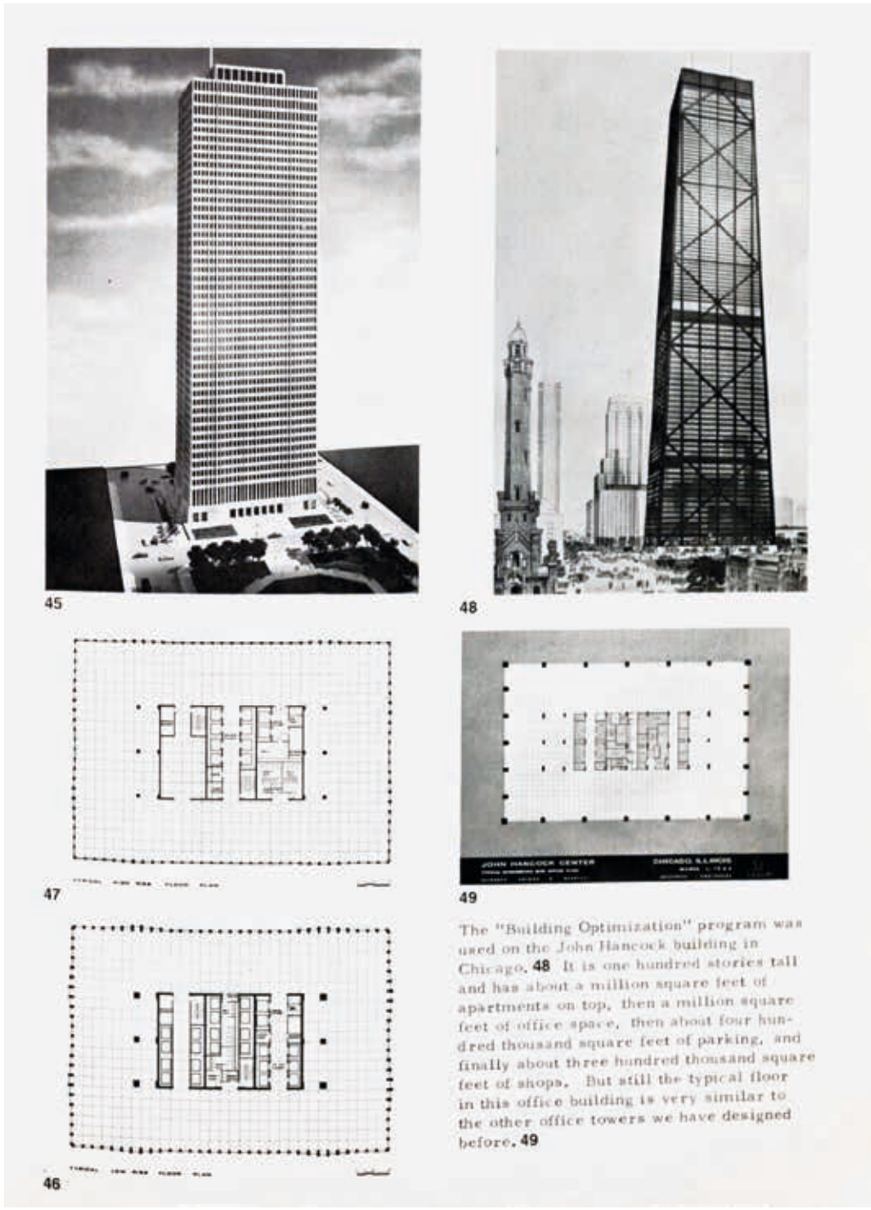
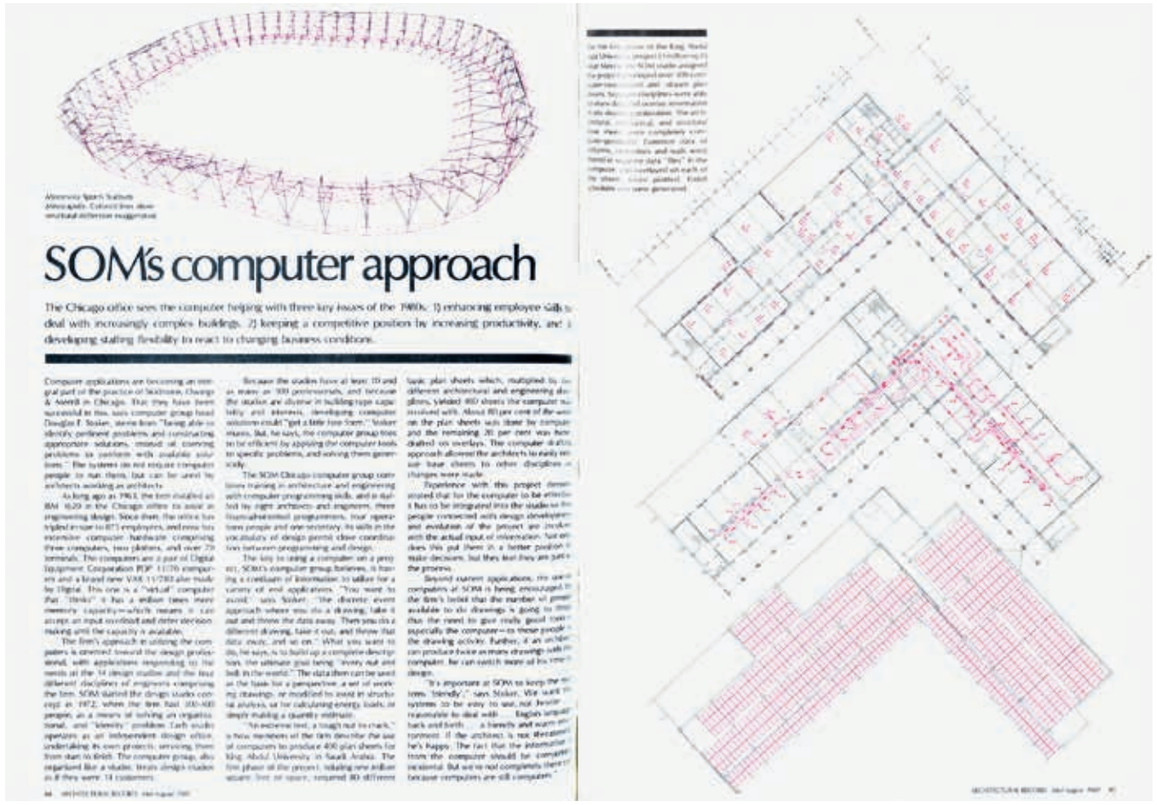
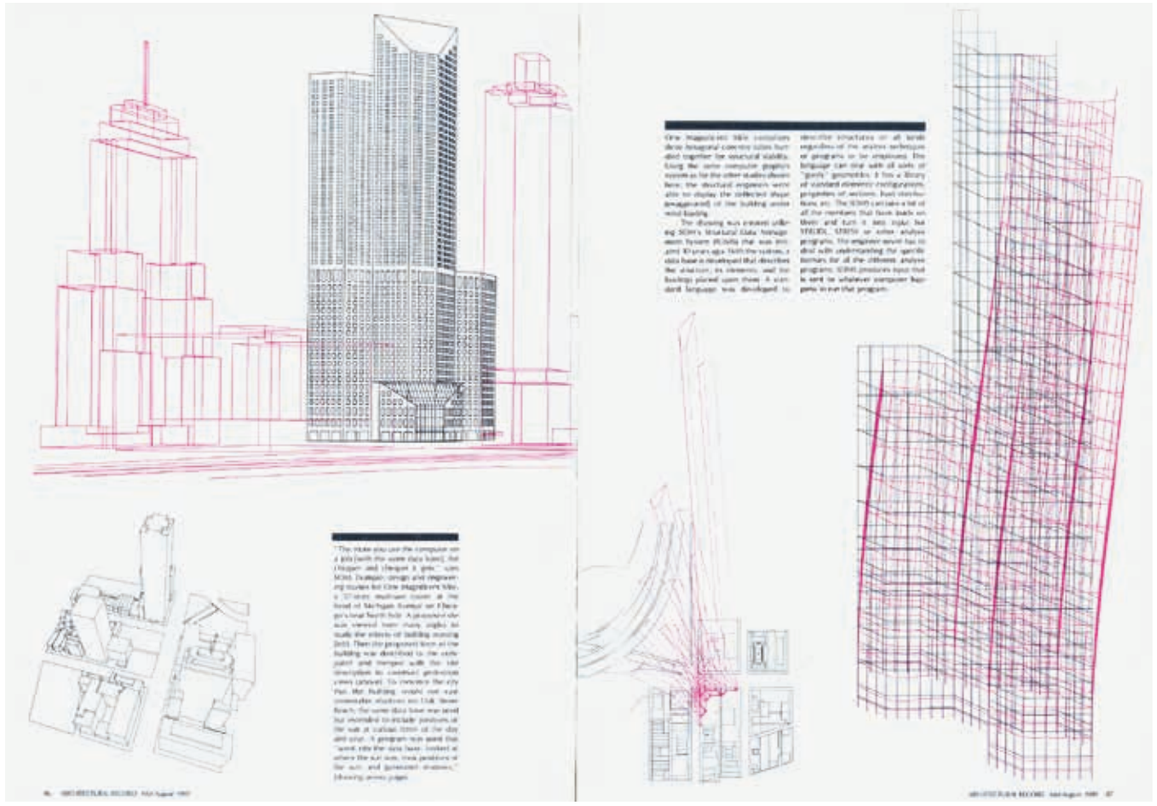


Fig. 3: From Bruce Graham's 'Computer Graphics in Architectural Practice' *Hancock Centre and One Shell Plaza.* Credit: Conference on Computer Graphics in Architecture, Milne. 'Computer Graphics in Architecture and Design: Proceedings'. Yale School of Architecture, 1969. Drawings: © Skidmore, Owings & Merrill LLP (46, 47, 49). Rendering: Helmut Jacoby (48).





anxiety that the "automation of physical functions [...] would not improve appreciably the decision-making or design process".[23]

Recognising the need to reckon with the advance of computers in architecture, the year after the Yale Conference, SOM convened the Appalachian Conference in an IBM research facility in Sterling Forest, NY. The conference is now cited as "architecture, engineering and the construction industry's first strategic technology planning session".[24] Very little documentation of this conference is available.[25] "The partners listened [and] had their own private discussions," Sides said of his memory of the event. "They never published any result(s)."[26] Yet an early memo from Lavette Teague to the participants of the Sterling Forest meeting, dated 28 February 1969, about one month before the conference, reveals the scope of the ideas discussed:

> "The first task is more than a matter of computer programmes and hardware, although it assumes a central role for the computer. It involves a fundamental redesign of our entire design process in relation to current and foreseeable information processing technology [...] Implicit in a different kind of design process are different kinds of personnel, procedures, and organization. The required information system must facilitate control not only over the result of the design process, but over the process itself."[27]

Teague's note to the participants makes clear the stakes of the Appalachian Conference: not simply the logistics of integrating the computer into SOM's office, but a total rethinking and reorganisation of the way the firm practised architecture, based in the handling and communication of information.

Those attending the Appalachian Conference, based on Teague's memo, were a combination of key members from SOM's leadership and relevant experts or industry representatives brought in to brief those from the firm. From within the office, the attendees included John Merrill,[28] as well as Bruce Graham and Fazlur Khan – the Computer Group's two champions. The list of the experts to present to the partnership represented a cross-section of industry and in-house expertise. These included Steven Lipner, a civil engineer from MIT who had been the project manager of COGO, a project developed by MIT's Charles L. Miller to handle geometric calculations used by surveyors. Also present was Jack Sams, a representative from IBM, a company which had an interest in selling 'timeshare' rentals of computer equipment to SOM as well as learning what kind of needs a large architectural firm – an untapped market – would have in the following years. David Sides, a future member of the Computer Group, was also present as a consultant.

Fig. 4 (opposite): *Architectural Record*, 'SOM's Computer Approach'. Credit: Printed with permission from *Architectural Record.* 'SOM's Computer Approach'. *Architectural Record* 168, no. 3 (August 1980), 84–91.

The specifics of the discussion remain unknown. However, Sides' paper issued for the conference gives a glimpse into both the head- and tailwinds facing SOM in the transition towards computer integration. "A vital element of this transitional period is the establishment of a new attitude towards the architectural process," Sides wrote.[29] This included a re-evaluation about what decisions architectural designers made regularly that could be automated, as well as about SOM's methodological relationship with their partners and consultants.

After the Appalachian Conference, the Computer Group rapidly picked up steam. The office strategically hired Sides, who in addition to serving as a consultant at the conference had also been a colleague of Teague's at Rust Engineering. The office further added to the group with Charles F. Davis, Bill Kovacs and Douglas Stoker in the early 1970s – a group of architects with a knack for what was then called 'systems engineering'. They together made up the core members of the Computer Group, with applications focusing mostly on small-scale specific solutions prioritising efficiency. During this decade following the Appalachian Conference, the group also opened its doors to interested students and researchers for the sake of cross-pollination. "What did happen occasionally would be people would come into the Skidmore office who were students and faculty members," said Sides. "We would make a point to get them computer time. We did that independent of the architectural practice, but we came out ahead because they brought in ideas."[30]

In the early 1970s, during a recession, early members of the group, including Teague, were let go from the office. Douglas Stoker replaced him as head of the Computer Group, taking charge of the group's identity and direction.[31] In April 1976, Stoker sent a memo to Fazlur Khan asking for a rethink of the role of the Computer Group at SOM. Stoker called for the group to be more fully staffed and considered as a resource for the office.[32] He called for the Computer Group to be turned into an atelier-style group with the freedom to develop an 'open-ended research agenda'. "What had hitherto been a collection of people answering to Fazlur Khan sought independent status as an applied research studio for the entire firm," wrote historian Nicholas Adams on this shift.[33] Stoker hired Bill Kovacs, an architect without training on computers but with a knack for systems, who became central to many of the Computer Group's works. By 1980, the team was 24 employees strong and SOM boasted more than 100 computer terminals.[34] By 1983, the Group was at almost 50 people, had added more computers, terminals and plotters to the office and had linked their success to the success of the firm, whose annual billing was reaching new highs.

The "computer group [...] treated [SOM's] design studios as if they were fourteen customers," explained *Architectural Record* in the 1980 feature 'SOM's Computer Approach.' (Fig. 4)[35] They billed the other studios for computation time and storage[36] and also

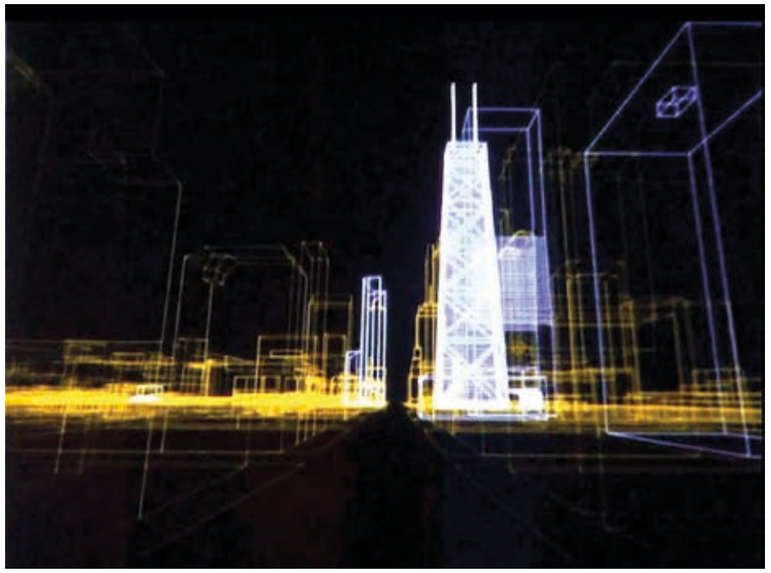


Fig. 5: *Flythrough Screen Shot*. Credit: © Skidmore, Owings & Merrill LLP. *9 Cities by Skidmore, Owings & Merrill 1984*. Scanned from the original 16 mm film, 1984, http://vimeo.com/93315120.

offered the same services to outside offices.[37] During this fertile period, the Computer Group's design of new applications was varied and diverse. Stoker led the group with a sense of rapid discovery and with little apparent fear of failure. "If it works, change it; if it doesn't work, document it," he would say to his team.[38] This period, marked by the team members as a time of rowdy camaraderie and technological experimentation, indexes both the unique needs of an emergent large corporate architecture office – a model of practice relatively new to the field – and the early, potent promise of computation as a system with the potential to change the design process entirely.[39]

"A BUILDING IS A 3D SPREADSHEET": APPLICATIONS OF THE COMPUTER GROUP

Over the course of its existence, SOM's Computer Group designed dozens of original programmes. No complete list exists; only the traces of a few remain through conference papers, references in industry literature on early computer graphics or by word of mouth. They were created by the various members of the Computer Group during their tenure at SOM, under leaders in different offices. Some of the applications were in collaboration with outside companies. Overall, these applications for the most part can be divided into three categories: solution-based, representational and building data simulation.[40]

The first category, solution-based programmes, represented how computing might be used to address the daily minutia which occupied any architecture firm. They serve as a small window into the range of issues that SOM's architects and engineers were tackling during these decades: a large quantity of early programming efforts remained in isolated disciplines, simply making speedier a task already at hand. They included the handful Graham presented at the 1968 Yale Conference, such as Auto-Spec (1965), Truck Turning Problem and Auditorium Layout. Others included a computational automation of the design of stair dimensions, given certain parameters, or the layout of fire sprinklers in a ceiling plan.[41] Others, which were developed for the management side of the office, included Project Return on Equity Programme (PREP) and Man Power Allocation and Personnel Programme (MAP). While programmes of this kind were unique to SOM and authored at the firm, similar tasks were being achieved at some of the firm's rivals, such as HOK and DMJM.

The office also tasked the Computer Group to develop a series of drafting and representational tools; these programmes attempted to transition both the documentation and visualisation of buildings to the computer screen. These included the DRAW2D (1975) developed by Bill Kovacs; DRAW3D (1977), its successor, developed by Nicholas Weingarten; and DRAFt (1981) by Mirsante and Huebner. These programmes, in terms of their technical development, hinged mostly on the development of computer graphics occurring in parallel to SOM's research. Their scope extended to the marketing wing of the firm, such as the creation of nine flythrough animated videos featuring the buildings designed by SOM in major cities including Chicago, New York, San Francisco, Portland and Boston. SOM's towers are wire-framed in sparkling blue, the rest of the city in a putrid yellow (Fig. 5).[42]

The applications that were most unique to SOM were those that reflected the office's ongoing work circling frameworks of efficiency and interest in the complete automation of a building's design. These expanded on Stoker's aphorism that "a building is a 3D spreadsheet",[43] and also spoke to earlier analogue efforts of SOM (such as in the design of Oak Ridge, TN) to systematise, streamline and think experimentally about large and high-quantity design methods. A series of programmes developed by the Computer Group reflected a new generation of research into not only how to make the process of design *faster,* but also how to manage larger scales of information and the relationships between them at a speed and complexity unable to be managed by humans alone.

This approach began with BOP (1967), which went through a series of iterations, including under Teague, who expanded it to work with larger scale buildings (above 40 floors) and to incorporate more mechanical and structural engineering factors. BOP was also followed by a series of more discipline-specific programmes, which focused on architectural design through accumulation of data and its synthesis. These included Planning and Land Use System (PLUS) (1969), which deployed BOP's analysis for urban-scale issues by breaking down taxes, mortgages and rental profits to find an optimised mix of programmes on a large site.[44] A characteristic example of this kind of attempt to use computer architecture holistically was the programme Storage and Retrieval of Architectural Programming Information (SARAPI) (1972) (Fig. 6). SARAPI, a data management system for interior design, was designed to streamline the commercial office furniture layout and space allocation process.[45] SARAPI was used during a phase called 'Programming', in which SOM designers interviewed their commercial client's employees and developed a space plan in which to accommodate their needs. SARAPI mechanised the organisation of this large dataset. Teague had previously developed a similar programme for hospital equipment layout, and adapted it to broader uses.[46] Beginning around 1980, SOM also began, in collaboration with IBM, to develop Architecture Engineering System (AES), which combined the interdisciplinary calculations of BOP with 3D graphic visualisation efforts. Considered an early precursor to what is today called BIM (Building Information Management) technology, AES represented an early effort and vision to move away from two-dimensional, orthographic drawing and towards the 'complete' representation of a building across many scales through computation.

In *The Architecture Machine,* Negroponte theorised about this kind of affordance: "Machines [...] are devices that can respond intelligently to the tiny, individual, constantly changing bits of information that reflect the identity of each urbanite as well as the coherence of the city," he wrote.[47] SOM's SARAPI software, as well as BOP and AES, began on the road towards BIM. While overtly primitive, in certain ways these programmes can be seen as eclipsing contemporary software such as Revit that remain largely limited to the construction of 2D and 3D representation rather than design-driven algorithmic assessment of possible options. These early SOM programmes began to speculate on the possibility of live-time, multinodal, architectural imaging which might allow a building's many variables to respond to a complexity of information stemming from its future users, its urban and governmental context and material limitations.

COMPUTATIONAL LOGISTICS: PROSTHETIC AIDS FOR ARCHITECTURAL OPTIMISATION

It was no coincidence that SOM's own critical computer integration conference took place at an IBM research facility. Throughout the Computer Group's existence, IBM would be a constant presence, beyond its role as a provider of computer equipment. In the postwar period, SOM had established partnerships with building material manufacturers such as Celotex and Pittsburgh Plate Glass Company. The right partner for the 1970s was IBM. Both companies capitalised and arrived on a tide of data-driven organisation: of architecture, offices, cities and employees – a self-dubbed "information explosion".[48] In the 1960s, IBM provided support and collaboration for SOM's architects-turned-programmers; on BOP, for example, Teague spent "many phone calls to IBM to determine how the embryonic PLAN [programming language] was supposed to work".[49] In 1969, SOM's Appalachian Conference was hosted at the IBM Research Facility in Sterling Forest, NY; Jack Sams attended to represent IBM. Sams was in part responsible for the second phase of BOP – which expanded its capabilities to larger buildings with more complex parameters – because of his development of IBM's programming language for 1130s, SOM's in-house mainframe.[50] Beginning around 1980, SOM also developed AES with the help of IBM.

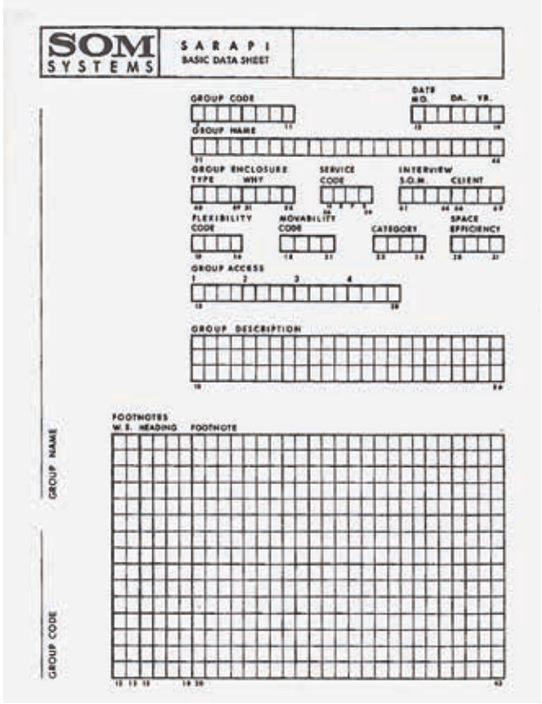


Fig. 6: *SARAPI*. Credit: © Skidmore, Owings & Merrill LLP. SOM Systems: SARAPI. Place of publication not identified: Skidmore, Owings and Merrill, 1972.

Yet this partnership that supported the Computer Group may have also heralded its end. In 1984, IBM began negotiations to purchase AES, rebranded as SKYLINE. In 1986, warning bells rang at the office Christmas Party: "SOM is Going to Town," the employees sang, to the tune of *Santa Claus is Coming to Town*. "You better watch out / Our forces combined / We're making a product / We'll call it SKYLINE."[51] This ominous jingle referred to the sale to IBM of AES, the crown jewel of the Computer Group's efforts that brought together past investigations in drafting and modelling into one comprehensive application. After its acquisition, it became apparent that, compared to the other products in the field, SKYLINE was too expensive and too comprehensive in its scope for the needs of other firms. It never sold well and was ultimately shelved.[52] However, SOM continued collaborating with IBM, proving the offices' close relationship; in 1988, *InfoWorld* quoted SOM's Douglas Stoker in an article about the roll-out of new products and cited SOM as continuing to "co-develop" software with IBM.[53]

Within a few years in the mid-1990s, the applications SOM had helped to pioneer would return from the world outside, changed and repackaged, infiltrate the office and replace the now-outdated customised solutions of the Computer Group. Over time, SOM relocated their practice completely from the drafting table to the interfaces of a suite of commercially available programmes. Across the industry, this first wave of architects-as-programmers operating under the aegis of large offices came to an end in the late 1980s, heralding the beginning of a new era of commercially available drafting software. Founded in 1982, Autodesk rose quickly to the top of the market gap with their flagship programme AutoCAD, by targeting and reaching the small architectural firms with limited budgets and drafting and documentation needs. Other independent software companies emerged to compete with them, including McNeel, which developed AutoCAD-based modelling that allowed for the modelling of free-form and curves-based surfaces, released independently in 1998 as the programme Rhinoceros. SOM's Computer Group dispersed, though some continued to pursue digital applications for architectural design.

Yet today, with the fascination for 'big data', embedded once again in the conversation are the echoes of what was heard early in SOM's pioneering digital applications: a shift from mechanisation to a more total simulation on the bootstraps of computation. Architects appear to be once again retaking the reins in the creation of the digital tools used in architecture production, such as plugins like Grasshopper and Dynamo. In 1994, when Gehry Technologies was founded, Frank Gehry critiqued architectural computer programmes for remaining tethered to an analogous "paper-based, two-dimensional world".[54] Sociologist Bruno Latour critiqued the architectural profession for remaining with analogue Euclidian space, deluded by static images in glossy magazines of buildings without recognising their perpetual movement and complexity of behaviour.[55] These barbs signal a wider discontent with the state of software building upon old analogue methods of drafting, and point towards a reconsideration of some of the early dreams of the Computer Group.

Ultimately, the Computer Group was not focused exclusively on the effect of the computer in architecture on the built environment, but also on the potential effect this new partner might in turn have on the architect. In his paper on BOP, Harper mourned that only a few rare architects were able to propose, sort through and synthesise the vast number of possibilities for a building that any site provoked. Yet he saw BOP as the next stage in the architect's evolution towards a perfectly optimised building. "It is conceivable," Harper wrote, "that these as yet unexplained human abilities can be extended and magnified if proper use could be made of appropriate computer techniques dealing with information processing."[56] The average designer, through computational logistics, could be elevated to a genius.

1 This paper was first developed for my SMArchS thesis at Massachusetts Institute of Technology, under the generous guidance of Arindam Dutta and Ana Miljacki. Thanks also go to Brian Lee and Eric Keune at the SOM Chicago office for allowing me access to the firm's archives.

2 C. David Sides, *Interview with David Sides*, Phone interview conducted by the author, November 11, 2014.

3 G. Neil Harper, "BOP – An Approach to Building Optimization", in *Proceedings of the 1968 23rd ACM National Conference, ACM '68* (New York, NY, USA: ACM, 1968), 575.

4 This anecdote is also described in: C. David Sides, "Notes on Computers an Architecture", in *Reflections on Computer Aids to Design and Architecture*, ed. Nicholas Negroponte (New York: Petrocelli/Charter, 1975): 128.

5 Ibid., 575. Emphasis added.

6 Much of this research draws from a comprehensive text by historian Nicholas Adams, which covered the work of the Computer Group, and also led to a SOM symposium reflecting on similar contents: Nicholas Adams, "Creating the Future (1964–86)", in *SOM Journal 8*, ed. Peter MacKeith (Hatje Cantz, 2013); also: Skidmore, Owings & Merrill, *Digital Design at SOM: The Past, Present and Future*, Streaming video (Arts Club of Chicago, 2012), http://vimeo.com/100126982.

7 Adams, "Creating the Future", 136, note 68.

8 Ibid., 135, note 16.

9 Bruce Graham cites the use of BOP on these two buildings in his contribution to: Conference on Computer Graphics in Architecture, Milne. "Computer Graphics in Architecture and Design: Proceedings". Yale School of Art and Architecture, 1969.

10 Sides, *Interview.*

11 Conference on Computer Graphics in Architecture, Milne. "Computer Graphics in Architecture and Design: Proceedings". Yale School of Art and Architecture, 1969.

12 Ibid.

13 Nicholas Negroponte, *The Architecture Machine: Toward a More Human Environment* (Cambridge, Mass: The MIT Press, 1973).

14 Kristine K. Fallon, "Early Computer Graphics Developments in the Architecture, Engineering and Construction Industry", *IEEE Annals of the History of Computing* 20, no. 2 (June 1998): 20–29.

15 "Currently, we are marketing HOK Draw, HOK Space, Plot Database (report format), and Invest (lease analysis). By the end of the year, we will offer six more systems from stacking and blocking to an interface between HOK Draw and other CAD software." *Progressive Architecture*, Vol. 66 (Reinhold Publishing Corporation, 1985), 141.

16 "So much of the development and thinking happened on cocktail napkins. More on a personal basis than company to company," from Sides, *Interview.*

17 William Sommerfeld, for example, left SOM to become the Director of Computer Applications at The Architects Collaborative; his name is credited as such on the paper "Computer Systems for Urban Design and Development", *Journal of the Urban Planning Division,* April 1971.

18 Bruce Graham, "Computer Graphics in Architectural Practice", (presented at the Yale Conference on Computer Graphics in Architecture, New Haven, CT: Yale School of Art and Architecture, 1968), 24–30.

19 Ibid.

20 Yasmin Sabina Khan, *Engineering Architecture: The Vision of Fazlur R. Khan* (New York: W.W. Norton, 2004): 113.

21 Final calculations were outsourced to consultants with bigger computing power. Ibid., 114.

22 *Oral History of Walter Netsch*, interview by Betty J. Blum, 2000 1997, Art Institute of Chicago Archives: 127.

23 C. David Sides, *A Transition in Architecture: Comments On Development of Architectural Information Systems*, March 22, 1969. Report provided to the author by Lavette Teague, meeting organiser; memo was issued for reference and use during meeting.

24 Fallon, "Early Computer Graphics", 24.

25 Information specifically on this conference was requested from the SOM Archivist, but none could be found. Most information gathered on this event are from interviews with Lavette Teague and David Sides, who were in attendance, and kept some personal documents which they authored or received.

26 Sides, *Interview.*

27 Lavette Teague, "To: Participants in the Sterling Forest Meeting, March 21–22, 1969. Re: Agenda and Preparation for Meeting", February 28, 1969. Memo provided to the author by Lavette Teague.

28 Based on the date, it is not clear whether this was John O. Merrill, the office's eponymous founder (who passed away in 1975) or his son.

29 Sides, "A Transition", 11.

30 *Interview with David Sides*, Phone conducted by the author, November 11, 2014.

31 Douglas Stoker worked in SOM's Computer Group from 1970–89 and was the Group's leader in the Chicago office.

32 Adams, "Creating the Future", 123.

33 Ibid.

34 Skidmore Owings & Merrill, "Computer Capability", 1980, SOM Chicago archives.

35 "SOM'S Computer Approach" *Architectural Record*, August 1980.

36 Adams, "Creating the Future", 136, note 54.

37 Fallon, "Early Computer Graphics", 24.

38 Adams, "Creating the Future", 132.

39 Ibid.

40 This divide between 'camps' of those involved in architectural computation continues today, in the form of computation (Grasshopper) types, rendering and visualization teams, and BIM management. See "Parametric Schizophrenia" by Peggy Deamer in: Poole, Matthew, and Manuel Shvartzberg, eds. *The Politics of Parametricism: Digital Technologies in Architecture* (London; New York: Bloomsbury Academic, 2015).

41 Sides, Interview.

42 Peter Little, *9 Cities by Skidmore, Owings & Merrill 1984*. Scanned from the Original 16 mm Film, 1984, http://vimeo.com/93315120.

43 Adams, "Creating the Future", 136, note 68.

44 Teague, Sommerfeld, Sutphin, and Harper, "Computer Systems for Urban Design and Development", *Journal of the Urban Planning Division, Proceedings of the American Society of Civil Engineers*, April 1971.

45 Skidmore, Owings & Merrill. *SOM Systems-SARAPI*. Place of publication not identified: Skidmore, Owings and Merrill, 1972.

46 SARAPI drew, in part, from a programme called *TABLE* that Teague developed at SOM as an 'outgrowth' of his master's thesis. (Teague, "Memoir", 6).

47 Nicholas Negroponte, *The Architecture Machine: Toward a More Human Environment* (Cambridge, Mass: The MIT Press, 1973).

48 "The Information Explosion", advertisement, Advertising B7, 1960–61, IBM. As cited in: Alexandra Lange, *Tower Typewriter and Trademark: Architects, Designers and the Corporate Utopia, 1956–64* (New York University, Graduate School of Arts and Science, 2005).

49 Sides, "Notes on Computers", 128.

50 Ibid.

51 Adams, "Creating the Future", 131.

52 'AES was pricey: between $22,000 and $35,000 for a minimum to typical configuration. Limited though it was to two dimensions, AutoCAD, the 'word processor for drawings', cost between $1000 and $2500,' Adams, "Creating the Future", 132.

53 Alice LaPlante and Jeff Angus, "IBM Promises Major Rollouts Will Continue", *Info World: The PC News Weekly*, February 22, 1988.

54 "New Gehry Technologies Will Enable Many to Boldly Go Where Only Frank Has Gone Before", *Architectural Record*, October 2003.

55 Bruno Latour and Albena Yaneva, "Give Me a Gun and I Will Make All Buildings Move: An ANT's View of Architecture", in *Explorations in Architecture: Teaching, Design, Research* (Basel: Birkhäuser, 2008).

56 Harper, "BOP", 575.

Deconstructive Cartography

Dominique Cheng

Maps express varying interpretations of the land around us through figuration and colour; they convey spatial information by organising and categorising symbols and codes into comprehensible diagrams. The lines we see on maps may vary in weight to describe both the hierarchy of borders between regions and variations in topography. While some maps can be ambiguous, they are more often than not carefully curated, and occasionally themed, to impart a particular understanding of reality. But to the extent that maps are constructed, they can also be deconstructed: by combining the discursive, linguistic and visual conventions of cartography with architectural drawings, one can try to subvert what is known about a place in an effort to evoke a different awareness of that place, one that is collectively evoked through the sharing of memories and experiences of a foregone urban phenomenon – in this case, a spectacular landing approach into a city. What happens when the relationship between symbols and codes on a map is blurred or removed entirely? Can maps be used to describe the procession of time and movement; to describe, in other words, a fourth dimension?

The *1331* series, which began in 2013, belongs to a larger study of deconstructive cartography; more specifically, it refers to the purposeful reduction of a map to one of its aspects through the erasure of known information and bricolage. The series was created to trace the inextricable relationship between the growth of a city and its airport – in this case, South Kowloon and the (now defunct) Kai Tak International Airport

When Kai Tak Airport (former Hong Kong International Airport) was officially retired in July 1998, plane spotters who frequently watched the spectacle of commercial aircraft sweeping across South Kowloon at dangerously low altitudes before making their final approach onto Runway 13/31 were beset by feelings of loss. The landing approach, in particular, left an indelible impression on the urban fabric, virtually inscribing a path of distinct low-rise buildings along its trajectory as a result of aviation clearance requirements. The relationship between the city and the landing approach was a constant negotiation of space–urban space to aerospace.

The 'map' is stripped of any reference to a specific geographical location – no text or borders are indicated. Instead, the architecture of the city is represented as a dense network of signs and shapes that are tentatively held together by a unifying stroke – the flight path. The physical drawings themselves are multilayered in composition, comprising transparent Dura-Lar sheets on which the line work is imprinted and clippings of printed media superimposed. Each formal layer could be seen to signify a specific point of view or perspective of the city:

The first layer is an architectural drawing of buildings and infrastructure – the urbanscape, then, can be read as concentrations of built elements reduced to simple Platonic forms with their heights accurately depicted.

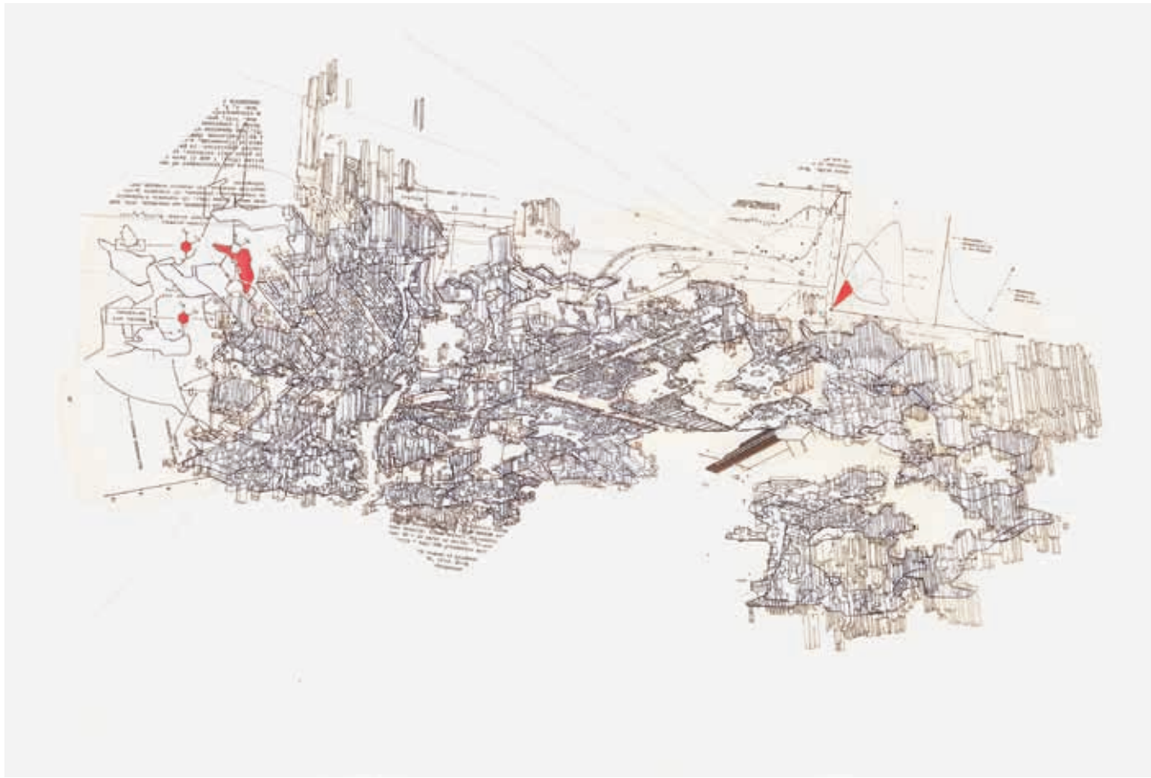
The second layer is an abstracted topographical drawing – the terrain on which the architecture is situated appears as a series of remote land masses floating in space.

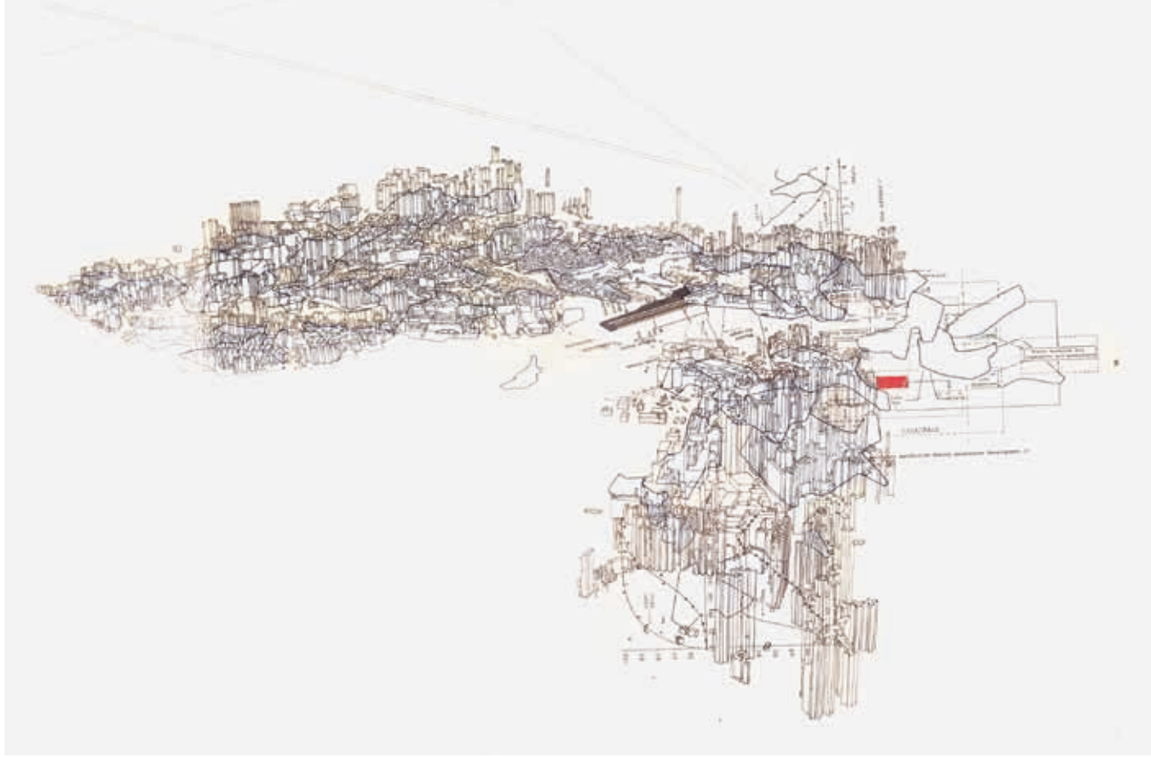
Aeronautical charts, which are navigation tools used by pilots to fix an aircraft's position in space, provide an analytical layer of directional vectors and numerical data. They describe optimal flight paths into, out of and around cities by demarcating the trajectories and boundaries within airspace.

The fourth layer of scientific diagrams, derived from old biology and chemistry textbooks, adds a layer of abstraction that promotes an understanding of the city as an ever-evolving biological organism.

The fifth layer consists of trajectory lines that trace all possible flight paths through the city by interpolating the directional vector data from aeronautical charts.

The resulting drawing becomes more than just a static two-dimensional articulation of space; rather, it formulates a much more complex narrative about the history and memory of a place through the superimposition of disparate layers of information about the city.





Figs. 1 and 2: Dominique Cheng, *1331 (Southeast)*. Studies of South Kowloon in isometric viewed from the southwest. The trajectory of the landing approach is traced.

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 Siwicki[1] and Choay[2], 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? Lowenthal[4] 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.

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.

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. 2: 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.

Fig. 3: 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.

Fig. 4: Bernadette Devilat, *House and vegetation,* 2014. Elevation image from the 3D laser scanning done in 2013 of 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), videos[1] 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[8] 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

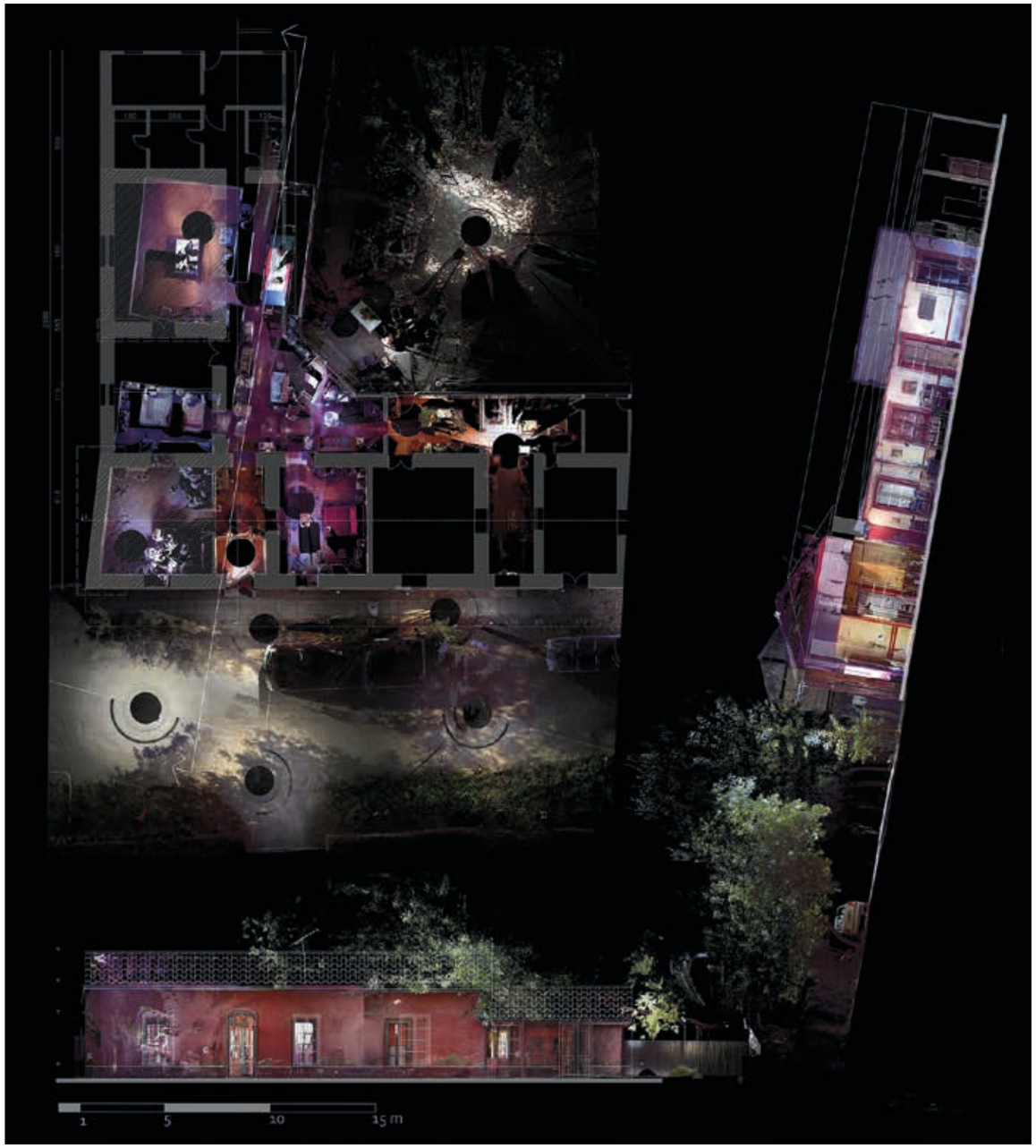


Fig. 5: Bernadette Devilat, *Domesticity,* 2015. Axonometric view from 3D scan data from 2013 of the interior of House 2 in Zúñiga, Chile.

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 futurev 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.

ACKNOWLEDGEMENTS

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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/1QltFW2.
8 Video of House 2 in Zúñiga available at: https://vimeo.com/125778121.

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.

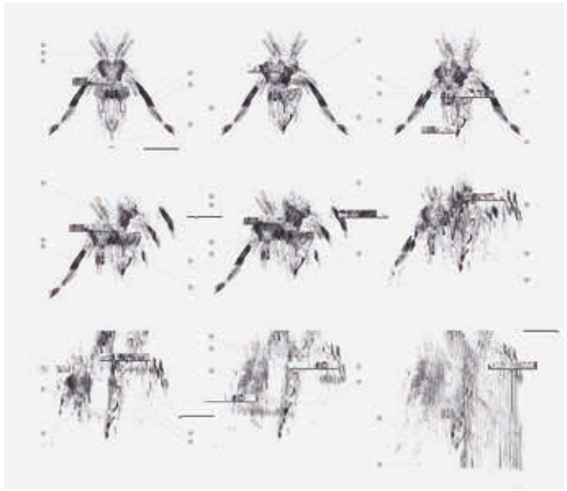

Fig. 1: Owen Duross, *Proxy Cast*, 2015. Each bust is sequential, caught in a state of unstructured narrative characterizing an inexactness that intuits the individual and the destruction of their half-familiar figure.

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. 2: Owen Duross, *Mongrel Battery*, 2015. Markers of measure and dimension code unstructured data space, expanding depth into a scattered field of floating poché and notational dust.

Fig. 3: Owen Duross, *Intimate Beast*, 2015. Mixing bodies alters the resolution of shape and image with black masses and pixelated fringes.

Fig. 4: Owen Duross, *Data–Tongue*, 2015. Matter and notation visually collapse through skips, lapses, and smears to re-seam the continuity of a graphical strip.

The Animate Drawing

Anna Hougaard

Oscillating between life and death,[1] drawing can be described as an animate condition. As an architectural convention, drawing seems to find new forms over and over again in congruence with changing architectural moods and with technological and social developments, and as a subjective practice it can feel as if a drawing is constantly regenerating itself as you draw along. In the present text, drawing is contemplated as being evolutionary, mutating and animate, and framed by Robin Evans's essay 'The Developed Surface: An Enquiry into the Brief Life of an Eighteenth-Century Drawing Technique'.[2]

A MUTATING DRAWING TECHNIQUE

In the essay, Evans investigates some interior drawings from around 1760 to 1820 of upper-class British homes drawn by architects such as Gillows and Co. and Thomas Sheraton. These interior drawings make him wonder, because they are drawn differently from usual, namely with what he terms the *developed surface drawing technique*. The technique allowed the architect to unfold the walls of a room as if they were hinged to the floor, an operation that would make it easy to decorate all the interior surfaces as one continuous skin. This way of folding a room out would focus attention on one room at a time, delving entirely into its world and cultivating different historical styles; the technique has what Evans calls a centrifugal effect,[3] obstructing relations to neighbouring rooms and focusing attention on a room's middle, which was left empty like the eye of a storm. This effect, however, was in congruence with the way people inhabited the room at the time, where the floor was left empty and furniture was arranged along the walls, mirroring a way of behaving in hierarchically defined social patterns. So the centrifugal effect of the drawing technique, interestingly, was in congruence with social behaviour and also in congruence with architectural aesthetics, since it enabled the outspoken ornamentation of the interior surfaces.

Hence, Evans describes a "set" of "related practices" where the drawing technique was "embedded in a nexus of other events";[4] that is, different conditions were acting upon one another – aesthetics, social behaviour and drawing technique – in such a way that a mutation in the conventional way of drawing happened, which led to the use of the developed surface drawing technique. Evans considers the historical cause of events in an evolutionary way, where both the emerging use of the technique and later its retrogression are a sort of mutation in the conventions. Both mutations happened in close response to changing social customs. For instance, the second mutation occurred where the use of the technique regressed, influenced by the social impulse to inhabit the floor as social interaction became freer. The technique made this wish difficult to design for, both because it obstructed the possibility of elaborating the relationships with the neighbouring rooms, unlike a conventional plan drawing, and also because it made it difficult to set the furniture free from the walls and draw a spatial scenario as with a perspective. So although mutations led to the technique's death, it was also during mutational phases that the openings occurred: openings for new ways of drawing and new ways of living.

CONTEMPORARY DRAWING MUTATIONS?

Architectural drawing today is also undergoing change.[5] If we define conventional architectural drawing in Evans' sense, it has three geometries – one for looking (projective geometry), one for making (descriptive geometry) and finally signified geometry; that is, geometry as a purpose in itself, laden with symbolic and aesthetic choices rather than fulfilling functional duties.[6] If we define drawing accordingly rather than as a pen and paper activity, drawing is still a very widespread way of looking at and thinking about architecture[7] that is hybridising with digital design media. While architectural working media are changing, conventional drawing upholds an orthogonal view of things and a shared reference frame for reading architecture, and this development creates drawing mutations – animate and searching drawings – which can cultivate and question the openings in the conventions and look for emerging *sets of related practices*, to paraphrase Evans.

An interesting view in relation hereto is given by Mario Carpo in *The Alphabet and The Algorithm*, which foregrounds digital design affordances. Carpo prognosticates that the creation of algorithms will replace drawing as a broad media convention in architecture. Inspired by Nelson Goodman's notational theory,[8] Carpo emphasises the ever-developing role of digital notation and points out that architectural authorship is changing when digital notation is increasing: not only do architects today share authorship with software, but also the use of participatory social media offers new and quite untried architectural design possibilities.[9] This is interesting because – as Evans outlined in his essay – the social space brings an important influence with it in the set of other related practices that affect the creation of architecture.

I have worked with these ideas in the drawings presented here, which reanimate the extinct drawing technique and a social space invoked by structuralist architects in the 1960s. Structuralist architects desired urban, dense and flexible spaces, deliberately aiming at their being changed over time in accordance with human needs. A project such as *The Free University* in Berlin, by Candilis, Josic and Woods, approached this wish by means of drawing a mesh-like structure in which modules could be placed and in principle be relocated according to needs.[10] Projects such as Constant Nieuwenhuis's *New Babylon* were also contemplating such ideas.[11] In parallel, experimental musicians like John Cage were questioning conventionalised notational forms and ideas of authorship by drawing out *fields for playing*, in which the

Fig. 1: Anna Katrine Hougaard, *Developed Surface Map*, 2014, CAD drawing, no scale, c.70 × 70 cm. The map notates the game pieces' possible movements. Plan and elevation elements are combined in an abstract pattern where change over time is described simultaneously, without beginning or end.

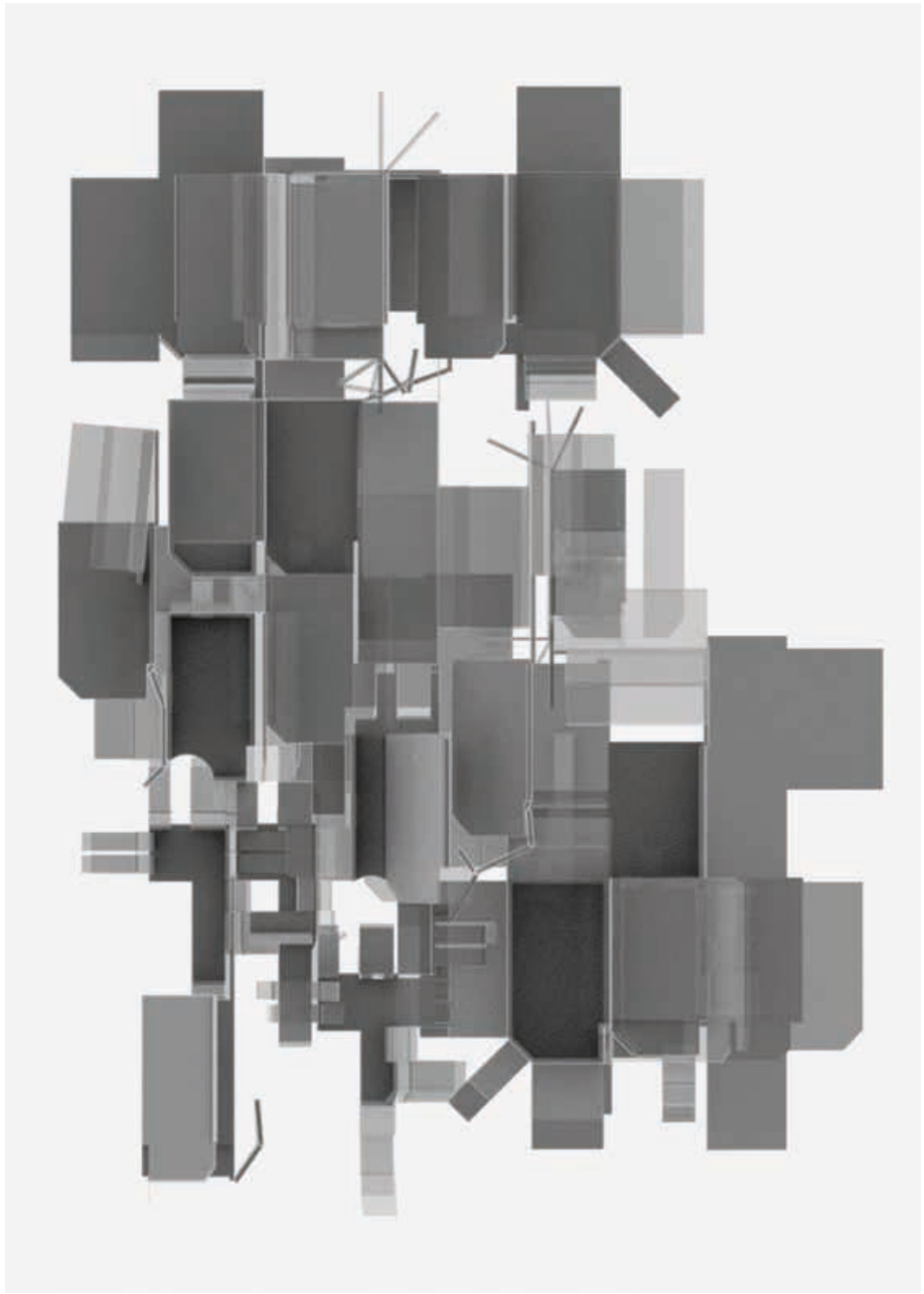

Fig. 2: Anna Katrine Hougaard, *Developed Surface Animation*, 2014, superimposed renderings. This map is made from some stills from a 3D animation depicting a field of game pieces in various states of foldedness.

musician and sometimes the audience would have to co-create the artwork.[12] In such musical and architectural open works, there is a desire for enabling a participatory social space to meet with aesthetics in loosely organised ways, an idea that has been contemplated in these drawings, too. They are maps of loosely planned generic sites that are open for reconfiguration over time. The maps' aesthetic is derived from the developed surface technique, where spaces can fold orthogonally. Hence, the developed surface technique is projected onto a larger scale than the domestic and is related to a field for playing where small spaces can be arranged in various ways and reconfigured by the players.

1 Cf. the many current discussions of drawing's future, e.g. *Is Drawing Dead?* Conference held at The Yale School of Architecture in 2012; David Ross Scheer, *The Death of Drawing* (London and New York: Routledge, 2014); Mario Carpo, *The Alphabet and the Algorithm* (Cambridge, Massachusetts; London, England: The MIT Press, 2011); Neil Spiller, ed., *AD Drawing + Architecture*, vol. 83, no. 5 (Sept/Oct 2013); Paolo Belardi, *Why Architects Still Draw*, trans. Zachary Nowak (Cambridge, Massachusetts, London, England: The MT Press, 2014).

2 Robin Evans, "The Developed Surface: An Enquiry into the Brief Life of an Eighteenth-Century Drawing Technique", in *Translations from Drawing to Building and Other Essays* (London: Architectural Association Publishers, 1997), 195–233.

3 Ibid., 209–10.

4 Ibid., 200, 227.

5 See note 1.

6 Robin Evans, *The Projective Cast – Architecture and its Three Geometries* (Cambridge, Massachusetts and London, England: The MIT Press, 1995), xxv–xxxvii, 349.

7 See the author's PhD thesis for a discussion of drawing as an orthogonal way of looking. Anna Katrine Hougaard, "The Animate Drawing", (PhD Diss., 2016, KADK).

8 Nelson Goodman, *Languages of Art*, 2nd edn (Indianapolis, Cambridge: Hackett Publishing Company, Inc., 1976).

9 Mario Carpo, *The Alphabet and the Algorithm* (Cambridge, Massachusetts; London, England: The MIT Press, 2011);

10 For various discussions of *The Free University* see Tomás Valena, Tom Avermaete, and Georg Vrachliotis, eds., *Structuralism Reloaded: Rule-Based Design in Architecture and Urbanism* (Stuttgart/London: Edition Axel Menges, 2011).

11 Simon Sadler, *The Situationist City* (Cambridge, Massachusetts; London, England: The MIT Press, 1999), 105–51.

12 See, for instance, John Cage, *Notations* (New York: Something Else Press Inc., 1969).

Variable Information Lineweights

Ryan Luke Johns

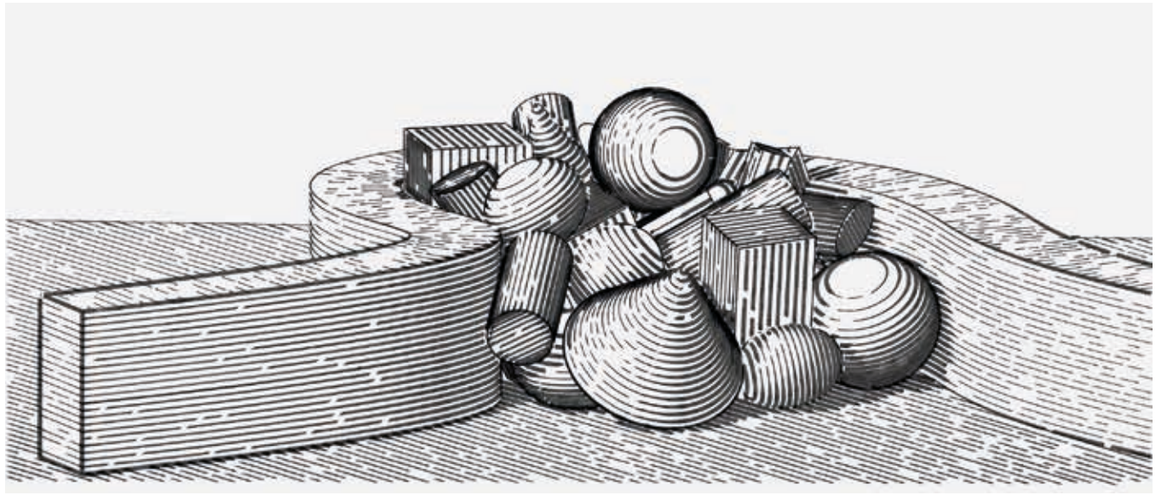

Fig. 1: Ryan Luke Johns, *Rigid Bodies*, 2016, ink on Mylar, 91.4 × 177.8 cm. Variable line weight rendering of rigid body simulation of random geometric primitives and terrain. Line frequency and weight are determined algorithmically based on a combination of depth (distance from viewer) and light exposure.

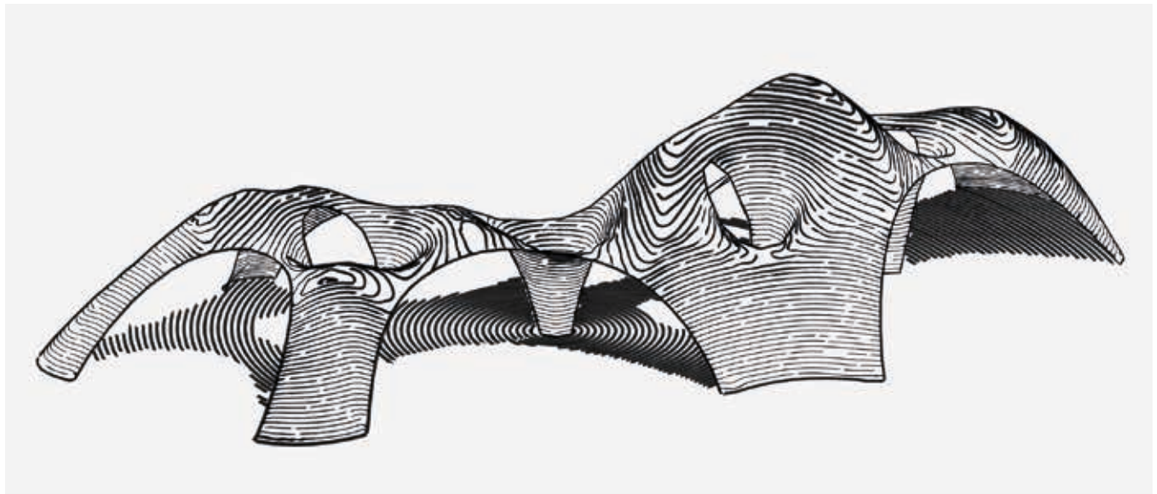

Fig. 2: Ryan Luke Johns, *Vault*, 2016, ink on Mylar, 91.4 × 220 cm. Variable line weight rendering of non-uniform thin-shell vault. Surface contour line weight conveys the von Mises stress diagram of the structure, while border line weight is determined by the depth.

While computer-aided drafting (CAD) offers a more plastic interface for rendering linework, the current practice of prescribing weights to architectural lines still bears a strong resemblance to the use of a fixed set of Rapidograph pens. Digital line data can be divided into an array of layers or objects that can be given a unique line weight, but each line still maintains a uniform width along its length. Despite the abundance of parametric features in digital modelling software, no clear CAD protocol exists for rendering a stroke with a controlled, variable width.

Variable Information Lineweights is a work-in-progress method for rendering three-dimensional models with non-uniform line weights that are dynamically linked to datasets of object properties (such as light exposure, depth and structure). At present, the software is used to directly output drawing code to an industrial robot (ABB IRB 6400), but the basic premise can be applied to a number of rendering strategies: curves are stored in a vector format, where each vertex is paired with a corresponding line weight (Fig. 3).

The relatively modest software ~2,000 lines is written in Processing and creates a link between geometry data (from Rhino) and surface attributes – providing a visual interface for tuning the relationship between these parameters and the rendered lines (Fig. 4).[1, 2] Geometry data is divided into layers in Rhino and exported with a custom descriptor document generated in Grasshopper.[3] Once imported into the Processing software, each layer is assigned an automatically generated control panel, which provides a series of sliders and editable bezier-based mapping functions. These sliders control basic parameters, such as minimum and maximum line width, and more advanced parameters, such as the ratio of influence of various attributes over line weight or the probability that a given vertex is rendered at all. For example, a layer might be set up such that the foreground is more heavily influenced by scene lighting, while the background is more heavily influenced by the distance between the object and the camera or viewer. The attributes that determine line weights can be loaded and correlated with the vertex data in a number of ways: either as a list of values, as an aligned black and white image or directly from the 3D information.

Once the shading strategy is tuned and selected, the software outputs robot code directly. This process involves optimising the drawing for robot motion by reducing unnecessary vertices, sorting and reversing curve direction to minimise transfer distances (and drawing time) and adding routines for avoiding robot joint errors (as most industrial robots cannot spin

Fig. 3: Ryan Luke Johns, *Variable Information Lineweights*, 2016. Drawing setup with six-axis robotic plotter.

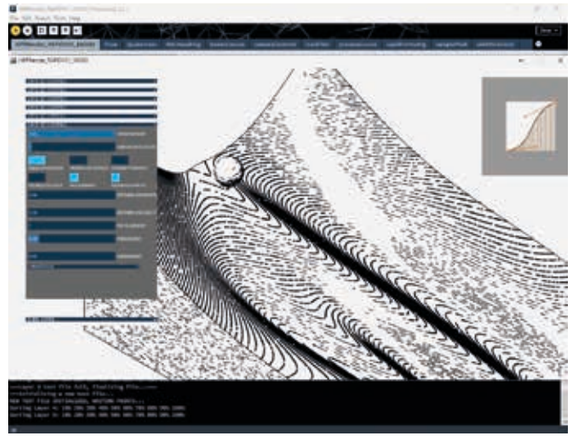

Fig. 4: Ryan Luke Johns, *Variable Information Lineweights*, 2016, Rendered surface based on C.H. Waddington's *Epigenetic Landscape*. Linework determined by ambient occlusion and depth.

their last axis indefinitely, certain long curves with significant rotations require that the robot lift up the pen, reset the rotation of the exceeding axis and then continue with the line).

The robot is equipped with a custom spring-loaded penholder that accommodates a variety of pen and marker types. A single calligraphy pen (6 mm Pilot Parallel) is used in these sample images, which allows for a stroke-width range of .065–6 mm depending on rotation.

The included images represent the first stage tests of this technique, which remains in development. While far from streamlined, the process enables fast prototyping of drawings with various types of data embedded into the linework and an intuitive control panel for editing the influence of each data type over the final image (Figs. 1 – 2).

[1] processing.org
[2] rhino3d.com
[3] grasshopper3d.com

Timberland, or How to Design a Sustainable City in Excel

Keith Krumwiede

Timberland is an ongoing investigation into the production of a low-carbon building and city building system. In the United States, it is increasingly clear that conventional housing practices and products hold little promise of a sustainable solution to the environmental and economic crises we face. We must adapt. Wood, the most ubiquitous – and inherently sustainable – building material in use today, is used primarily in the construction of single-family houses built at low densities, an inherently unsustainable development model. Conversely, higher density urban districts are most typically constructed in concrete and steel, the least sustainable and most carbon-intensive of building materials. Essentially, we are either using the right materials in the wrong manner or the wrong materials in the right manner.

Timberland seeks to rebalance this equation by asking if it is possible to confront the conflict of efficiency and waste that characterises the production of buildings and cities today by linking the economic and environmental benefits of building with wood to the social, political and environmental benefits of building more densely. While most research into the use of timber has focused on the building scale alone, assuming that taller and bigger is necessarily better, Timberland works across scales, from wood panel to urban district, with the goal of producing not standalone instances of low carbon density but variably dense and, in the language of parametricism, continuously differentiated urban settings.

The differentiation, however, is not smoothly defined. It is less about formal properties than about spatial qualities. A pixelated plan – produced in Microsoft Excel – calculates a distribution of building block hybrids of varying openness and density along a gradient, from the loose aggregate of free-floating houses typically associated with suburban settings to the denser, more compact full block build-outs of traditional city cores. In this manner, the system generates building blocks capable of adaptation to a range of situations that can be deployed as single instances, tuned to their specific context, or as districts with a varied range of densities and their associated urban qualities.

All of this is tied back to a material module – an 8-foot by 24-foot cross-laminated timber (CLT) panel. Working up from the scale of the panel, a 24-foot by 24-foot cell is the primary planning pixel for the project. The plan itself, never fixed, was developed, or more accurately computed, in Microsoft Excel using a formula that modulates the ratio of built to open space (as well as the ratio of pervious to impervious surfaces) along a vector from suburban to urban and back again. In this manner, as the density shifts along a gradient from the two-storey freestanding house to the eight-storey street wall-defining urban block, the grain of the urban fabric itself transforms as a range of crossbred conditions emerge between the base typologies: at one end, the single family house standing alone in the centre of its individual parcel; in the centre, the urban courtyard building filling its city block; and at the other end, the freestanding suburban commercial box floating in a sea of parking.

The project's continuously differentiated plan was generated using a ratio-based formula and random number generators to develop rows in which the structure of each building block (with an area of 160 cells) was linked to those on either side of it, with the 'core' typologies functioning as anchors for the operation. Each time the plan was processed – each time the 'return' key was hit – the random number generators produced new iterations of the blocks with gradated arrays of built and open cells. These rows were then arrayed to produce the field of blocks shown here (Fig. 1). As can be seen in the drawing – in which black represents built cells, green represents pervious cells and orange represents impervious cells – the resulting field is marked by a gradient pattern of striated blocks, all of which bear, to varying degrees, the genetic markings of the core typologies.

In order to extrapolate the promise of this quasi-figure ground plan into three-dimensions, it was necessary to translate the pixels of the plan into three-dimensional spatial units. Here, we returned to the material specificity of the CLT panels, projecting the 24 × 24-foot cell into spatial units measuring 24 × 24 × 10 feet. With this new unit in hand, the Excel diagrams were transferred to Rhino 3D and Grasshopper, where a script was developed in which the diagrams functioned as a kind of database for a three-dimensional aggregation process in which density was the primary parameter. The script essentially 'reads' the coloured cells of the Excel diagrams – now raster images – and, using a series of diagrammatic curves that describe different levels of density, 'stacks' the pixels into three-dimensional clusters of different densities with varying spatial and formal properties. For example, if given a ten-unit-tall mass, a bell curve would describe a distribution of units where the middle levels would be the densest, while a straight curve with a positive slope would describe a situation in which the highest levels would be denser. In this manner, another set of iterative data was overlaid on the Excel diagrams,

Fig. 1 (opposite): Keith Krumwiede, assisted by John Vogt, *Field of Blocks, Timberland*, 2016. This plan – generated in Microsoft Excel using a formula that modulates the ratio of both built to open space and pervious to impervious surfaces – describes a pixelated field of building block hybrids of varying openness and density along a gradient from suburban to urban and back again.

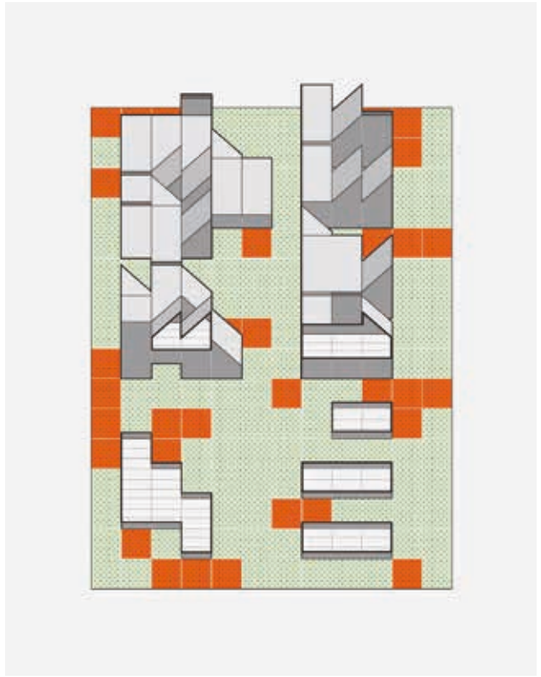

Fig. 2: Keith Krumwiede, assisted by John Vogt, *Study of Building Block from Column 2, Timberland*, 2016. The zero-degree cutaway oblique study of a hybrid building block from the second column of the field of blocks shown in Fig. 1 provides a means of comparatively assessing its spatial/formal properties in relation to those shown in Figs. 3–5.

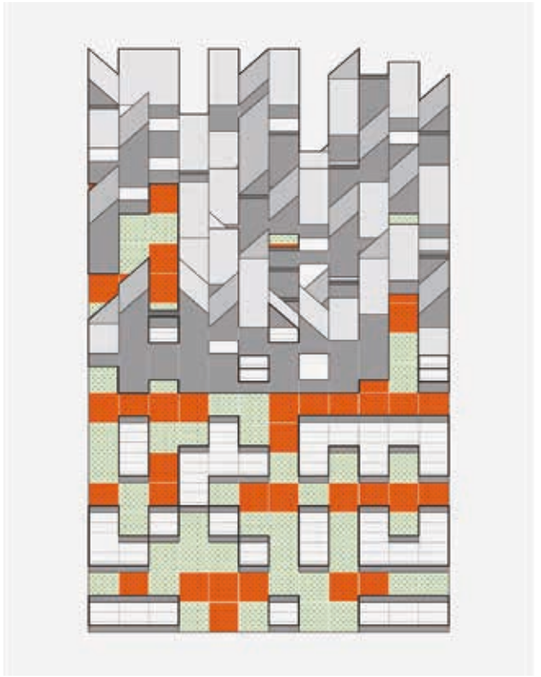

Fig. 3: Keith Krumwiede, assisted by John Vogt, *Study of Building Block from Column 5, Timberland*, 2016. The zero-degree cutaway oblique study of a hybrid building block from the fifth column of the field of blocks shown in Fig. 1 provides a means of comparatively assessing its spatial/formal properties in relation to those shown in Figs. 2, 4 and 5.

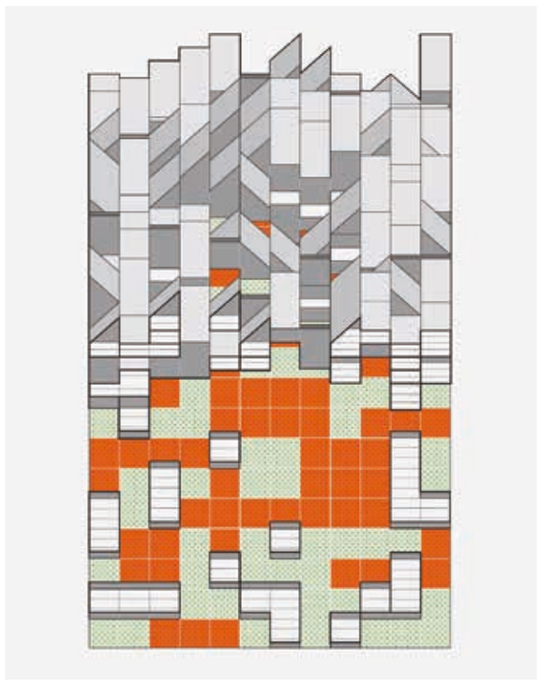

Fig. 4: Keith Krumwiede, assisted by John Vogt, *Study of Building Block from Column 7, Timberland*, 2016. The zero-degree cutaway oblique study of a hybrid building block from the seventh column of the field of blocks shown in Fig. 1 provides a means of comparatively assessing its spatial/formal properties in relation to those shown in Figs. 2, 3 and 5.

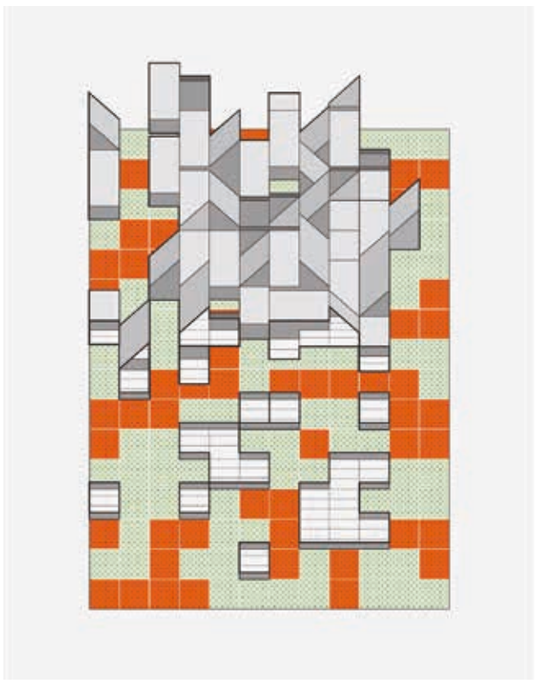

Fig. 5: Keith Krumwiede, assisted by John Vogt, *Study of Building Block from Column 9, Timberland*, 2016. The zero-degree cutaway oblique study of a hybrid building block from the ninth column of the field of blocks shown in Fig. 1 provides a means of comparatively assessing its spatial/formal properties in relation to those shown in Figs. 2–4.

thereby allowing for the creation and analysis of several different formal and spatial configurations of each hybrid building/block in the original plan.

In order to assess the viability of the various iterations generated through this process, a series of diagrammatic sections were drawn. These were used to analyse and evaluate each block in relation to questions of access to light and air, possible programmatic mixtures and overall formal/spatial fitness. These drawings not shown here, functioned as a kind of check in the process, allowing for the optimisation of the parameters to prioritise certain results – greater or lesser levels of porosity, for example – and in that sense to exercise greater agency in the computational process. For example, considering the original ambition of the research – to imagine viable, sustainable alternatives to the freestanding single-family house – it became evident that resulting configurations were not yet descriptive enough of the idea of dwelling, at least in an American context. So the script was revised to introduce sloping shed roofs – their orientation randomly assigned – at the uppermost position in any 'stack' of units.

The series of hybrid oblique drawings shown here (Figs. 2–5) represent the latest stage in the process. Each drawing is representative of a different block condition in the full field of blocks. The drawing method employed – a zero-degree oblique view employing both horizontal and vertical cuts – provides a means of analysing the spatial/formal properties of each block both independently and in relation to the others studied. This method, more objective and less pictorial than perspective projection, provided a means of comparatively assessing the spatial texture of the hybrid blocks in comparison to the anchor typologies from which they were derived. Additionally, their fitness could be evaluated relative to the parameters driving their configuration – the ratio of both built to open space and pervious to impervious surfaces; the density of units in each block and the distribution of that density at various levels with the block; the bulk and massing of the block and its impact on the potential for various forms of inhabitation; and, not insignificantly, the overall formal properties of the blocks in relation to the composition of the district as a whole.

House for a House

Chee-Kit Lai

'House for a House' is a design of a house that houses the memories of a lost home. The work is autobiographical and inspired by the house that psychologist Carl Jung built for himself in Zurich; a house he described as a 'confession of faith in stone'.

> "To put my fantasies on solid footing something more was needed. I had to achieve a kind of representation in stone of my innermost... Put another way, I had to make a confession of faith in stone. That was the beginning of the tower, the house I built for myself at Bollingen."
> Carl Jung, 1963

We have all revisited an old school or childhood home and felt the uncanny sensation of revised scale in relation to our bodies; familiar yet different at the same time. I wanted to explore the gap between leaving home as a child and returning as an adult, the gap where memories and desires are intertwined. With the passing of time, the rebuilding of memory becomes fantastical, the rewriting of history becomes fictional and even the most faithful redrawing of a house becomes surreal. When does a house become a home? Walls and floors do not make up a home; the construct of one's home is formed by the details of objects and memories.

'House for a House' utilises stage set design and optical illusion techniques to explore the psychological complexity of the house through artifice, illusion, memory and shifting scale. 'House for a House' exists as a series of fragments ranging from models to 1:1 installations, each time with an illusion that explores the present perception of time and occupation of different parts of the house, which in turn alludes to the whole, while never revealing the overall tectonics of the enclosure.

> "There is a certain degree of deception; for if artists were to give the true proportions of their fair works, the upper part, which is further off, would appear to be out of proportions in comparison with the lower, which is nearer; so they give up the truth in their images and make only the proportions which appear to be beautiful, disregarding the real ones."
> Plato, *Sophist*, 360 BC

The drawings, produced in traditional 30–30 degree isometric, simultaneously address the conventions of plan, section and elevation. No orthogonal representation exists for the house. The isometric drawings serve a fundamental architectural purpose, as instructions to build. Each drawing measures 700 by 1,000 mm, obsessively hand-drawn first with pencil on trace, followed by ink on film. Subsequently, this is transferred onto white high-gloss Astralux paper and finally applied with matte block pastel colours to contrast with the glossy surface. The idea of chasing a house that possibly never 'was' seems so preposterous, so fleeting and ephemeral, that I wanted to produce one-off drawings as the mode of representation, drawings that cannot be reproduced. Hand-applied Pantone Letrafilm (a semi-translucent self-adhesive film used during the 1960s-80s by graphic designers), used for the colours, was at the time of production already rare and discontinued.

The house is designed from the inside out, starting with the detailed drawing of a memory – the furniture. This process is followed by the drawing of the room which the furniture occupies, followed by other rooms, spaces and corridors that slowly make up the house and finally the landscape in which the house is sited. Each drawing bears clues to the space beyond and contains a miniaturised representation of the space as it was through the shift in scale – much like a Russian matryoshka doll. The technique is inspired by the projects in *People in Architecture* (Michael Gold, AA, 1983), although in 'House for a House' there is no figure/protagonist

Fig. 1: Chee-Kit Lai, *House Interior*. Hand-drawn black and white isometric drawing on gloss lux paper, 100 × 70 cm.

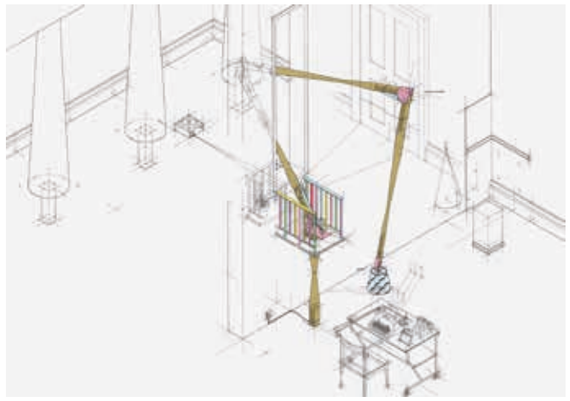

Fig. 2: Chee-Kit Lai, *Anglepoise Light*. Hand-drawn black and white isometric drawing on gloss lux paper with hand-applied Pantone LetraTone, 100 × 70 cm.

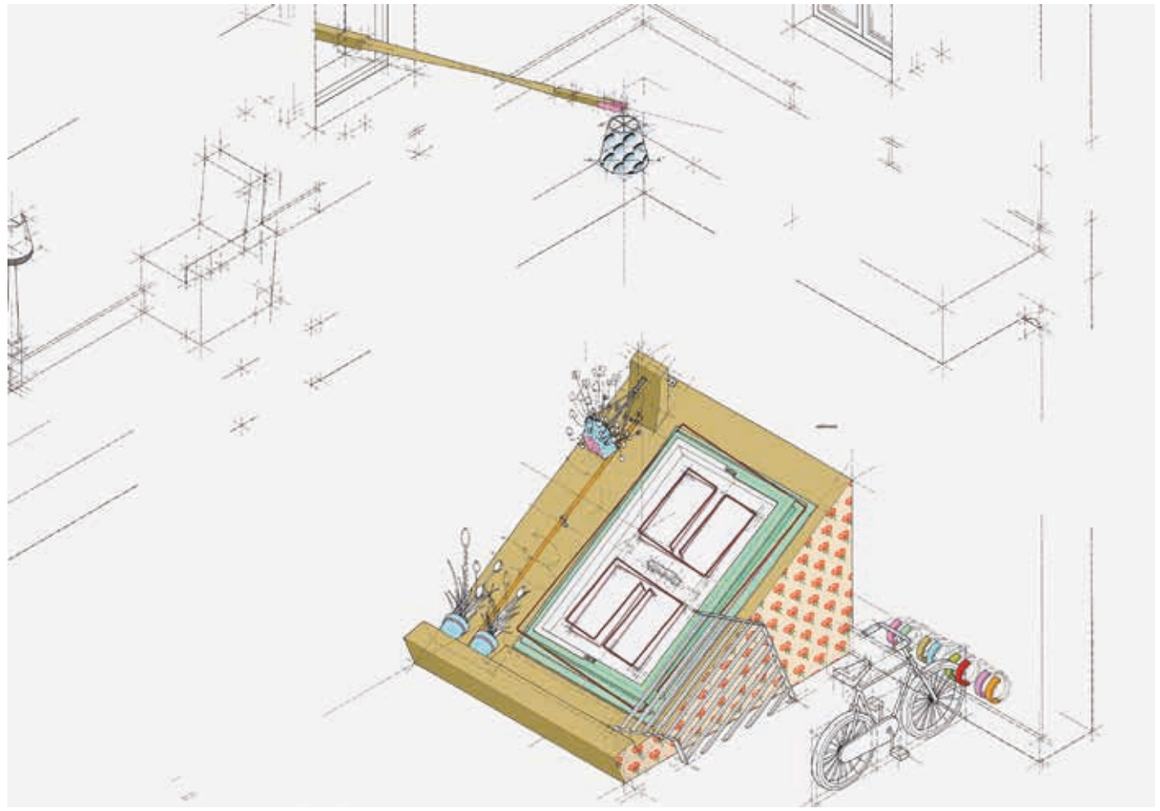

Fig.3: Chee-Kit Lai, *Telephone Door*. Hand-drawn black and white isometric drawing on gloss lux paper with hand-applied Pantone LetraTone, 100 × 70 cm.

at the start of the process – instead, the occupation is suggested through choreography. In Dennis Severs' *House* (18 Folgate Street), visitors are carefully led through a sequence of rooms with furniture, food, drink, smells, etc bearing the trace of occupation. 'House for a House' utilises architectural conventions such as construction lines, setting out information and notations to suggest the viewer's specific viewpoints, positions and sequence they may take on a journey through the house. The physicality of the drawings is crucial. They are like film stills, framing enough information to create a fragment of a space, with allusion to the next space, while withholding the construct of artifice at the same time.

> "The ambiguity between representation and reality is a powerful source of meaning, but it can also be a source of illusion which obscures the distinction between architecture and pure scenography."
> Dalibor Vesely, 1983

Some of the spaces are modelled at dolls' house scale, a nod to Queen Mary's Dolls' House by Sir Edwin Lutyens. Other spaces are made at 1:2 and 1:1. The dialogue between drawing and making enables multiple readings of the architecture and the imagination of fantastical spaces. The specifications of the spaces are precise in order to create the architecture and atmosphere intended. However, the constraints of fabrication and the limitation of space and budget require elements to be reused and objects to behave differently when shifted from one film set to the next. Building fragments are doubled-up (like the garden to Queen Mary's Dolls' House hidden inside a 1:1 drawer at the base of the model) to create paradoxical spaces, spaces of multiple possibilities and conditions, as inspired by Magritte's paintings.

> "Everything we see hides another thing, we always want to see what is hidden by what we see."
> Rene Magritte, 1946

Unlike painting, sculpture or other art forms, it is virtually impossible for a single architectural drawing to hold both the idea and construct. The isometric drawings for 'House for a House' attempt this ambition. While each isometric drawing can be read separately as fragments, when combined together they form a giant fantastical drawing of the whole building in situ, a nod to artist Paul Noble. The drawings use 'insertion points', another architectural convention, to enable the precise alignment in order to produce the final overall form, which in turn reveals a composition similar to its origin, the furniture that started it all.

> "One builds what one no longer knows."
> Gregor Schneider, 2001

A Collection of Circle-Spheres: A Pre-Digital Post-Digital Convergence

Carl Lostritto

While drawing:
All Spheres are Circles, All Circles are Spheres.
All Artists are Scientists, All Scientists are Artists.

The winners of a 'Computer Art Contest' in 1963 were scientists. As a byproduct of their work at the US Army Ballistic Research Laboratories, they produced *Splatter Pattern* using a 'Dataplotter', a massive table-sized apparatus first released by Electronic Associates Incorporated in the 1950s. The machine, larger but similar in nature to the pen plotters used in the work presented here, produced small drawings by moving a pen across a fixed piece of paper based on electronic input, which could be generated by computer. Art critics – including the authors of 'The Electronic Computer as Artist', published in *Canadian Art,* which Grant D. Taylor identifies as the first piece of 'Computer Art' criticism – were sceptical. Computer control required mastery of computer engineering. Artistry, as distinct from art production, requires analysis. Artists mastering the computer was as improbable – absurd, even – as scientists adjusting their data based on aesthetic judgment.[1]

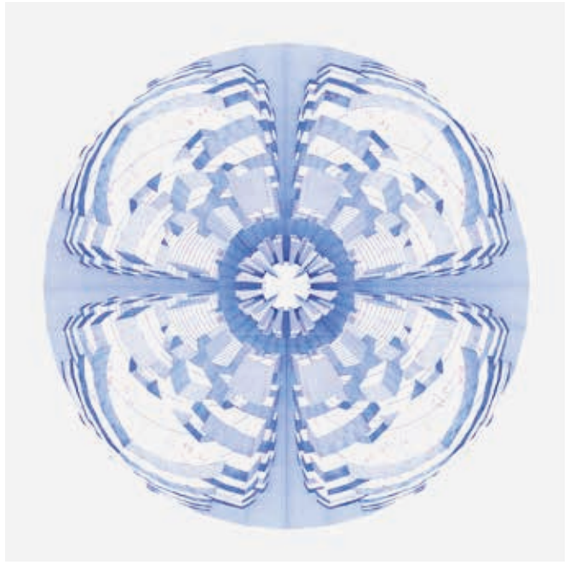

Fig. 1: Carl Lostritto, *DB-001-012 Room C1 Blue Hatched,* 2015, pen plotter with felt pens, 25 × 38 in. The algorithm used to produce this drawing, catalogued as 'DB', involves spherical projection and a system of hatching to transform three-dimensional solid surfaces into lines. Each line on paper is informed by its position in (three-dimensional) space and position on (two-dimensional) paper. Hatches are computed first based on distance to camera and surface orientation and are projected to a position on paper, occlusions are resolved using a binary space partitioning tree, lines are trimmed in two dimensions and finally machine language instructions are computed and sent to an HP-DraftPro EXL pen plotter. '001' in this drawing's ID refers to a room enclosed by a three-dimensional array of rectilinear solids and '012' indicates that this drawing is the twelfth run of this series.

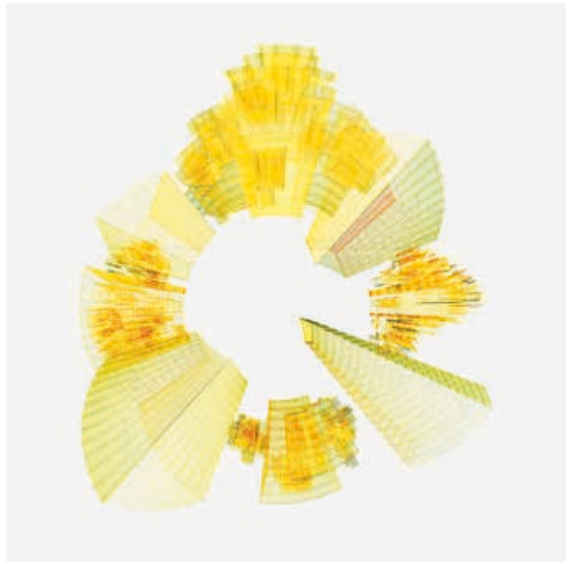

Fig. 2: Carl Lostritto, *DB-002-004 Piles of Blocks at a Perimeter,* 2015, pen plotter with felt pens, 25 × 38 in. The algorithm used to produce this drawing, catalogued as 'DB', is identical to that described in Fig. 1. '002' in this drawing's ID refers to an arrangement of rectilinear solids on a ground plane. '004' indicates that this drawing is the fourth run of this series.

In collaboration, Charles Jeffrey Bangert and Colette Stuebe Bangert together accomplished what was previously unfathomable. Colette Bangert recalls, reflecting on her work in the 1960s and 1970s:

> "Using a computer-plotter extends my hand-eye-head. The computer draws, my eyes see, my hand draws, the computer is programmed by [Jeffrey], the computer draws [...] in an endless productive cycle. Computer drawn lines enrich my hand lines which in turn enrich my computer drawn lines [...] Jeff and I use the computer as a traditional drawing medium. The resulting drawings are to be seen, to hang on a wall, to communicate. They are not just examples of computer technology, not just geometry, not just mathematics. We ask this new medium questions and get new (and old) answers."[2]

The Bangert collaboration produced *Large Landscape: Ochre and Black*, which is an unusually perfect representation of the 1960s computer-drawing zeitgeist. Drawings from that era are a specific subset of an already marginalised, though recently celebrated, niche. In the catalogue to the 1968 'Cybernetics Serendipity' exhibit, which features some pen-plotted drawings, Jasia Reichardt notes, "The engineers for whom the graphic plotter driven by a computer represented nothing more than a means of solving certain problems visually, have occasionally become so interested in the possibilities of this visual output that they have started to make drawings which bear no practical application, and for which the only real motives are the desire to explore, and the sheer pleasure of seeing a drawing materialize. Thus people who would never have put pencil to paper, or bush to canvas, have started making images [...] which approximate and often look identical to what we call 'art' and put in public galleries".[3] However, the most compelling and challenging works of that time were the interactive installations, robots and sculptures that "[were] treated as separate categories by art critics, art colleges and galleries. To some extent they still are, largely because there is not sufficient historical background to suggest how we should think about them".[4] According to Reichardt, the *Evening Standard* wrote about the exhibition, "Where in London could you take a hippy, a computer programmer and a ten-year-old schoolboy and guarantee that each would be perfectly happy for an hour without you having to lift a finger to entertain them."[5] A hint of a paradigm shift was in the air, but the emphasis was not on drawing.

Drawing is slow. Drawing is discrete. Drawing defies the third dimension – and the world – even as it represents it. Interaction is only possible in the domain of perception and thought. In the time since 1970, the definition of 'drawing' has become muddied almost beyond productive scholarly function. By some definitions, almost nothing produced with contemporary tools should be labelled a 'drawing' – a representation of lines in digital software is surely a model. By other definitions, anything on paper, having been captured or projected into two-dimensional space, is casually called a 'drawing'. Despite the contemporary confusion about the definition of – let alone the opportunities and futures for – drawing, the Bangerts' work screams with contemporaneity. Its object-field, smooth-striated and variation-versioned ambiguities fit well within current architectural discourse. Space is captured between lines and form emerges as lines aggregate. Randomness, a still commonly misunderstood term that has been nonetheless completely assimilated into design discourse, offers a useful stepping stone into issues of control, authorship and aesthetics.

So what now? What's the value of operating with a pen plotter in a purposefully vintage setup in which the Python programming language controls a machine in the same way the Bangerts constructed a medium with the Fortran programming language and their machines? The novelty of the single-run computational work is significant – and while resistance, difficulty and restraint are always valuable to the artist, what are the historical implications of this? This project proposes a history that eschews the fixation on application that resulted from the personal computer revolution. Drawing is still relevant, as long as we respect drawing traditions: one gesture leads to one mark, which is constituted by the presence of ink and the pen's physical effect on the paper. Drawing with technology is more meaningful than speculating about how technology might change, replace or kill drawing.

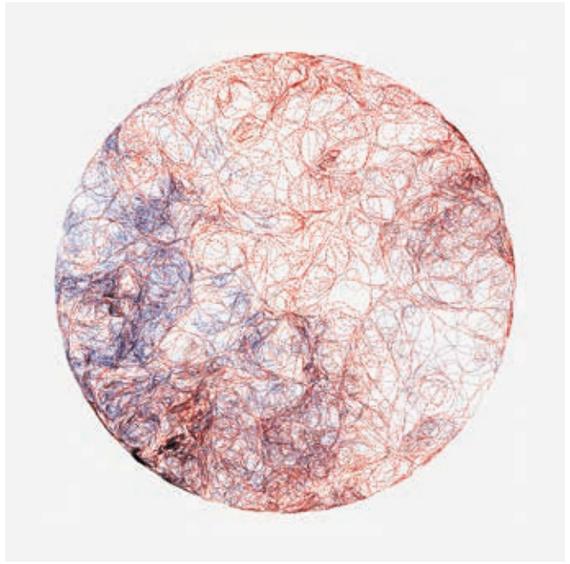

Fig. 3: Carl Lostritto, *D-002-008 Walking From Red to Blue,* 2012, pen plotter with felt pens, 22 × 34 in. The algorithm used to produce this drawing, catalogued as 'D', treats the paper as space and ink as object. 'Line' remains open to interpretation. The series identifier '002' is associated with marks made by a particle 'walking' in a random but generally curving path within an invisible boundary. The travelling particle leaves a dashed trail, which it is never allowed to make contact with. If the particle is nearing collision with its trail, its angular acceleration increases – it steers out of the way. The gaps between the dashes are openings, which the particle may move through. Over the course of the drawing, the particle speed decreases (causing the curves to be tighter and smoother) and the proportion of dash to gap decreases.

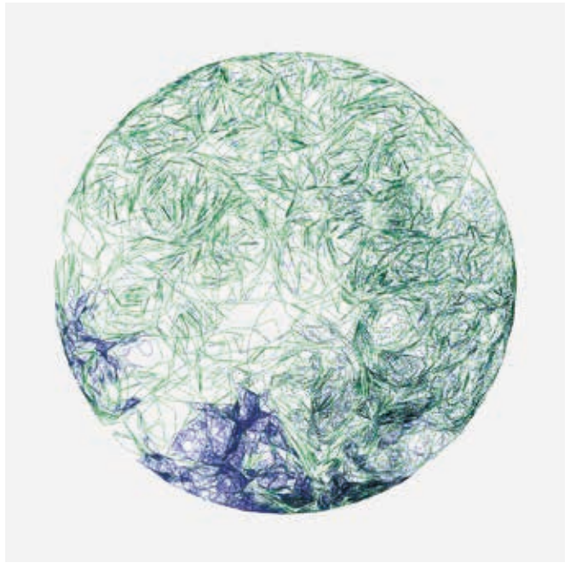

Fig. 4: Carl Lostritto, *D-002-007 Walking From Green to Blue,* 2012, pen plotter with felt pens, 22 × 34 in. The algorithm used to produce this drawing, catalogued as 'D', and the series, catalogued as '002', are identical to those associated with Fig. 3. In run '007', the seventh run of this series, green and blue pens are used. The contrasting zones of light and dark, as well as the clarity of line path versus line segments, can be compared to those of Fig 3. The discrepancies are evidence of the cascade effect of a few initially random values on the final outcome of the drawing.

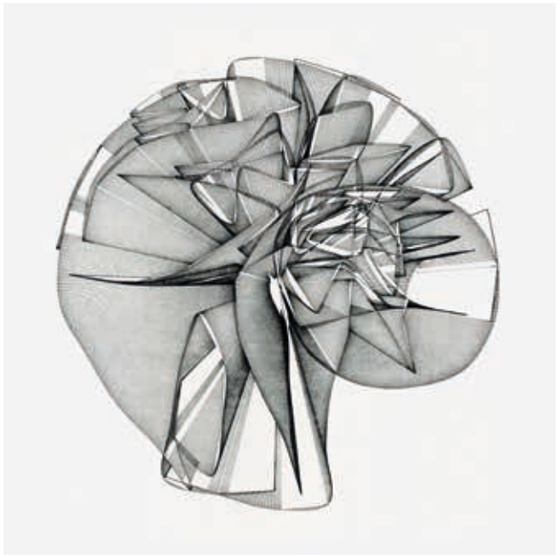

Fig. 5: Carl Lostritto, *C-004-001 Towards Spherical Figure*, 2012, pen plotter with felt pens, 22 × 34 in. The algorithm used to produce this drawing, catalogued as 'C', draws lines in sets with respect to a focal point. In the series catalogued as '004', a single coarse path is calculated first, within a circular boundary. The path tends to avoid intersections. A finer path with 50 points is generated per each initial point and forms an interpolated spine curve. Each new point marks the beginning of a drawn line towards, but not ending at, the focal point. Lines stop at any intersection with the path. As the '001' indicates, this is the first run of the series. Initially intended as a test run, the spline was set to a relatively course 70-segment length and the plotter was loaded with a highly worn pen.

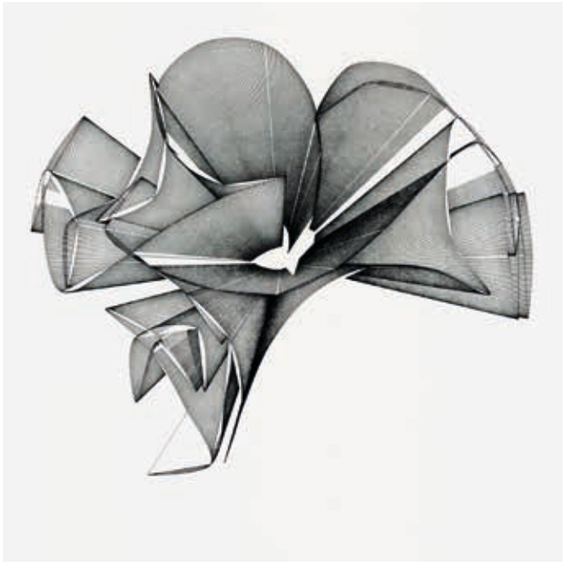

Fig. 6: Carl Lostritto, *C-004-002 Densely Towards Spherical Figure*, 2012, pen plotter with felt pens, 22 × 34 in. The algorithm used to produce this drawing, catalogued as 'C', and the series, catalogued as '004', are the same as in Fig. 5. After the surprise success of the aesthetics of the worn pen in run '001', another pen with similarly worn effects was created to again capture the tonal variability within each mark. Run '002' ran for 120 segments, producing a much denser field compared to the first run.

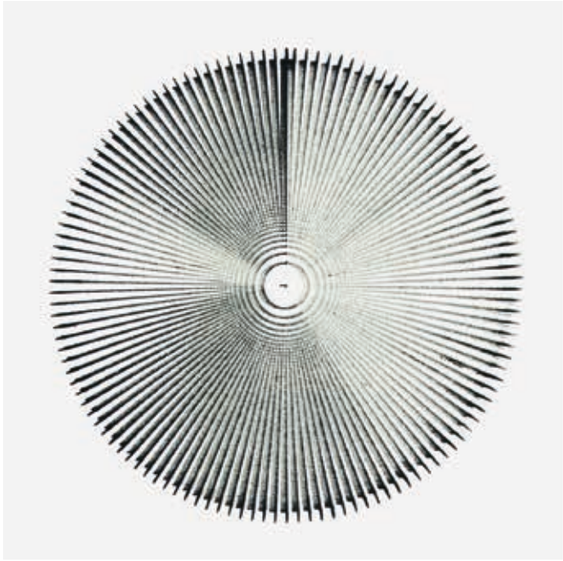

Fig. 7: Carl Lostritto, *BC-001-001 Dashed Mass*, 2014, pen plotter with felt pens, 11 × 11 in. The algorithm used to produce this drawing, catalogued as 'BC', involves a surface model of a sphere. The sphere serves as a datum for the creation of many lines, which are orthographically projected onto the paper plane and used to generate machine language code sent to an HP-EXL Pen Plotter. In series '001' of this algorithm, line segments are created between randomly selected pairs of points on the surface of the sphere. Segments are then divided into dashed subsegments in three-dimensional space.

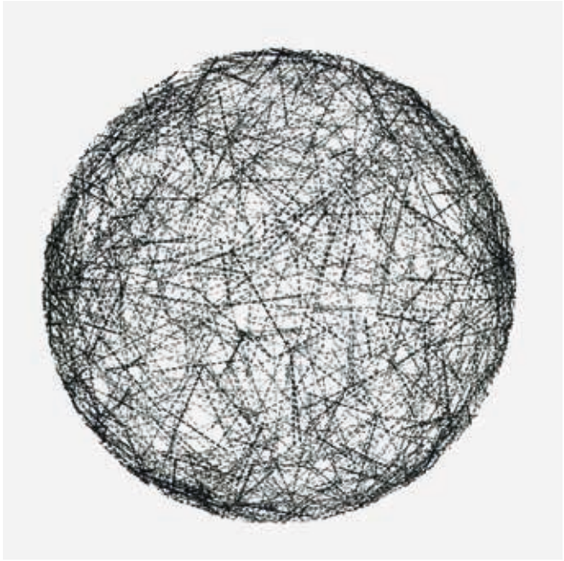

Fig. 8: Carl Lostritto. *BC-002-001 Flat-Looking Sphere with Radial Lines*, 2014, pen plotter with felt pens, 11 × 11 in. The algorithm used to produce this drawing, catalogued as 'BC', is the same as that used to produce the drawing in Fig. 7. In series '002', L-shaped line segments are created on the surface of the sphere at even increments. The shape, size and orientation of those segments relates to the vector between a reference point and the point on the surface. In run '001', a worn pen is used so that lines on the back side of the sphere, drawn last, are barely visible.

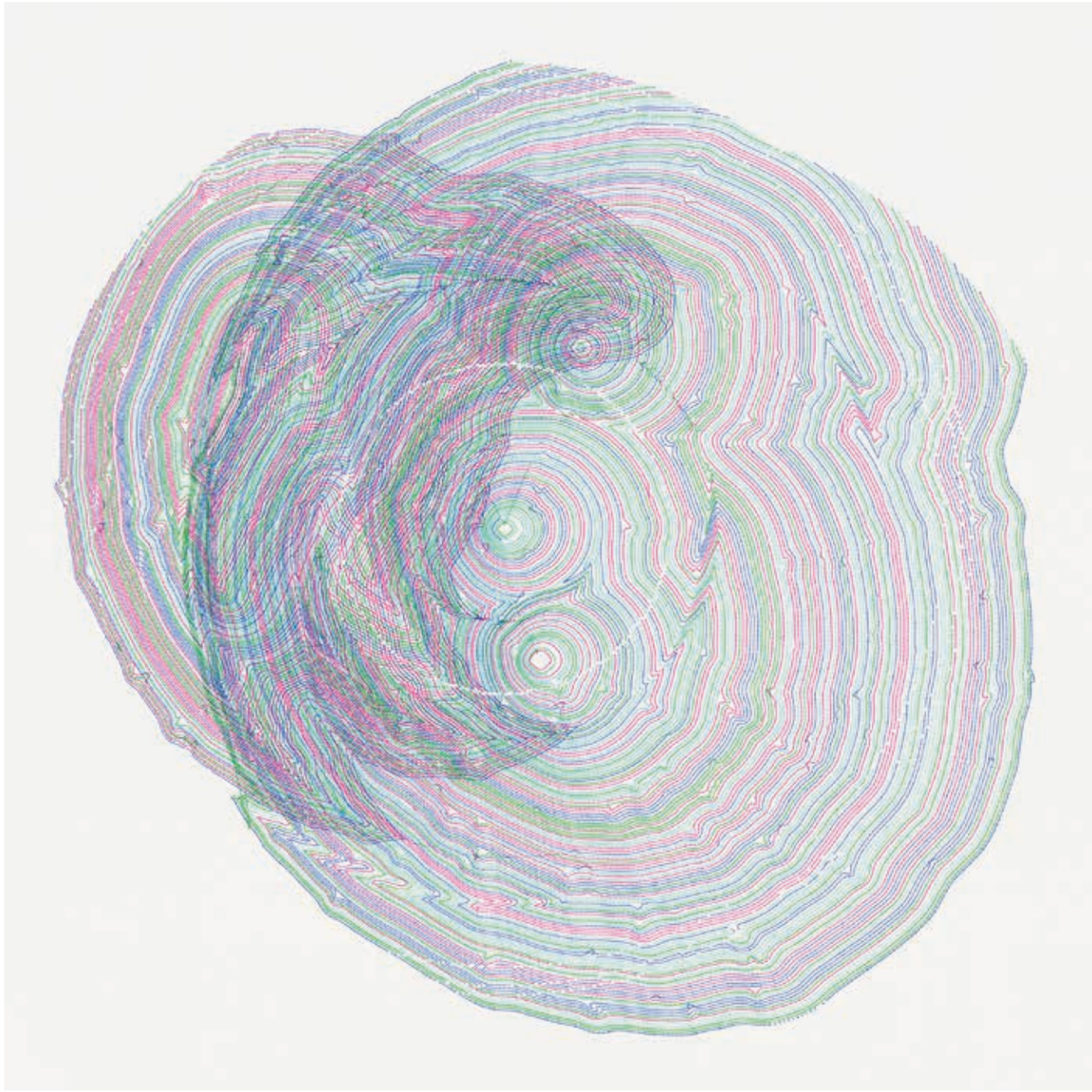

Fig. 9: Carl Lostritto. *DC-006-020 Cascading Lines Break the Circle*, 2016, pen plotter with felt pens, 25 × 38 in. '006' uses three points and concentric circles as the trimmers and guides, while the shapes are drawn as continuous lines at their boundaries. Each of those lines is assigned randomly to one of four groups. In run '020' the groups are drawn with four different pens, and one area of lines is allowed to grow beyond the prescribed circle. This irregularity functions as a depth cue implying three-dimensional surface.

Fig. 10: Carl Lostritto, *DC-007-001 Pink Circle*, 2016, pen plotter with felt pens, 25 × 38 in. The algorithm used to produce this drawing, catalogued as 'DC', uses three kinds of base geometry: seed points establish epicentres of radiating lines; guide lines transform portions of lines that cross over them, effectively 'pulling' them along their path; and trim lines leave gaps along their paths. At each step in the algorithm, one new shape is drawn at offset from its previous position. Intersecting shapes merge. Offsetting is irregular, with slightly more spacing at the right than the left. This irregularity functions as a depth cue implying three-dimensional surface. Series '007' uses three points and concentric circles as the trimmers and guides, while the shapes are drawn with many tiny individual segments randomly assigned to one of four groups.

The primary difference – the quantum leap, so to speak – that would occur in a history that ignored the years between 1971 and 2011 would, then, be a matter of an expanded territory within the field of software. Object-oriented programming allows a structure of the line, and a representation of the drawing, to exist within the linguistic structure of computer code. Digital surfaces allow the mapping and reprojection of geometry multiple times before being marked on paper. Even the drawings that are computed with straightforward algorithms – algorithms 'C' (Figs. 5 and 6) and 'D' (Figs. 3 and 4), for example, which are structured with a line 'travelling' around the space of the paper, avoiding its trail – involve a quantity of computation that would not have been possible given the memory limitations of the 1960s. Algorithm 'DC' (Figs. 9 and 10) likewise operates in a flat plane despite the overwhelming presence of form, surface and depth. Conversely, algorithms 'BC' (Figs. 7 and 8) and 'DB' (Figs. 1 and 2) 'play out' in a mix of three-dimensional and two-dimensional spaces. In the drawings produced by these algorithms, dense hatching reasserts the planar presence of the paper.

The other leap is one of values. The 'circle' and the 'sphere' bring the weight of the humanist notions of shape and symbol back into play. The human author asserts a figure, as an artist provoking architecture. This is something the Bangerts would understand and sympathise with, but which would undermine many of the purist motivations of computer art and architecture post-1970. The human reader is called upon to interpret, to close an open ambiguity, to project intention and to decode the relationship between process and product.

[1] Grant D. Taylor, *When the Machine Made Art: The Troubled History of Computer Art* (London: Bloomsbury, 2014), 5.
[2] 'COLETTE S. BANGERT CHARLES J. BANGERT.' Artist and Computer. Accessed July 11, 2016. http://www.atariarchives.org/artist/sec5.php.
[3] Jasia Reichardt, "Introduction." *Cybernetic Serendipity, the Computer and the Arts, a Studio International Special Issue*, September 1968, 5.
[4] Jasia Reichardt, "In the Beginning..." *White Heat Cold Logic: British Computer Art 1960–80*, edited by Paul Brown, 71–81. Cambridge, MA: MIT Press, 2008.
[5] Ibid.

A Room With a View

Alison Moffett

My practice maintains an interest in the built world, space, perception and how we as conscious beings understand the world through the filter of an intermediary such as drawing or mapmaking. This investigation seeks to reveal how space or landscape is often a constructed device. A view can be as simple as a signed pull-off along the side of the road or a very obvious rendering of single-point perspective. Both are constructions created with a conscious aim at understanding or at least humanising something chaotic and utterly beyond our comprehension. In mapmaking, it is the overlay of the logical grid that allows the wilderness to be tamed, in essence the act of landscaping. This grid is functioning in the same way as the signed roadside view or the constructed linear perspective drawing. They are all matrices through which we view. Of course, these are only a few examples of a much greater complexity. Numbers, geometry, language and signs of all sorts are necessary to simplify and order the natural world enough for comprehension.

My personal interest circles around drawing precisely because it sits so commonly in that place of in-between. It can be a work of an instant, a sketch, an idea,

Fig. 1: Alison Moffett, *First Scenic View*, 2014, graphite on graph paper and crumpled paper, two A4 pieces of paper, 297 × 210 cm.

a comprehensive study, a performance, a mistake. Drawing has also, since fifteenth-century Florence, been inseparable from architecture. This is not to say that people before this who built did not also draw out their ideas; instead, that drawing came to define what it is to be an architect – someone who draws the design, rather than someone who builds. It is this separation, drawing (or ideas) from building (trade craft), that has defined architecture to this day. This leaves drawing in the position of a translatory object that can be read quite literally: one reads plans to build; or more conceptually: the process of drawing itself reveals more complex themes to be addressed. Not unconnectedly, this elevation of drawing comes at the same moment in time as exploration and conquest, great scientific advances and philosophical investigations, most notably humanism. Within all of these burgeoning fields, there seems a disjunction between how the world is and a new 'logic' that is applied as it is striven to be understood. Often, drawing is the object or tool of comprehension. It is in this way of thinking that I question the role of the drawing in understanding or reading the environment around us. Drawing can be, like a screen, something that comes between us and the outside world. In this intermediary role, it illuminates our attempt, and often failure, at comprehension. And yet it is this very failure that is interesting.

These three drawing projects each address this larger investigation using a unifying duality: order vs. chaos, the grid and nature. First, the three *Scenic View* works 'map' their twinned terrain. It is only within this act of mapping that the creation of a landscape can be both illustrated and logically understood. In this, there is a small sadness, for while the magic of transformation from rubbish paper to topography is set free, it is at the same time tamed by the rules of measurement and order: the practicality of the coordinate system. As graph paper, the grid is always there, functioning differently within the two halves: the crumpled landscape graph is slightly distorted, following topography; the drawn representation is slightly distorted, following the grid. It is the combination of the dual actions of the grid with the empathetic understanding of the drawing process that the map serves to authenticate with the creation of a new landscape, while the landscape gives rise and meaning to the drawing.

The large drawing *Impossibility of Clouds* works more directly at addressing the paradox of order and disorder through the process of drawing itself. Order, the grid, is built within the form of the work, each square of paper drawn separately and only assembled when completed. The image is modelled on a found photograph of a cloud, a form of ever-changing ephemerality. Indeed, clouds were deemed too chaotic even for Brunelleschi to include in his seminal demonstration of perspective, famously left to be real-time reflections in applied polished silver. This drawing is constructed as each square is carefully copied and connected within the grid system, but as it is pieced together the drawing reveals an embedded failure: no square completely aligns with its neighbours. The tool of the gridded system – to break down an image,

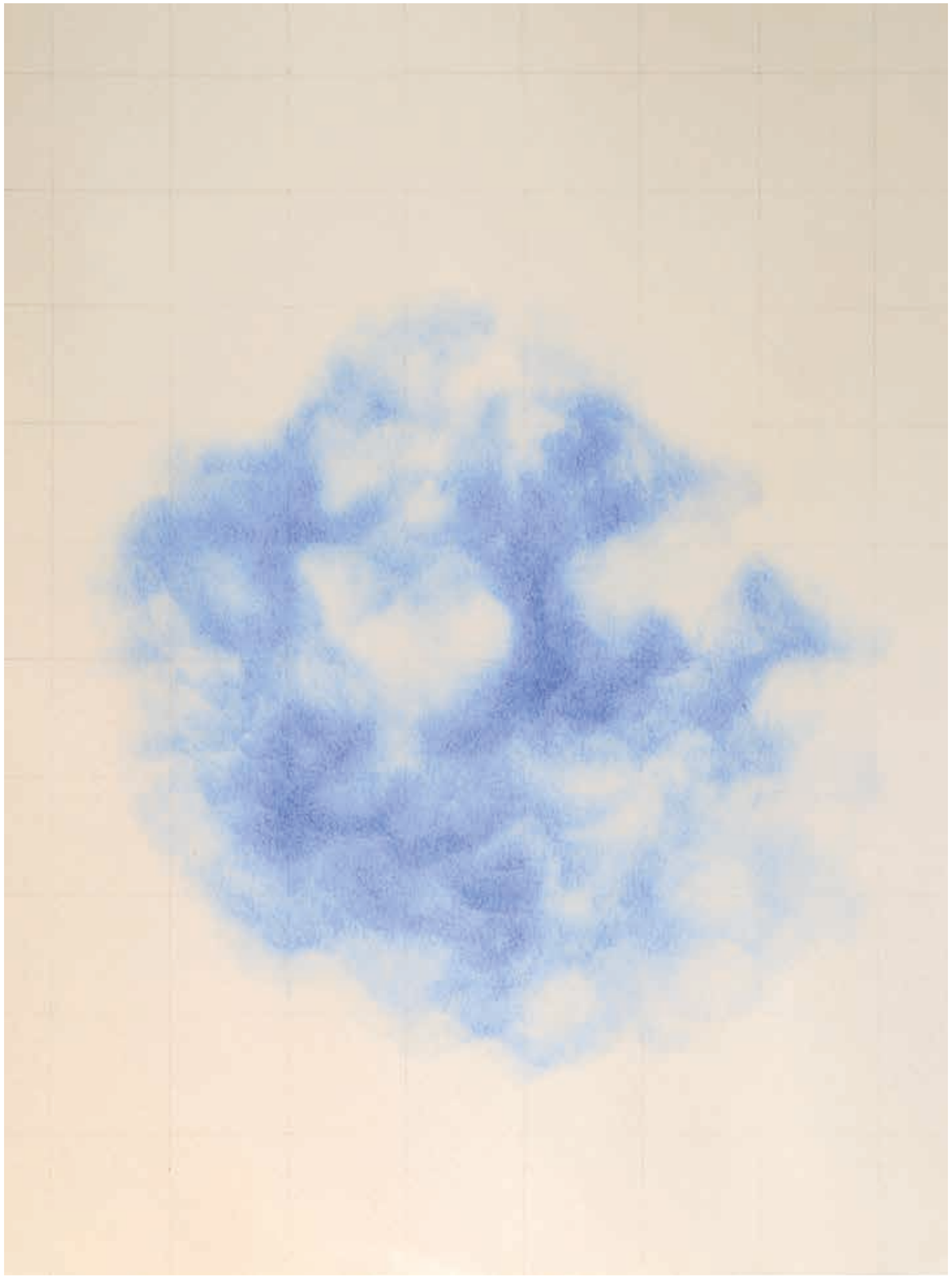

Fig. 2: Alison Moffett, *Vanishing Point*, 2014, coloured pencil on paper, 40 × 55 cm.

to pixelate – only exposes my inability to capture the image. Seemingly an error, it is actually this very human failure of creation that highlights the magic of the paradox.

Lastly, *Vanishing Point*, an exercise in capturing a mark, can be read as the most personal of all. Once again, the act of drawing is embedded within the image. The process begins with the most final of marks, a full stop, made simply with a pencil. Also a vanishing point, final in a more epic way, this point is the simplest of marks to make – a recording of presence. Scanned and enlarged, this absolute point is shown to be as ephemeral as a cloud, finally redrawn through the tool of gridded logic. In redrawing this, I return to the simplicity of the original mark. They are, in essence, the same thing, drawn with the same material and the same hand, but their form and authority have been turned inside out: from singularity to nebulous. The drawing illustrates the connectivity between the smallest, most discrete of dimensions and the grandest, the most chaotic. Like the Eameses' *Powers of 10*, the ever-present logic of the grid both enables and defines these associations.

Fig. 3: Alison Moffett, *Impossibility of Clouds*, 2014, graphite on paper, 238 × 357 cm.

SIFT'd Visualisations: The Defamiliarisation of Architectural Drawings

Matthew Parker

Semi-autonomous algorithms, tasked with sensing and making sense of the built environment abstract architecture into data for the digital (re)construction of the city. Within this process, architecture has the capacity to produce multi-dimensional space by schizophrenically mapping polymorphic manifestations across the physical-virtual layers of the city. However, to exploit this opportunity, architecture must first acknowledge a new type of non-human observer, one who does not possess human-level perceptual and aesthetic capacities, but rather something that is uncanny and interesting precisely because it does *not* posses these things.[1] These non-human onlookers, specifically architecture's *algorithmic observers*, 'see' despite a lack of eyeballs, rods, cones and visual cortex. Instead, they produce vision through the use of sensors capable of detecting light, heat, motion and colour data to produce 'images' that mediate our relationship to the world. This inhuman vision has the capacity to distort, destabilise and disturb our perception of images and objects by provoking new optical regimes that have the potential to situate aesthetics at the forefront of how architecture is conceived and constructed. *SIFT'd Visualisations: The Defamiliarisation of Architectural Drawings* explores the ability of algorithmic observation (AO) to produce novelty through the computational processing of architecture's image towards the production of 'defamiliar' architectural drawings.

THE DESTABILISATION OF OPTICAL PROSTHESES

From the introduction of Alhazen's camera obscura in the tenth century through to the increasing number of visual prostheses (lenses, astronomic telescopes, etc) of the Renaissance, architects have continually deployed optical prostheses to augment the contexts that define architectural speculation and visualisation. These devices confront objects in a fundamentally *inhuman* manner that exposes excess data intensities otherwise concealed from unmediated human perception. Whereas previous optical prostheses sought to flatten multi-dimensional data on to two-dimensional image planes (the use of Alberti's veil to describe the principles of perspective ultimately exposing the phenomenon of foreshortening or the modernist use of photography to flatten spatial and temporal dimensions), AO inverts this relationship by producing *n-dimensional* vectors from the data contained within two-dimensional images. N-dimensional vectors facilitate AO's perceptive capabilities, as they allow for sorting, stitching, compositing and cataloguing of the extensive image-based datasets that aggregate to produce the gaze of AO. This new data (re)animates and multiplies the image of the city, its artefacts and its citizens, as it assists in constructing the narratives that surround an object's digital footprint.

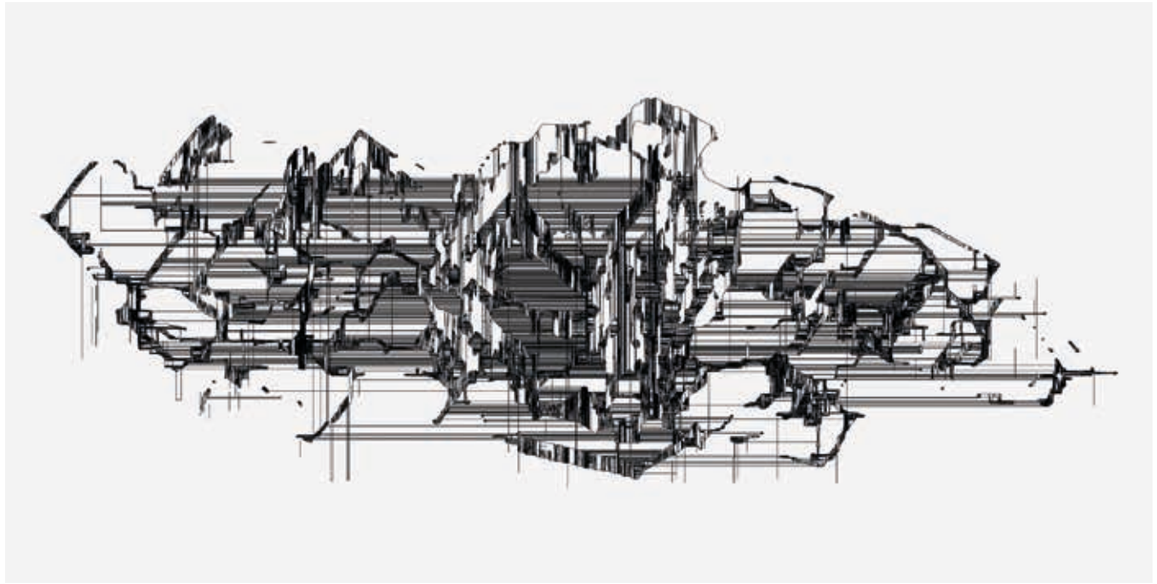

Fig. 1: Matthew Parker, *Data-Rich Plan 018*, digital media. The speculative plans of nine projects are superimposed and composited through a computational workflow that mobilises SIFt algorithms towards the production of new architectural assemblies.

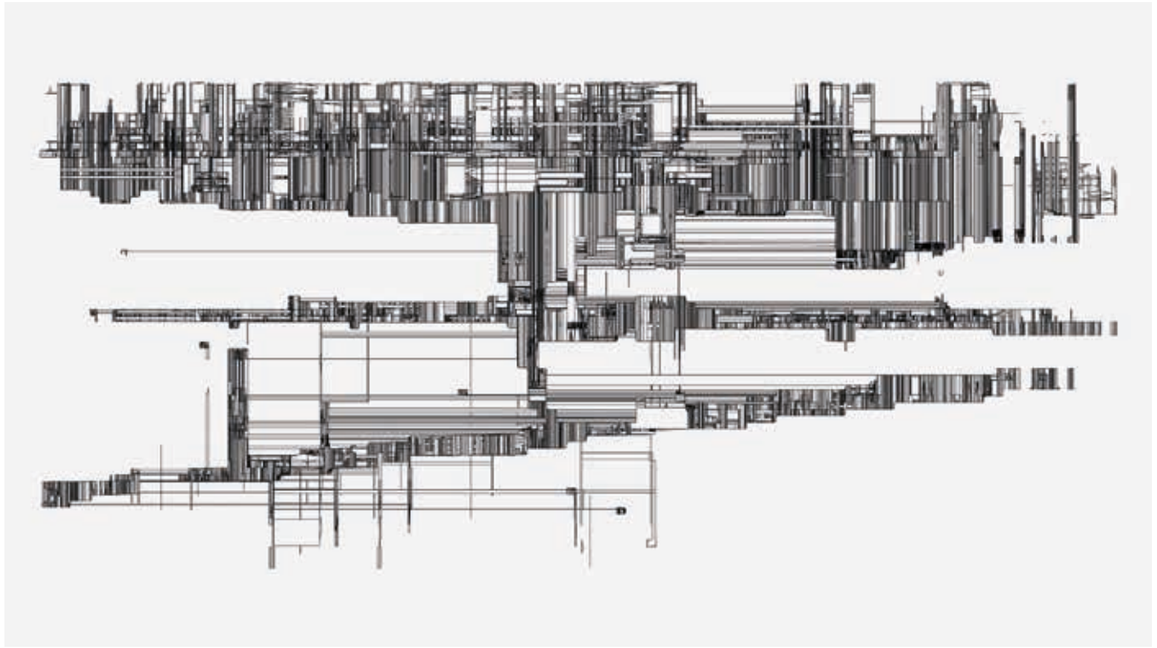

Fig. 2: Matthew Parker, *Data-Rich Section 011*, digital media, The speculative sections of fifteen projects are superimposed and composited through a computational workflow that mobilises SIFT algorithms towards the production of new architectural assemblies.

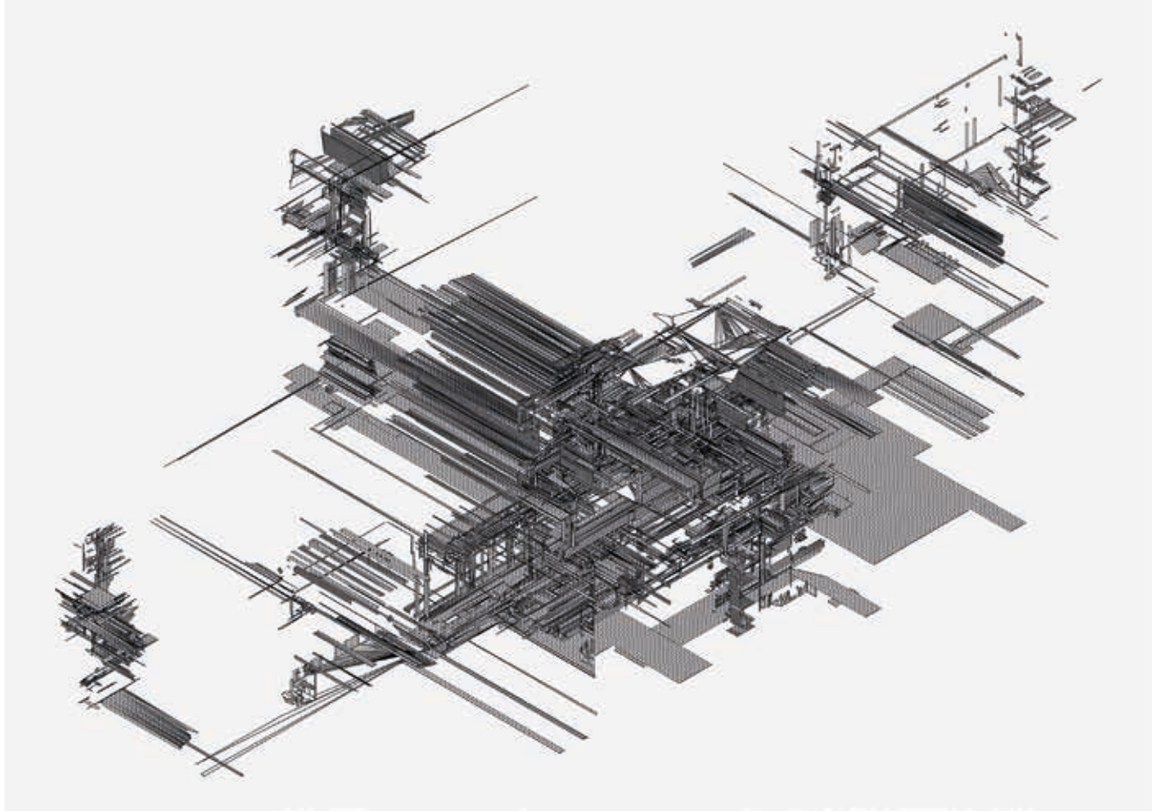

Fig. 3: Matthew Parker, *SIFT'd Form Study 006*, digital media. The n-dimensional vectors of five data-rich plans and seven data-rich sections are mobilised as the construction lines for an architecture accessed and visualised through algorithmic observation.

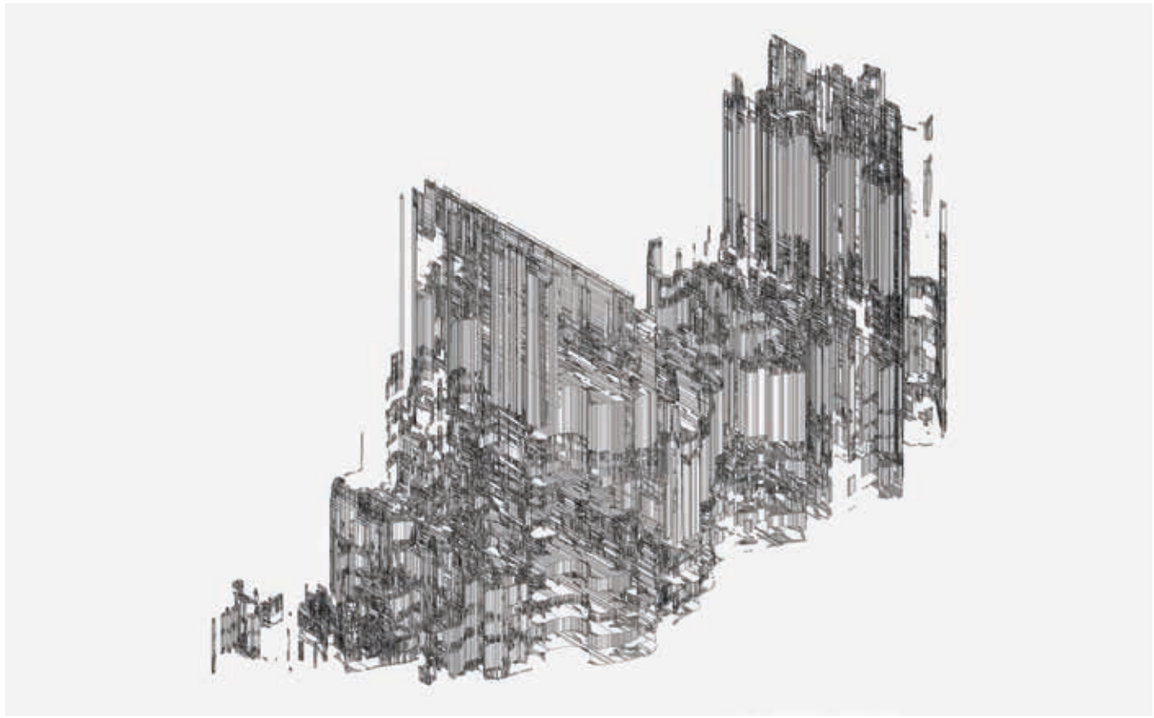

Fig. 4: Matthew Parker, *SIFT'd Form Study 026*, digital media. The n-dimensional vectors of eighteen data-rich plans and six data-rich sections are mobilised as the construction lines for an architecture accessed and visualised through algorithmic observation.

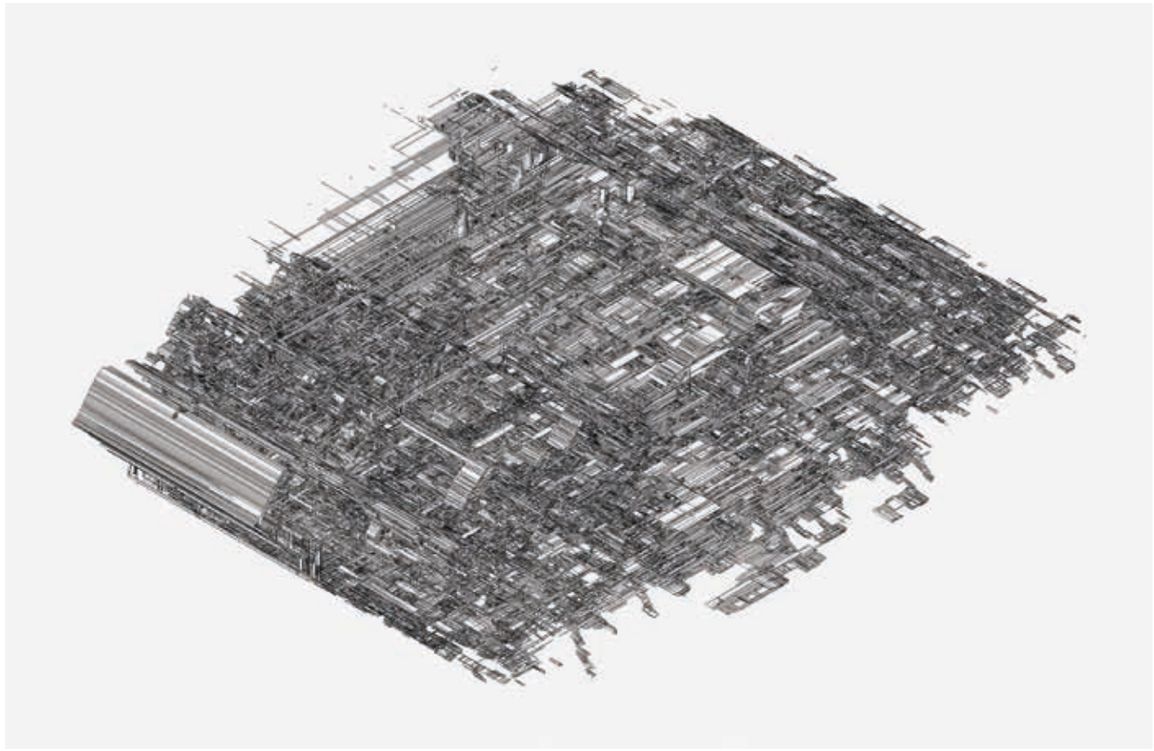

Fig. 5: Matthew Parker, *SIFT'd Form Study 059*, digital media. The n-dimensional vectors of thirty-four data-rich plans and twenty-one data-rich sections are mobilised as the construction lines for an architecture accessed and visualised through algorithmic observation.

THE DRAWING IMPLICATIONS OF SIFTS

The machine vision protocols of AO computationally deconstruct images into collections of unique features that can be identified, organised and matched across dynamic image sets. Often overlooked within this statement is that AO relies on images of *existing* artefacts to produce vision. The implications of this is that anything 'new' produced through AO exists in relation to a set of input images and visual data that describes a previously documented artefact. This is not to say that AO cannot produce novelty – in fact, the opposite is true; AO must produce 'new' to signify the existing. Just as an artist produces novelty through the intentional augmentation of a medium, AO perpetually produces images that rely on an internal and autonomous interpretation of data. Simply put, AO outputs should be engaged in a manner more akin to paintings or drawings than photographs. It follows that the value of AO for architecture goes beyond its (in)ability to accurately construct architecture's digital footprint, but resides instead in its ability to access previously concealed data intensities that are simultaneously present in the built environment and suggestive of speculative ecologies and future worlds.

If architecture is to access the excess produced and exposed through AO, it must first gain entry into the computational logics that govern computer vision. This project situates SIFts (Scale-Invariant-Feature-Transform)[2] and their associative algorithms as the primary protocols of AO, as they enable AO to identify specific invariant image features across extensive image datasets. SIFt algorithms abstract multiple images into their geometric constituents in order to make sense of a particular object or scene, a process that relies on the construction of locally defined SIFt descriptors, or *keypoints*, that contain clusters of pixels representative of a unique image feature. Once a series of images has been codified through SIFt processing, AO algorithms search image datasets for correlate keypoints, which are then superimposed and mapped on top of each other, a process that flattens multiple datasets into a single *data-rich-territory*. A data-rich-territory is a datascape whose quantity of data trees does not change but the complexity of each data tree is magnified to respond to the superimposition of multiple bodies of *soft data*.[3] This process of superimposition results in the construction of n-dimensional vectors, vectors that this project extracts and mobilises towards the conceptualisation of an architecture otherwise withdrawn from unmediated perception; an architecture capable of distorting, destabilising and defamiliarising unmediated artefacts of architectural production.

DRAWING WITH N-DIMENSIONAL VECTORS

As large aggregate sets of architectural drawings (plans and sections) are processed through a previously developed SIFt platform,[4] they are abstracted to their recognisable geometric configurations. These SIFt'd plans and sections (Figs. 1 and 2) are processed and superimposed, constructing n-dimensional vectors that are extracted as a *vector-flow-range*, a spreadsheet that includes the UV values for each pixel's vector and the maximum and minimum vector difference between correlate images. These vector values are mapped to 3D model space by extracting the UV directional values of a pixel and its associated vector magnitude to produce dynamic *vector-flow-fields* that represent the amount of movement a keypoint undergoes as correlate keypoints are composited.

The vector-flow-fields produced through the processing of plan drawings are mapped to the XY plane of 3D model space, with the vector-flow-fields associated with sectional drawings mapped to the XZ and YZ planes (dependent on their longitudinal or latitudinal qualities), creating a three-dimensional vector field. By testing plan-based and section-based vector-flow-fields for intersection, new geometries start to take shape. Mesh faces are produced around the point of intersection, with the face extruded outwards, perpendicular to the plane of the dominate vector.[5] The faces act as a tracing of complexity contained within and across correlate keypoints, with the overall 'complexity' of the output image defined by the number of input images and the number of overlapping and intersecting SIFT descriptors inherent to a composite set of architectural drawings (Figs. 3, 4 and 5 show varying complex assemblies produced through increased levels of soft-body superimposition).

FUTURE WORLDS AND SPECULATIVE ECOLOGIES

Through a design strategy of heteromorphic deformation to embed historical and speculative architectural artefacts into newly formed n-dimensional bodies, this project seeks to expose a veiled dimensionality concealed within the withdrawn qualities of an object. By activating hidden bodies of *new* data, these drawings embrace AO as a technological agent capable of shaping our experiences and relationship to the city. Outputs of this methodology are merely a first step in accessing and mobilising architecture's concealed vectors – a preliminary investigation into an architecture that utilises AO within a drawing methodology that seeks to represent the concrete futurity of the city while simultaneously signifying its digital spatiotemporalities.

[1] Benjamin Bratton (2015) discusses the uncanny qualities of the machinic visual subject, a subject that can be understood as transferable with the algorithmic observer within the context of this investigation.
[2] SIFTs, first developed by David Lowe (1999), are invariant to feature scaling, rotation, illumination and 3D camera viewpoint. Due to their strong matching capabilities and computational stability, they are deployed for the purposes of image retrieval, image stitching, machine vision, object recognition, gesture recognition, match moving and, for the purposes of this project, architectural drawing.
[3] 'Soft data' is a term put forward within this project to describe datasets that possess the ability to elastically deform in response to external forces while not altering their original unique characteristics.
[4] This research builds from the computational protocols of the SIFT Flow Algorithm produced by Ce Liu and team (2011) and has been modified to reflect the intentions of this project.
[5] The dominate vector is determined by testing intersecting vectors and identifying the vector with the largest magnitude. Extrusion perpendicular to the plane of origin is utilised as extrusion along the length of the prevailing vector or an averaging of all directional vectors produced a general illegibility and fuzziness within the drawings.

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Phenomenon of Transparency: Cityscape Transformations Mapping

Snezana Zlatkovic

The aim of this work is to explore the impact of *transparency* in relation to transformations of a city, i.e. to reveal how many layers of transparency can be placed within the heterogeneous urban structures that our cities have become. The phenomenon of transparency constructs the cityscape from different layers of representation. Together, they compound the complex situation of *literal* and *phenomenal* transparency. The urban structure is becoming difficult to perceive – from its very size to its spatial values and its specific aspects. In other words, the city provides a significant domain for researching drawing: the insufficiently explored role of architectural drawing in interrogating the transformations of heterogeneous urban structures and the meanings this could impart on the architectural design process.

Rapid progress of urban changes has influenced the city so rapidly that such complex phenomena often remain unexplained. Moreover, the possibility for their transformation into new concepts has not yet been explored. In order to explain the phenomenon of transparency, I start from two basic activity states. First, I analyse a fragment of the city separately for each of the states. After that, I merge them through drawings according to how they have transformed and changed. The first state is the result of a historical process: a physical, closed, static structure that might be subjected to possible changes in the future. It is the product of various design processes, as well as of unplanned constructions. Together, these form a unique urban whole. The second state of activity belongs to the dynamism of the city structure. Drawing can articulate the variability and rhythm within the structure of a city – it is a series of single moments and lives that cannot be repeated, but might prove valuable for the process. On the other hand, our study is not based on making clear distinctions within the phenomenon of transparency, but on establishing the connections between actions in both identified states. Without putting *literal transparency* ahead of the

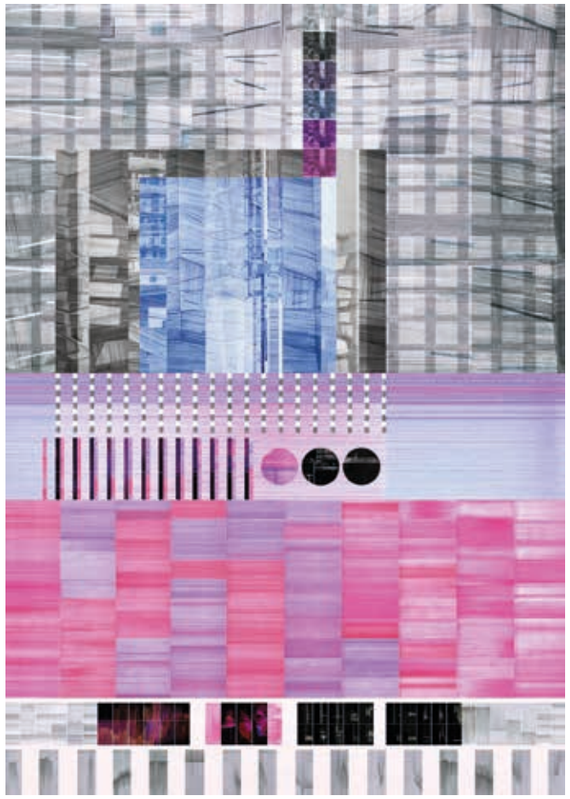


Fig. 1: Snezana Zlatkovic, *Phenomenon of Transparency: Cityscape Transformations Mapping – The Map of Methodology – The Books of Drawings*, 2016, digital collage, transfers of hand pencil drawings on paper, 59.4 × 84.1 cm. The sum of the first analysis of the most variable drawings which research the relationship between the states of transparency.

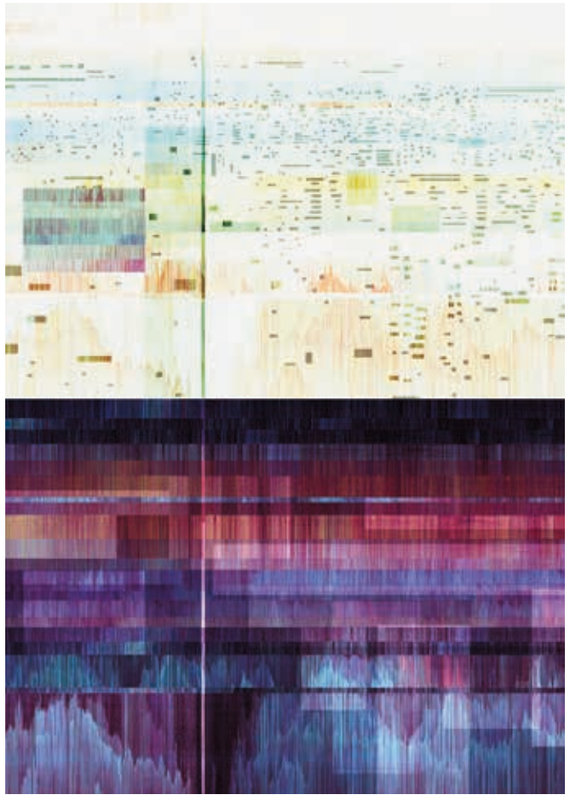


Fig. 2: Snezana Zlatkovic, *Phenomenon of Transparency: Cityscape Transformations Mapping – The City of New Belgrade – Experiment 1*, 2016, digital collage, transfers of hand pencil drawings on paper, 59.4 × 84.1 cm. The first experiment of methodology: encoding the fragment of reality of the City of New Belgrade.

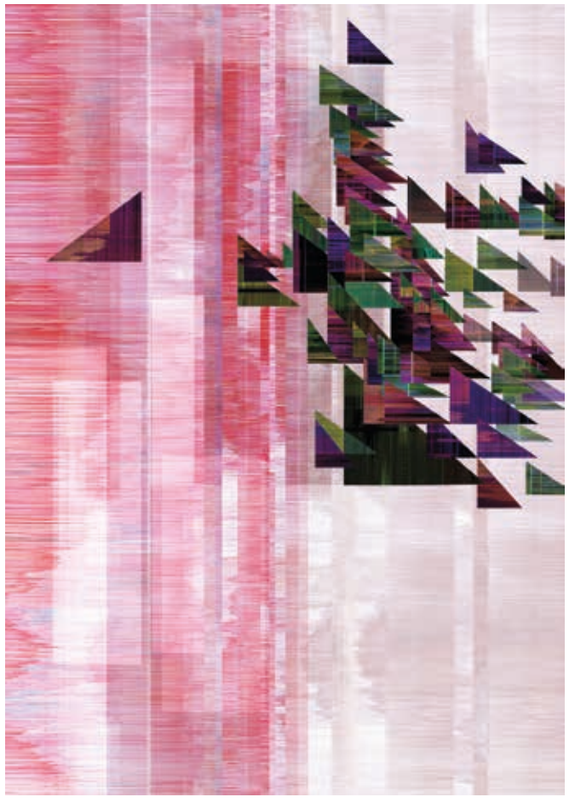


Fig. 3: Snezana Zlatkovic, *Phenomenon of Transparency: Cityscape Transformations Mapping – Suburbs Meeting the City of New Belgrade – Experiment 2*, 2016, digital collage, transfers of hand pencil drawings on paper, 59.4 × 84.1 cm. The second experiment of methodology: encoding the fragment of reality of the City of New Belgrade and its boundary with suburbs.

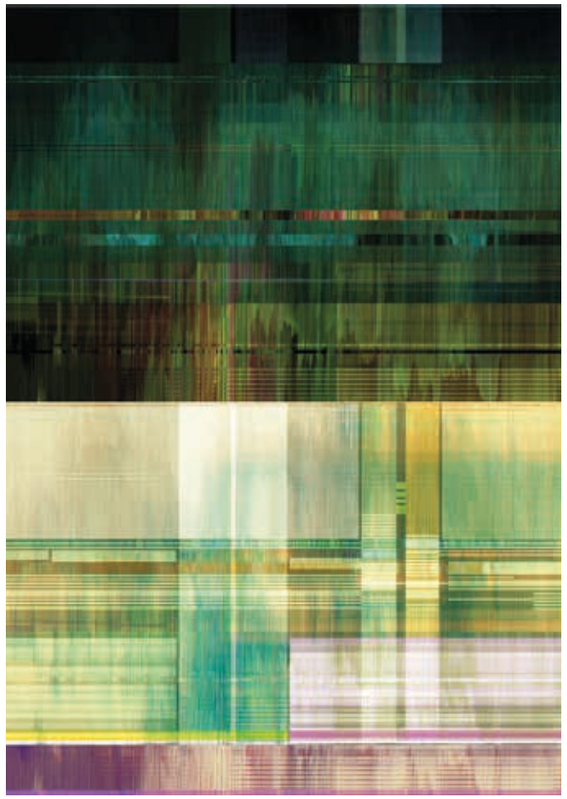


Fig. 4: Snezana Zlatkovic, *Phenomenon of Transparency: Cityscape Transformations Mapping –The City of New Belgrade – Experiment 3*, 2016, digital collage, transfers of hand pencil drawings on paper, 59.4 × 84.1 cm. The third experiment of methodology: encoding the fragment of reality of the City of New Belgrade.

phenomenal one, or vice versa, but by consciously taking both into account, we are on the verge of capturing the urban phenomena as a complete entity.

With two basic states of the phenomenon of transparency (static and dynamic), the methodology produces drawings as a sequence of experiments on cityscape transformations. The first results of this experimental methodology are two books of a hundred drawings each, researching scales of transparency (Fig. 1). The changes of transparency are explored with subtle, hand-drawn lines extracted from colour. These original drawings are then used as a resource material for the next phase of research – the digital processing of images via a series of computerised techniques (Figs. 2–5). Using both analogue drawing techniques and digital image processing brings new opportunities for analysing the complex and chaotic network of cityscape transformations, both working together to make them readable. In order to comprehend differences, we use the visible and the material to expose the invisible, the immaterial and their relation to the unbuilt. The study of spatial conflicts that are not directly visible through drawing stimulates new points of view and new analysis and finally yields new information. Therefore immateriality depends upon materiality and is based on the intuitive abilities of the observer and a certain level of his/her own knowledge and understanding of the phenomenon. Under these circumstances, we can reach the point of mapping transformations of the urban fabric where we can establish a common language in the drawing, an abstract code that communicates dynamism to the viewer. In order to create a poetic diagram for dynamic mapping, we search for answers in the relationship between the hand-drawing as the first critical tool and the computer as the second one. This relationship between the intuitive trace of a hand and the mechanised processes of digital tools provides our drawn methodology with comprehensive tools to encode any transformation using these techniques. While there is still something incomplete in the analysis when we draw purely by hand, there are many computer techniques that could upgrade these drawings to new levels of information; so that drawing becomes a critical tool to extract and explain the potentials of the layers of transparency within our cities that conventional tools may not address.

Methods of encoding levels of transparency through drawing also change our own attitudes to the space being drawn; at the beginning of each new drawing, we are trying to establish the distance of observation in relation to our view of the cityscape's transformations. By drawing, the architect has to be able to analyse and understand the speed of the spatial changes through the drawn process itself. Drawing these spatial traces sets up a basis for the architect to understand how to weave these abstract traces of unexplained phenomena in the future. The methodology captures all specific individual atmospheres of life in the city within a drawing, before the view shifts distance in order to perceive the ground of the city – to summarise all those lives.

This study of spatial relations, from inside to outside, from micro to macro, stimulates new points of view and new analyses between two ends of the potentials of transparency. I use drawing as a critical tool to try to decode spatial contradictions, to describe what belongs to the phenomenological experience, as opposed to the common understanding of the world as it appears to be. The role of the phenomenon of transparency is reflected in the fact that essentially separated, dispersed parts of the heterogeneous urban space are being merged through new forms of representation. Layer by layer, the drawings are slowly disentangling our field of view into new perceptions by inverting the contradictions, deconstructing the sequences and merging what is seemingly incompatible. Layers of transparency become sections through the cityscape's transformation. Uncontrollable appearances and disappearances of the transfigured spatial volumes, anatomised through drawings, build a new grid of traces, new moves and new rhythms, which could challenge the future organisation of our cityscapes.

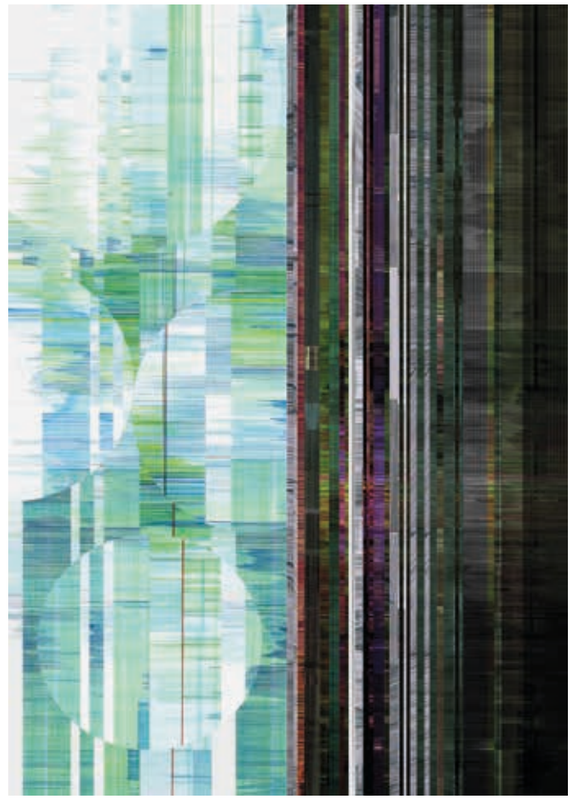


Fig. 5: Snezana Zlatkovic, *Phenomenon of Transparency: Cityscape Transformations Mapping – The City of New York, Manhattan – Experiment 4*, 2016, digital collage, transfers of hand pencil drawings on paper, 59.4 × 84.1 cm. The fourth experiment of methodology: encoding the boundary between natural and artificial on a fragment of the City of New York.

Drawing the Map, Drawing out the Territory

Nicholas de Monchaux

"A large part of an architect's life is spent beating his brains out trying to establish himself enough so that he can make a decent living – then when he arrives, his career is about over…" So reflected the then fifty-one-year-old Howard T. Fisher in 1954. "While this may be good for building strong moral fibre and advancing stamina," he concluded, "it's a pretty tough racket."[1] The irony was that Fisher, a patrician, well-mannered architect of shopping centres and prefabricated houses, was to make the greatest impact of his long career in a field largely unknown to him until several years later – the drawing of maps with computers, today known as geographic information systems, or GIS. Fisher's encounter with GIS, and in particular the way in which his architectural training caused him to deploy and demand from it more than had ever before been accomplished graphically and conceptually, would have a seminal (if not often acknowledged) effect on the field. His outlook and goals, moreover, offer a tantalising glimpse at a series of possible histories – and so also contemporary alternatives – for architecture's new encounters between drawing, technology and information.

"GRAPHICALLY TENTH-RATE"

Perhaps unsurprisingly, given the origins of the firm in nineteenth-century census counting, one of the first uses of IBM's computers by 1950s researchers was for the mapping of census data. This was not an entirely digital process, but rather one that added a layer of computer-produced numbers and symbols to a series of transparent overlays, bound together in a final, photographic composite.[2] It was at a two-week workshop at Northwestern University in 1963, led by Edgar Horwood (the pioneer of these techniques at the University of Washington), that Howard Fisher was first introduced to the concept. Almost immediately, Fisher thought he could do better. While he had closed his professional practice in 1957, retiring (or so he thought), he was moved by his own aesthetic outrage to begin a new career: "As I work on this whole problem," he would write in 1966, "I am impressed by how graphically tenth-rate a major portion of statistical maps are, regardless of the technique used."[3]

HOWARD T. FISHER

Drawing had been the central thread of Fisher's career. Arriving at Harvard in 1922, the well-born son of President Taft's secretary of the interior, Fisher's skill in drawing drew him to the fine arts department and then to the nascent Faculty of Architecture (which had been formally organised only ten years prior). He graduated *magna cum laude* with a BS in architecture in 1926 from Harvard College, having won two summer scholarships to draw and study architecture in France. Until 1928, he taught classes in drawing and architectural history while taking graduate classes. But the opportunity to begin work on building his brother Walter's house in his native Chicago proved too tempting, and he left Cambridge without receiving a master's degree in the spring of 1928.[4]

After six years of building in Chicago, he became a contributing editor of *Architectural Record* and turned himself to the problem, in his words, "of the low-cost factory fabricated house".[5] After detailing the history and prospects for prefabrication in the pages of *Record*, he leapt into the problem himself, organising the General Houses Corporation in 1933 to produce his own models of panel-built, prefabricated dwellings. Beyond the claims of economy and speed, the emphasis in General House's marketing materials was on the houses' good design. After coverage in *Fortune* and the display of a prototype at Chicago's 'Century of Progress' exhibit in 1933–34, General Houses would demand his full-time attention for much of the rest of the decade – but without providing him with a dependable income. It would take the demands and opportunities of wartime to alter his prefabricated fortunes; after limping through the 1930s, he was able to secure wartime contracts for prefabricated housing beginning in 1940.[6] Having entered government service through the provision of 'demountable' wartime housing, Fisher stayed in it through the postwar 1940s and early 1950s. First, he served as a consultant to the veterans' housing programme; then, through 1953, he served as a consultant to the Inter-American Development Bank, the Organization of American States and the United Nations, primarily in Honduras and Bogota, Colombia, where he became familiar with the machine-driven accounting and analytic procedures used in development work.[7] It was partially in recognition of this wide-ranging experience that Fisher was offered an adjunct position at Northwestern on his full-time return to Chicago in 1953, where, a decade later, he would first be exposed to computer mapping techniques.

DRAWING TOGETHER

While the techniques Fisher was exposed to in 1963 at Northwestern were highly original in their own way, they were also representative of the institutional origins and character of much of digital mapping. Even in the 1960s, computers were only owned by large institutions, and so the chief concerns in computer mapping were the interests of these institutions, who alone could fund the enormous costs associated with computer work (the rental cost for a single IBM 7090, on which SYMAP first ran, was $63,500 a month – or more than $500,000 in 2015 dollars). Edgar Horwood's work, for example, was funded largely from the enormous outlay of government funds associated with Title I urban 'renewal,' in particular from the Federal Department of Urban Redevelopment. The data-driven composite overlay maps produced by the University of Washington surveyed, for example, "census blocks with ten percent or more deteriorating housing units" in Spokane, each offending hand-drawn block obscured with a computer-plotted asterisk that foreshadowed its resulting demolition.[8]

Such a connection between resources and mapping was true – at a literal and continental level – of another pioneering computer mapping programme of the time: the vast Canada Geographic Information System, which gave its name to the emerging field. The Canadian GIS emerged from a policy discussion of the continent's natural resources and the fact, in the words of the system's founder, Roger Tomlinson, that "[a]lthough these resources had long been regarded as limitless, there was now competition among the potential uses of land in the commercially accessible parts of the country".[9] A 1968 film produced by the Canadian government, *Data for Decision*, highlights the sort of overlay-based map questions the system was intended to automate: "What resources can be developed?" "How fast?" "At what cost?"[10] At their core (which, by virtue of the primitive nature of the hardware they used, the first mapping programmes were not far from), computers parsed the world in a language of thresholds and decisions – black and white, not shades of grey.

Fisher's interest, by contrast, was precisely in shades of grey – both literally and conceptually – as well as, in further contrast (as it were) to those who came before him, in making the tools for digital mapmaking as widely available as possible. In this, he was guided by a vision of the process of shaping the physical environment – of design – that was as much intuitive as it was systematic. Fisher sought, in his own words, an "interaction of man and machines [that] emphasizes the power of each. The computer acts as a repository [*sic*] and processor of information i.e. it deals with quantitative information, while the designer controls the design process and performs the final evaluation *which is not readily quantifiable* [emphasis added]".[11] The result of this approach, initially cemented during a year-long collaboration with programmer Betty Benson at Northwestern from 1963 to 1964, was what Fisher called the SYnagraphic MAPping programme, or SYMAP. 'Synagraphic', a characteristic neologism of Fisher's, combined the Greek root *συν*, or *syn*, meaning 'together', with *γραφή*, meaning 'graphic' or 'drawing'. It emphasised the programme's ability not just to envision the world as a separate set of layers, but to manipulate and encode multiple variables together, in the same graphic field; its goal was, literally, to draw together – visually, strategically and creatively. In this, SYMAP emphasised the map less as method of optimally acting on the world and more as a method of seeing it anew.

To help advance his work on SYMAP, Fisher turned to the same foundations and public interest groups he had been moving among since wartime. Fisher and the Ford Foundation discussed the idea of a large-scale grant to develop SYMAP further, but as of 1964 it was unclear who the institutional recipient of such a grant would be. Fisher's appointment at Northwestern was as an adjunct instructor only and, while demonstrations of SYMAP had roused interest at both MIT and the University of Chicago, very little credence was given to his academic qualifications (or rather, his lack of them).[12] The solution came in 1965 with an appointment as a lecturer at the Harvard Graduate School of Design (GSD), since 1936 its own professional school within the university. But the GSD, focused on professional training, needed to create a proper research-focused institutional setting to potentially receive the Ford funds.[13] And so, under Fisher's direction and with the cooperation of Dean Sert, the Laboratory for Computer Graphics was created. It was there, finally, that the Ford Foundation awarded $294,000 ($2 million today) in January of 1966.[14] The grant's purpose was explicit: to develop and distribute SYMAP as widely as possible.[15]

THE SOFTWARE ITSELF

The first version of SYMAP, created in 1964, was later credited with establishing the 'basic functions' of all subsequent cartographic display software: "separating the base geometric data from the thematic attribute, scaling the map to different sizes and permitting distinct graphic treatment of the same source material."[16] Its instrument for doing so – the idea for which had occurred to Fisher upon observing Edgar Horwood's line-printed map layers in 1963 – was a treatment of the thirteen-inch-wide surface of line-printed paper, output from the IBM 1403 electromagnetic chain printer, as a graphic 'field'. The technique literally coaxed scales of grey from a system otherwise incapable of providing it.

The 1403 printer was a device sufficiently iconic at the time that it featured in the set design and plot of Kubrick's *Dr. Strangelove* (where it fatefully hides the transistor radio that reveals that the remote-sensed Soviet attack is not real). Instead of moving a type head to each position on the page – as in, for example, a contemporaneous electric typewriter – the iconic, computerised chain printer moved a 'chain' of raised letters behind an inked ribbon in front of the cog-driven paper. Within this mechanism, SYMAP could manipulate the printer's instructions so that, rather than printing recognisable strings of text, the device instead layered one character on top of the other to create a series of tones and lines, forming a recognisable image or map. Unlike standard IBM code, which was designed to allow overprinting of two characters only – to produce, for example, underlined text – SYMAP hacked the printer to overprint up to four characters on every point of the map's surface: the lightest texture could be given by a period; the heaviest by overprinting four characters such as 'OXAV' or 'MWI*'.[17] From this humble misuse came an expressive range of tone and texture.

At Harvard, Fisher's Laboratory grew quickly to meet several goals: the further development of SYMAP and related tools, the support and training of those at other institutions eager to use the software and, finally, the project of encouraging and experimenting with the use

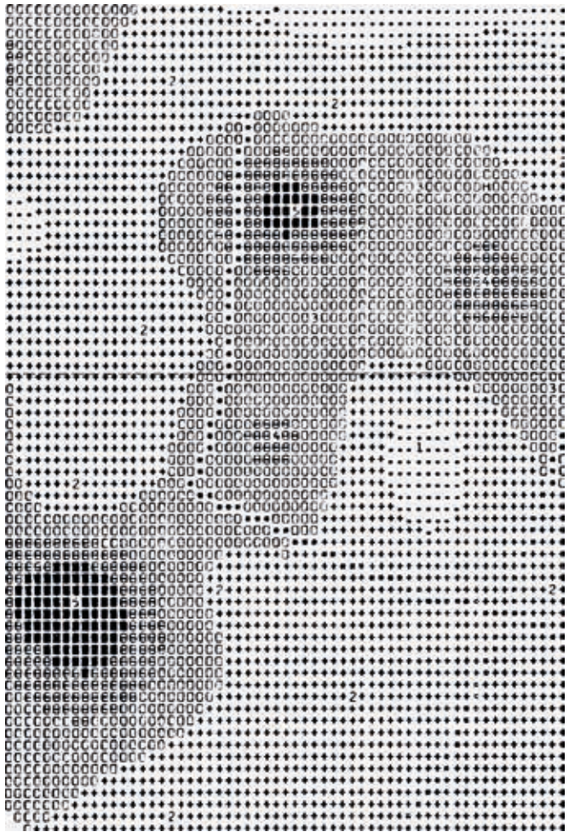


Fig. 1: A detail of a 1966 map prepared with SYMAP, showing a surface contour of car thefts in Boston Harvard University Archives, Howard T. Fisher Papers.

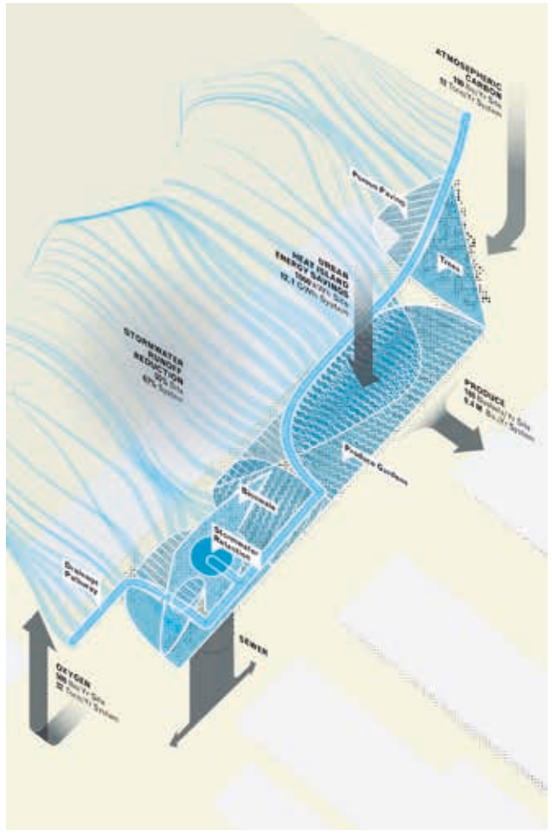


Fig. 2: Nicholas de Monchaux, *Local Code San Francisco Case Study*, 2009–16. Key to 1,375 drawings of individual proposals for San Francisco.

of the software by studios and programmes within the GSD. And yet the Lab did not own or administer a single computer. Rather, it simply prepared punch card stacks, including those containing the source code of SYMAP in Fortran, for what was (at the Lab's founding) Harvard's only such device – an IBM 7090-series mainframe located in the raised-floor computing centre several buildings away.[18]

Yet for all the singular success of Fisher's tenure as director of the Lab (which saw SYMAP become the most widely distributed software of its kind in the world), it was also singularly brief. He would reach Harvard's then mandatory retirement of sixty-six in 1969, the same year that the Ford Foundation funds were depleted, and in the event chose to step down a year earlier in what would turn out to be an unsuccessful attempt to allow the Lab's new director, geographer William Warntz, to better establish his leadership.[19] Nearly shuttered in 1974, when a sharply worded report judged its software distribution activities to be ill-suited to Harvard's goals and culture, and its efforts reduced in scope until its eventual disbandment in 1991, the Harvard Laboratory would never again hold the central role in digital cartography that it did during Fisher's tenure. Yet, viewed from a half-century's distance, several essential observations can be made about the contributions of this brief, mid-century moment, as well as about the alternative possibilities that might have emerged (and might yet) from its mould.

Firstly, SYMAP established for the first time the nature of digital mapping as a visual tool and not just an administrative technique. Unlike the more specific pieces of software prepared before and around it, SYMAP was not intended for a specific administrative purpose. And as a result, it had to define its own internal tools – of managing features, scale, data structures and a variety of graphic representations – far more broadly. More often than not, these functions were created out of a deliberate misuse and reappropriation of the information technology of the time – most visible in the overprinting and layering of supposedly singular alphanumeric outputs, but also visible throughout the software's economical source code.

Secondly, a result of his encounter with computing as a mature practitioner, Fisher made contributions towards an understanding of the precise limitations of digital mapping and practice. "It must be recognized," he wrote (in response to a 1974 GSD memorandum recommending closure of the Laboratory), "that the computer at its very best is nothing more than a tool. It is a remarkable tool in terms of its accuracy, speed and economy – and particularly in terms of its increasingly fabulous capability for storing information in memory ready for use. The computer must, however, be directed by human beings and thus can never be thought of as other than a tool." He then adds, for emphasis, "it is particularly important that this fact be recognized in giving thought to its potential role in *architectural* design".[20] Presciently and perceptively, Fisher openly declared the centrality of drawing – that is, representation as opposed to technical knowledge – to urban, landscape and architectural practice. This was SYMAP's great strength, and his own goal. The professions at the core of the GSD's mission, he argued in the same memorandum, had always been primarily concerned with visual communication. "It is unthinkable," Fisher contended, "to try to communicate from one person to another information as to the complex variables existing in an urban area without the benefit of graphic display – or to communicate the facts regarding an architectural design of more than the most elementary simplicity."[21] Yet what interested him about graphic expression in design was as much its subtle complexity as its superficial clarity. Nowhere is his awareness of the subjectivity of visual representation, and so of mapping as well, more vividly shown than in what became one of his last, great obsessions – the visual perception of tone and colour (or, in his belaboringly precise words, "the psychological evaluation of colour, as reflected from non-luminous surfaces").[22]

EXPANDING OVERLAYS

After Fisher, SYMAP was to become deeply influential both inside and outside academia – even as the conceptual character of its use was to fundamentally, and influentially, change.

One of Fisher's first hires on receipt of the Ford Foundation grant was a PhD student at MIT's School of Architecture and Planning, Carl Steinitz. Brought on as a research associate in the Laboratory, Steinitz would add an appointment as assistant professor in landscape architecture in 1966 and remain a full-time landscape faculty member at Harvard until 2007. Steinitz's particular contribution at this time was to connect the field established by Fisher with the emerging practice of overlay mapping as it was developing in landscape architecture and with the larger 1970s trend towards system-based approaches in design.

The use of overlays in landscape architecture was a direct result of their advocacy by the Scottish landscape architect and UPenn professor Ian McHarg – although Steinitz and his students, seeking to widen the foundation of their own efforts, subsequently traced their use as far back as the office of Frederick Law Olmsted.[23] McHarg joined Steinitz in 1971 for one of a series of studios Steinitz led with procedural map-based techniques (the first of these, using SYMAP, had looked at the Delmarva Peninsula in 1967). At times unapologetically anti-urban (the city is home to those "indistinguishable from the patients in mental hospitals" as well as "the bitch goddess of success"), McHarg's seminal 1969 *Design with Nature* – heavily featuring hand-drawn map overlays – set itself squarely in the countercultural environmental movement and sought above all a utopian merger of city and countryside.[24]

Yet map-based practice in this context developed into something distinct from the purely presentational tool that Fisher had originally envisioned or the related gestalt approach of observation advocated by McHarg. In addition to a device for visual demonstration and subsequent intuition, the map became the framework for a systematic, procedural design process.

Part of this can be traced, somewhat unintentionally, back to Fisher's own graphic production. As a developer of GIS in his late sixties, he was well-schooled in the awkward nature of reality and advocated mapping chiefly as a tool to better perceive it. Fisher was insistent, however, on a diagrammatic clarity when it came to preparing the conceptual outlines of a map for the SYMAP software, which was crucial for the intense structuring of data and calculation involved in the map's punch card-based production. To this end, he borrowed the visual language of the programming flowcharts often used in the preparation of Fortran code to explain the procedural steps of mapmaking and their translation into code. Such symbols had been developed as early as John Von Neumann's first writings on computer logic in the 1940s, and were so essential to the preparation of code in the 1960s (before higher-level coding and development environments gained widespread use) that IBM distributed plastic drawing templates to allow their efficient if-this-then-that construction.

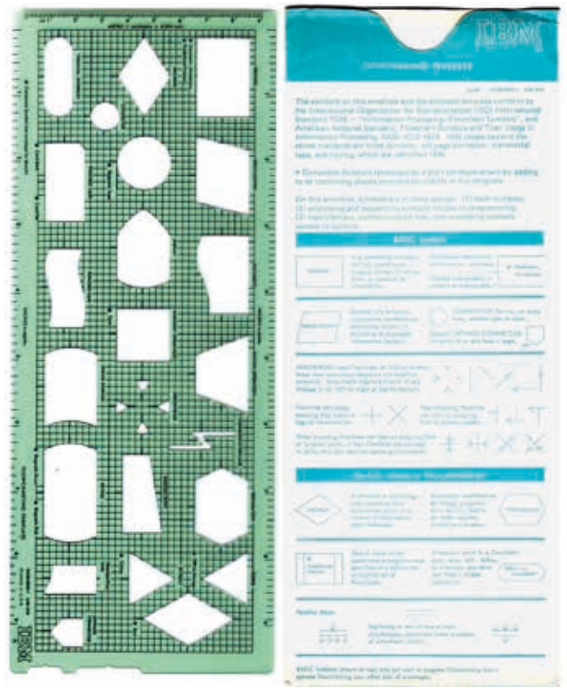


Fig. 3: IBM flowcharting template, 1962, collection of the author. Collection of the author

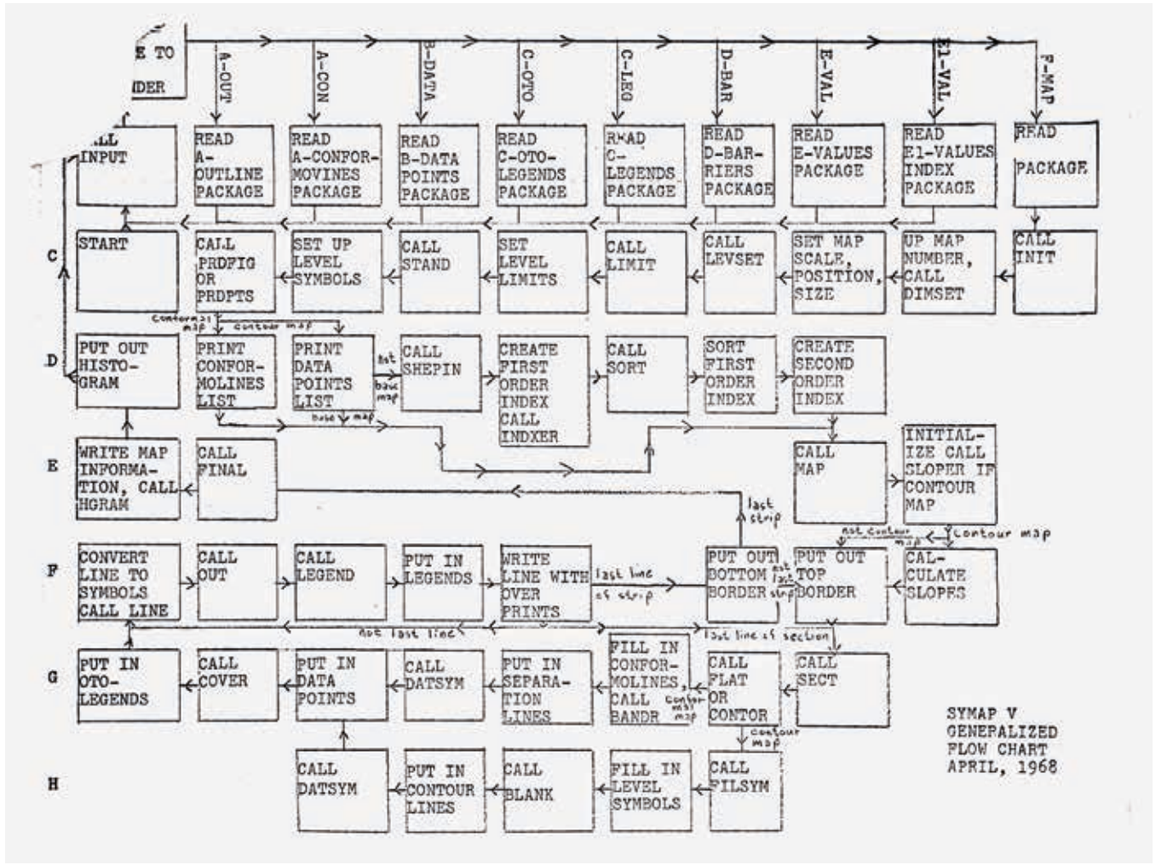


Fig. 4: *SYMAP V Generalized Flow Chart*, 1968. A diagram of the data processing of the SYMAP code in FORTRAN. Harvard University Archives, Howard T. Fisher Papers.

In this progression, we see first the flowchart of SYMAP's operations, prepared by Fisher in 1968, and then Fisher's later diagram of the strategic preparation of data and map design. The symbols, and logics, are precise – and near identical.

Yet in Steinitz' work, and in the larger field of systems-based urban planning, we see an extension of the logic of such diagrams; not stopping, as they did in SYMAP, with the map itself, but flowing out and around the map into the landscape of practice, in a series of ambitious simulations and design strategies. The result was a truly strange hybrid – an ostensibly open, ecological approach with military-industrial origins. Technocracy is victorious over drawing – yet that victory is belied by the central role of such representations in the triumph.

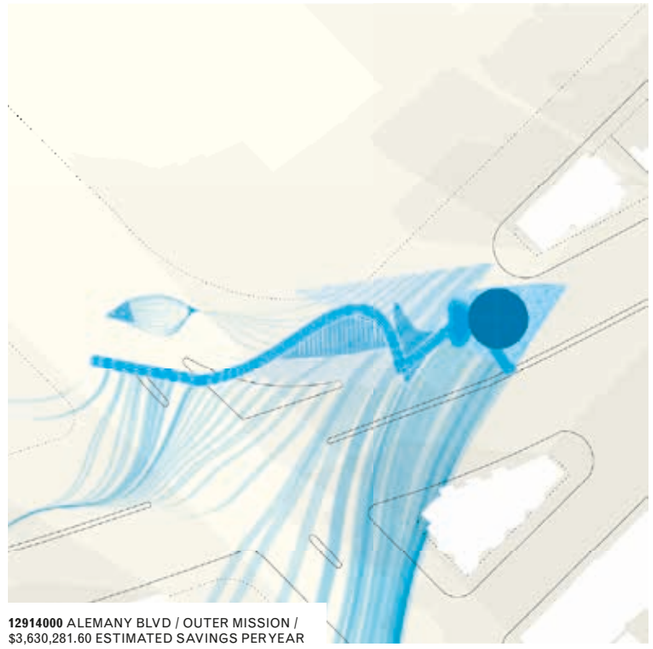
In the report of the 1970 studio, designed by Steinitz as a model for future practice inside the GSD and in the fields it sought to lead, we see a flattening of the diagram, leading directly from the ingesting of data at one end to the implementation of actions within it (if, for the sake of the studio, in the bounds of simulation). In such a diagram, the map is not the end to a process, but merely a symptom of it.[25] The territory of action is inside the machine and out in the world – but nowhere in between.

In such a systems-planning context, the computer map was only one point of feedback in a larger superprocess of cybernetic planning and feedback. Indeed, the report of Steinitz's 1970 studio – *A Systems Analysis Model of Urbanization and Change* – explicitly advocates for a procedural, systems-based approach not just to the practice of design, but to its education as well. This procedural and Boolean bent was to receive further reinforcement by another departure from SYMAP's original template; this related not just to GIS's conceptual architecture, but to its literal ownership and distribution as well.

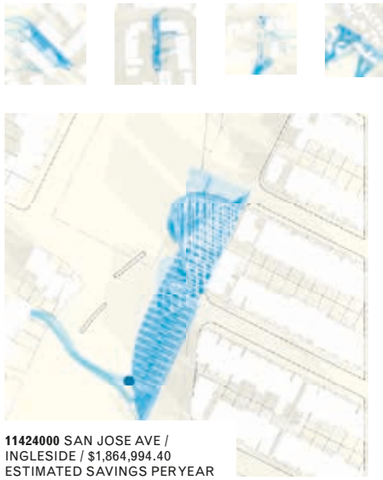
ESRI

"Really now – who is or what is ESRI?" wrote Fisher on 24 January 1973 to Laura Dangermond, the partner (both marital and business) of Jack Dangermond, one of Fisher and Steinitz's students at Harvard.[26]

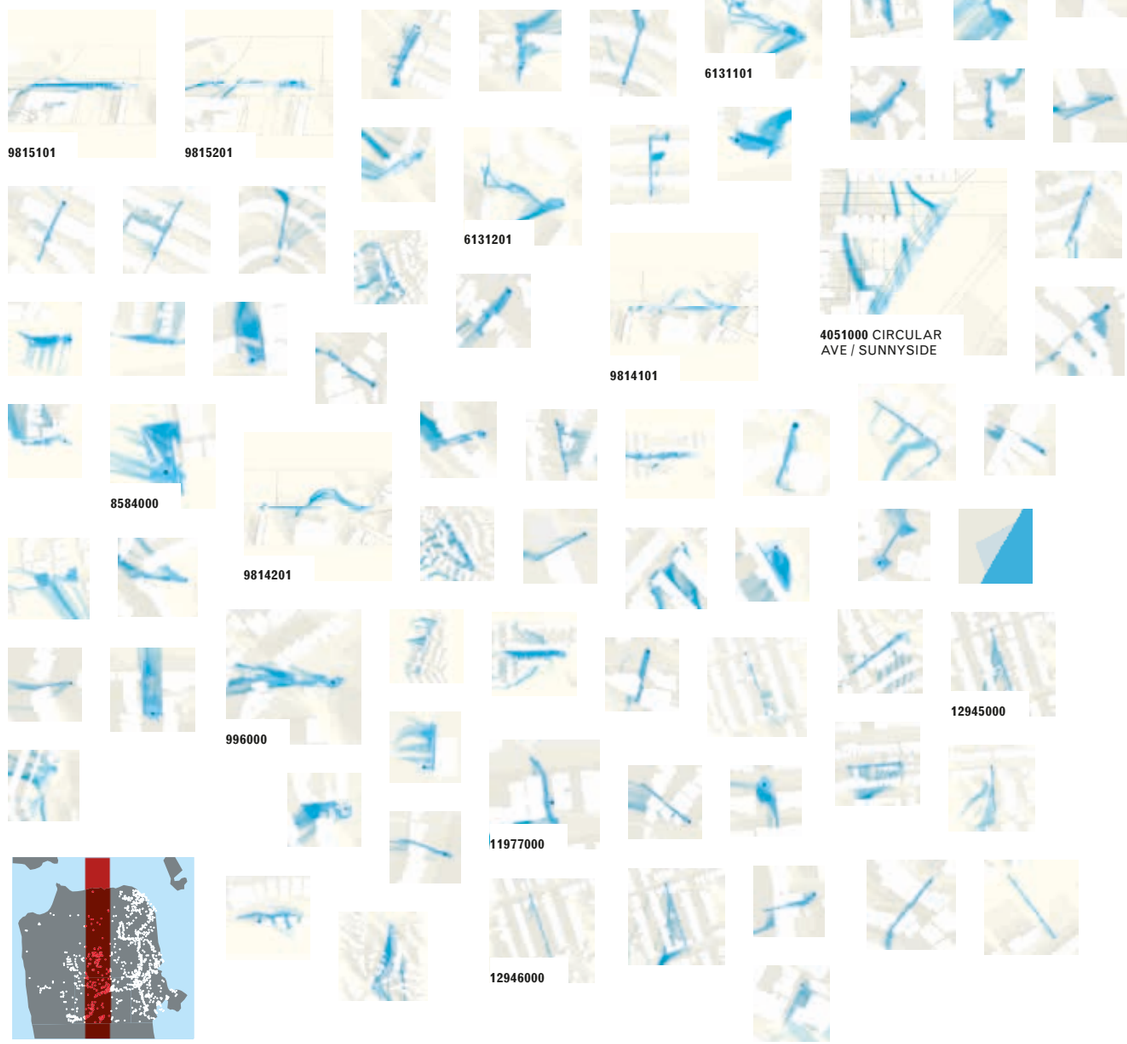
Fig. 5 (opposite): Nicholas de Monchaux, *Local Code San Francisco Case Study*, 2009–16. Selection of drawings for local ecological interventions in San Francisco, arranged from West to East and sized according to ecological contribution. (Stormwater remediation, heat island mediation, and carbon capture).



12914000 ALEMANY BLVD / OUTER MISSION / $3,630,281.60 ESTIMATED SAVINGS PER YEAR



11424000 SAN JOSE AVE / INGLESIDE / $1,864,994.40 ESTIMATED SAVINGS PER YEAR



Dangermond had come to Harvard in 1968 from Redlands, California, some eighty miles west of Santa Monica in the Inland Empire, east of Los Angeles (where his Dutch immigrant parents owned a landscaping supply store). After undergraduate studies in landscape architecture and environmental science at California Polytechnic State University, Pomona, Dangermond completed a one-year course in urban design at the University of Minnesota and an MS in landscape architecture at Harvard, the latter specialising in "systems for geographic information".[27] He then returned to Redlands to found what was initially billed as a nonprofit consultancy: the Environmental Systems Research Institute, or ESRI. Most of its early work was conducted using SYMAP.[28]

While the Harvard Lab had charged money to distribute copies of the programme on punch cards, especially after the depletion of the Ford Foundation grant, its code was open, modifiable by its users and in the public domain. By 1970, Fisher was recommending the "extremely inventive and competent" Dangermond and ESRI as a consultant on SYMAP.[29] Shortly afterwards, Dangermond approached him about taking on responsibility from Harvard for the correspondence lessons for SYMAP and SYMVU ('SYMbolic VU', a Lab-authored follow-on to SYMAP that allowed the depiction of continuous surfaces using a pen plotter). "Wouldn't it be great," Dangermond proposed, "if one organization were responsible for standardization and distribution of the various forms of computer graphic systems...?", adding, "I think I am very interested in grabbing hold and assuming responsibility of this project, if you feel [...] I am capable."[30]

Fisher was in turn so convinced of Dangermond's skills that he strongly encouraged him to take the position of Lab Director after William Warntz resigned suddenly in 1971. "[Y]ou are," Fisher wrote to Dangermond in May of 1971, "the single best living person for this job."[31]

And yet a different, and more difficult, tone enters into the conversation between teacher and student starting in late 1972: within the space of several months, ESRI would shed its nonprofit status and begin selling its own proprietary GIS software to government and industrial organisations. Dangermond publicly announced this strategy in a paper presented at the Urban and Regional Information Systems Association (or USIRA, founded by

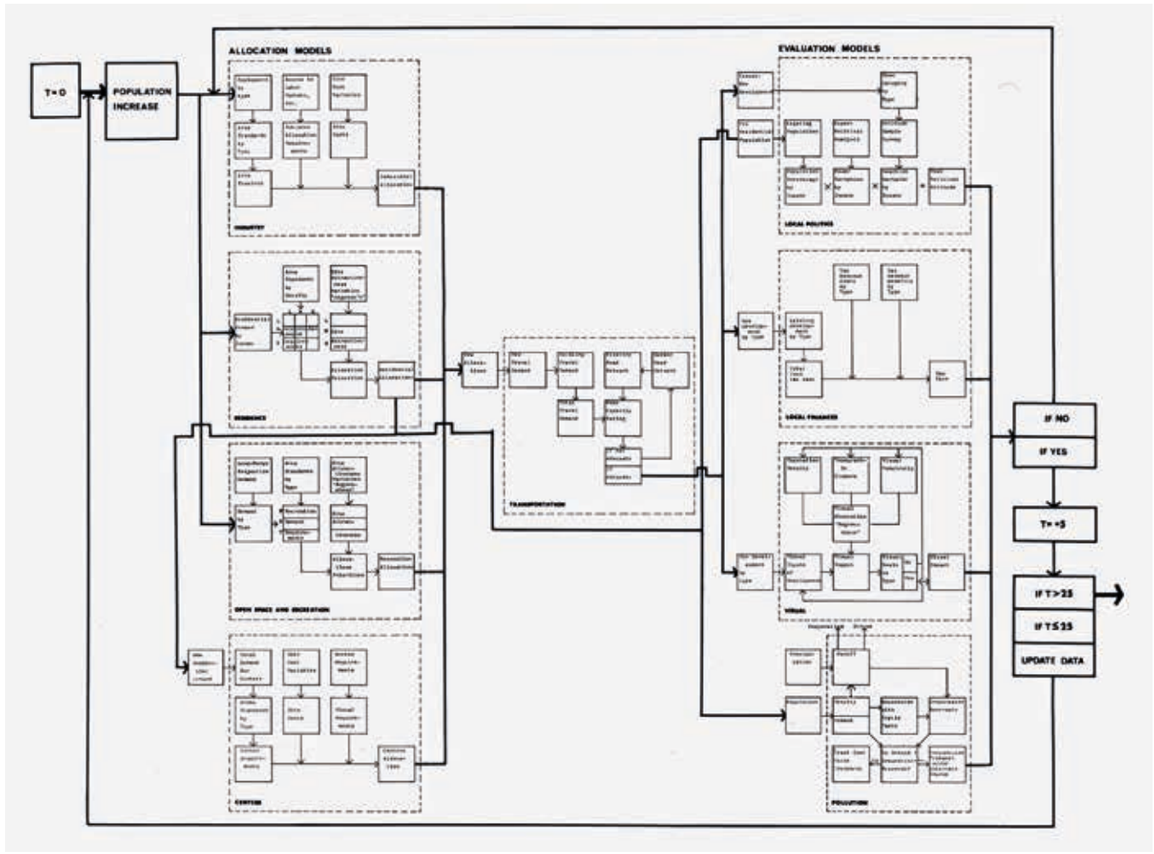


Fig. 6: Flowchart showing software, simulation, and design, from Carl Steinitz and Peter P. Rogers, *A Systems Analysis Model of Urbanization and Change: An Experiment in Interdisciplinary Education* (Cambridge, MA: MIT Press, 1970) Courtesy MIT Press.

Edgar Horwood) conference in the late summer of 1972; his submission announced a new programme, Automap 1, for sale by ESRI, that "does everything that SYMAP does and also fits on small computers".[32] Especially given the two programmes' shared Fortran code, this produced a pointed, if mannerly, response from Fisher: "I think your failure to give full and proper credit to SYMAP as the source of your endeavors has prejudiced a number of people against you in an unfortunate way," he wrote ("I never felt personally upset," Fisher hastily adds).[33]

SOFTWARE ARCHITECTURE

Writing in 1959 about a new machine developed to replace the 7090 on which SYMAP was developed, the IBM engineers F. P. Brooks Jr., G. W. Blaauw and Werner Buchholz were the first to apply the word 'architecture' to the relative arrangement of computer components.[34] For the computer in question, the IBM 7030, or 'Stretch', they proposed a rearrangement of the computer's interior circulation of information to achieve greater usefulness and functionality that – argued Brooks – was analogous to the rearrangement of physical space designed to achieve the same goal.[35]

In the case of SYMAP, ESRI and modern GIS, two questions about the software become relevant: first, its internal architecture – the way, that is, that the software draws in and treats the world. And second, its external architecture – how the software itself is shaped and distributed. From an Inland Empire storefront, the privately held ESRI has grown to control more than 40 percent of the now enormous global market for mapping software and services, and far more within the military and large corporations; this dominance proving resistant even to the disruption of digital mapping resulting from more freely available tools like Google Earth.[36] (The Dangermonds' resulting financial worth is estimated at $2.9 billion.[37])

However, the ESRI-driven version of GIS hewed closely not to questions of surfaces and their display, as had been SYMAP's original concerns, but rather to the simpler, Boolean logic that replaced it, in Steinitz's work and others. This remains true to this day, when the latest version of ESRI ArcMAP provides a visual editor of GIS procedures that deploys the arrows, decision points and outlines of latter-day programming flowcharts. The firm's subsequent success has been less in promoting the use of GIS by designers (few of which can afford the full software's expensive license) than in selling software and services to more deep-pocketed local governments, corporations and the military (this despite a recent marketing effort around so-called 'GeoDesign', complete with a Steinitz-authored textbook).[38] Here, the ultimate procedure is not so much representing the world and its possibilities for change, but targeting the resources of its powerful actors.[39]

THE MAP AND THE TERRITORY

In 1931, the Polish-American scholar Alfred Korzybski coined the phrase 'the map is not the territory' to describe the seemingly inevitable semantic and structural gap between the description of a landscape – of thought or earth – and its representation.[40] Yet, in regards to today's ubiquitous encounter with digital cartography, we are experiencing an ever-accelerating collapse of these two semantic conditions. This transformation is not limited to the design professions, but is transforming them just as surely nevertheless. And so, to a large extent, our territory has become the drawn map, and the drawn map itself an essential kind of territory. Thus, the final lessons from the story of Howard Fisher are these:

Firstly, maps remain at their most powerful when used not as instruments of unattended action or procedure, but rather as devices to change our perception of the world and our understanding of its possibilities. As Fisher implied, at their best they draw out and draw together.

And secondly, alongside its necessary precursor of drawing, architecture matters. This is true both inside and outside of the computer, and in particular along the connection between the two. Particularly as the distinction between the space of information and the space of our own cities is subject to its own, evermore complex shades of grey, we need to be mindful in a new way. We need to remember that the way in which we would seek to operate in the city – carefully, transparently, collaboratively and creatively – must hold true in the irreversibly interlinked space of city and data as well.

[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 Monchaux in Fisher's Harvard archive – Fisher's housemate in Tegucigalpa was my grandfather, French-Australian business machine consultant Emile de Monchaux. 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 Monchaux. 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, I–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, I–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, I–9.

[20] Howard T. Fisher, memorandum response, May 22 1974, HTFP, I–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.

Biographies

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 (CLUI), Los Angeles, the British Council and the Land Art Archive, Nevada.

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Contributors

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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 Ilnar 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 Lodders 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), Kunsthal 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), 'Eximitat' (Palma), 'Der Untergang – Doomsday' (Berlin), 'Connect the dots and see the unseen' (Roma), 'Interlife Crisis' (Seatte), 'The Radius' (Chicago), 'Il Pardosso 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 Lanuza 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 Arkitekter (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 Städelschule 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 Superieure 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 Hentrich 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.

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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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