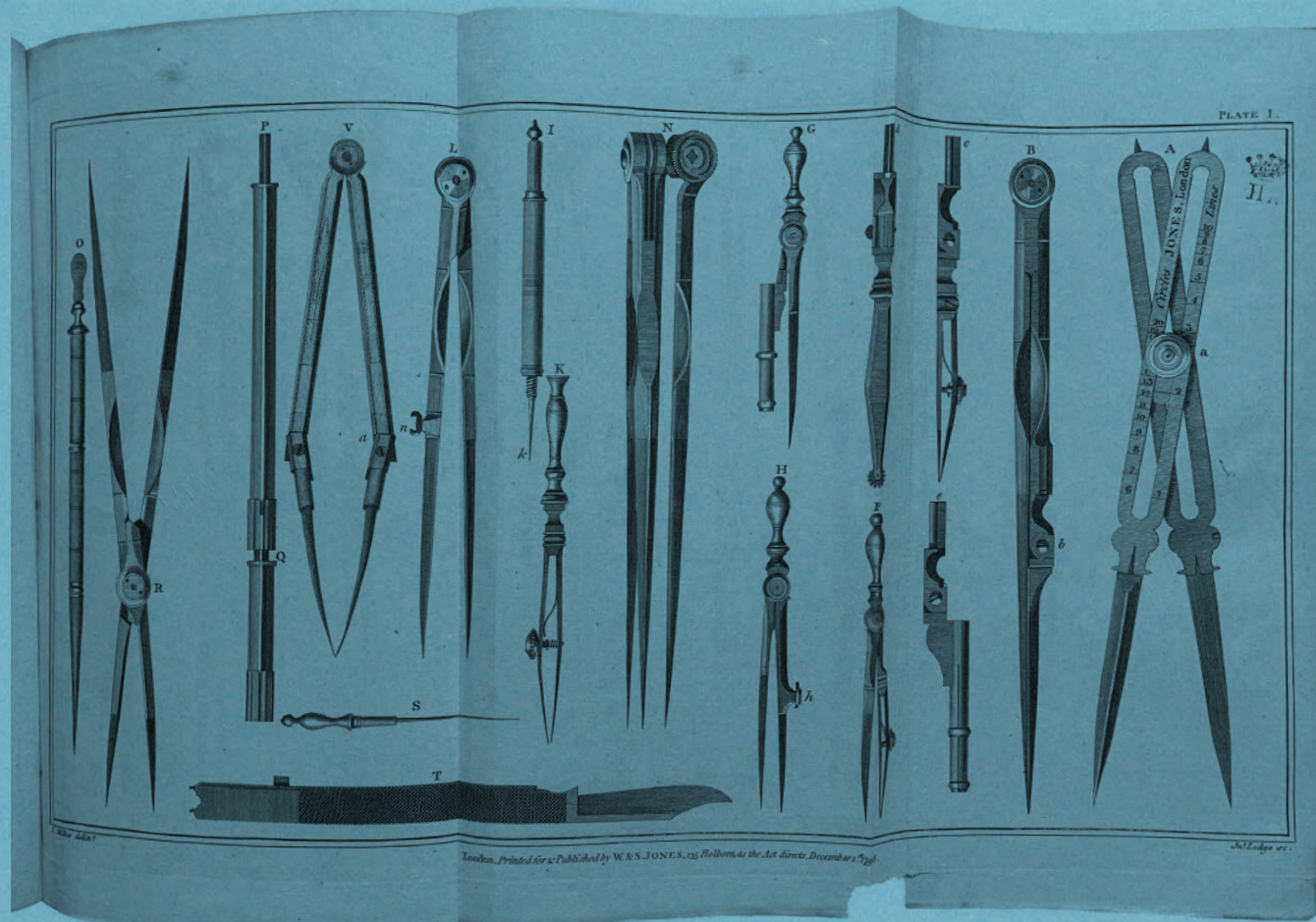


# Editors' Introduction —

Mark Dorrian and Paul Emmons



Place the thumb and middle finger of the right hand in the opposite hollows in the shanks of the compasses, then press the compasses, and the legs will open a little way; this being done, push the innermost leg with the third finger, elevating, at the same time, the furthest, with the nail of the middle finger, till the compasses are sufficiently opened to receive the middle and third finger; they may then be extended at pleasure, by pushing the furthest leg outwards with the middle, or pressing it inwards with the fore finger.<sup>1</sup>

This is George Adams, instrument-maker to the King, describing in detail something that we might think simply self-evident and banal – how to open a closed pair of compasses. The intricacy of the description, with its staged set of procedures, anticipates the accounts that he will shortly provide regarding the use of the device for transferring, dividing and scribing, and leads us to imagine our hands as themselves ‘instruments’, the precision of the device disciplining the body that will come to wield it. In the preface to his translation of Nicolas Bion’s *Traité de la construction et des principaux usages des instrumens de mathématique*, in whose wake Adams was writing, Edmund Stone had observed that ‘MATHEMATICAL INSTRUMENTS are the Means by which those Sciences are rendered

useful – the Affairs of Life. By their Assistance it is, that subtle and abstract Speculation is reduced to Act. They connect, as it were, the Theory to the Practice, and turn what was bare Contemplation, to the most substantial Uses.’<sup>2</sup> Here instruments are presented as mediating objects that negotiate between the ideal realm of geometrical figuration and that of material reality, and the exactitude toward which they strive is reflected in their own material constitution and the forms they take. The mediation brings a certain loss as well as profit, even if Stone’s emphasis comes down firmly upon the latter – the absolute is diminished, but this is the necessary precondition for the bringing to bear of mathematical knowledge upon the world. The legs of compasses straddle domains.

Signifying the demiurgic activities of measuring, apportioning, and setting in proper relation, compasses or dividers would become the characteristic emblem of architects, appearing in the frontispieces of their treatises and in their portraits, in which they are depicted as receiving or holding them – as in the 1776 portrait of the young John Soane, which Sue Palmer reproduces in this issue as part of her article on the drawing instruments of Soane’s office. Such images allow us to recognise that, as symbolic objects, instruments are never just narrowly functional and instead are things whose associations, morphologies and forms



of action carry meanings for us and engage our imagination in manifold ways. Throughout history, tools have exerted a powerful, even uncanny, fascination, exuding simultaneously promise and threat. As objects that, by turns, extend, amplify, and refine capacities of the body, and in doing so both mimic and reorganise it, so they have been imagined to display ‘character’ (explored, for example, in *Toolbox*, the 1996 book by the Mexican poet Fabio Morábito) or even to operate magically under their own volition. In ancient Athens, building tools like an axe that fell and injured someone were tried in a court of law with all the rights of a human defendant. If convicted, the tool was banished.<sup>3</sup> The esoteric power of tools is often relayed through ritual. Prescribing observances for the first entry into a newly constructed house, the medieval-age South Indian architecture treatise *Mayamata* directs that: ‘The builder’s implements are arranged on strewn grains contiguous to vases in the west. Offerings should be made to them and [prayers] should be pronounced from the middle of them.’<sup>4</sup> Afterwards, the architect is instructed to stand and salute all the tools before carrying them away. The 15th-century Chinese building manual *Lu Ban jing* recommends the ideal number of tools to be 28, corresponding to the number of constellations in the sky.<sup>5</sup> And yet in 1615 we find Vincenzo Scamozzi cautioning that those who ‘have come to believe that to draw well one has to rely on the quality and beauty of the instruments ... deceive themselves, because the beauty of the invention, the elegance of their form, and the levity of the wrist in guiding the hand, accustomed to drawing well, prevails over everything else’.<sup>6</sup> William Ford Stanley would preface his 1866 treatise on drawing instruments with an epigraph drawn from the writings of the poet and statesman Alphonse de Lamartine: ‘It was the hand of man which was the only machine of the spirit.’<sup>7</sup>

Architectural drawing has long been executed with the use of instruments which become somatically incorporated, so that even ‘freehand’ architectural drawing comes to reflect their influence. Over 2,000 years ago, Vitruvius instructed the use of the straight edge and compasses for drawing plans, the same instruments allowable for constructing Euclidean geometrical proofs.<sup>8</sup> Until recently, drafting tools were known as ‘mathematical instruments’, which encompassed a diverse field of procedures for measured geometrical drawing shared by architecture, astronomy, cartography, engineering (including ballistics), navigation and surveying, and which incorporated optical contrivances including devices for drawing in perspective, such as the camera lucida.

While mathematical instruments aim at universality (a circle, or straight line, or right angle is to be true irrespective of wherever and whenever it is drawn), there is, at the same time, an affective dimension in their use, which makes them not simply

equivalent. This may be to do with their provenance (with the way an instrument passes through time and our sense that something is conveyed through it), with the way an instrument ‘feels’, and with the pleasure that derives from drawing with it. Around these, attachments grow up that give a specific value to the use of something. We see the presence of this sensory aesthetic quality in, to take one example, John Farey’s discussion of rulers when he writes: ‘Ivory is the best substance for small rulers and divided scales, because being so smooth, the drawing pen slides freely against it, and draws beautiful lines.’ The only problem, he continues, is its ‘liability to warp on every change of the weather’, and so he recommends cutting it from the ‘tooth’ in such a way that the grain of the ivory radiates from the centre of the ruler ‘to appear something like the feather of a quill’, this ensuring that contraction and expansion are regular in all dimensions.<sup>9</sup> Moving away, and consciously so, from mathematical instruments, in her contribution to this issue Laura Harty gives us a striking example of the affective power of something taken up as a drawing tool when she discusses Aldo van Eyck’s propensity to use appropriated objects to draw circles with. These included, it seems, a totemic amulet for which he harboured particular affection and whose image he reproduced in his circular-plan Sonsbeek pavilion. It is something that seems to bring an entire thought-world to the work and to enchant it.

This example also allows us to recognise the way things harbour latencies or capacities that allow them to unexpectedly enter the stage of drawing and to play a role upon it. John Ruskin, for example, recommended stale breadcrumbs for the removal of pencil marks so as not to ‘waste the good bread, which is wrong’, making of them an instrument whose edibility resonates with the later characterisation of Carlo Scarpa’s eraser, by his associates, as a ‘stomach’.<sup>10</sup> (The intimate relation of drafter to drawing instrument is further exemplified by the modern practice of moistening a plastic eraser with one’s saliva to make it more efficacious for removing ink from Mylar plastic drawing sheets.) Archizoom famously used a typewriter, with its incremental character spacing, tabs and line return, to set out the spatial field of their No-Stop City (1969). Contemporary architects have developed approaches such as throwing rice grains or splashing liquids on drawings to produce aleatory outcomes. On the other hand, sometimes drawing tools evolved for specific purposes become displaced, taken up and put to other uses to powerful effect – in the pages below, Neil Bingham makes a case for the importance of the ship curve in the early work of Zaha Hadid.

In his contribution, Bingham also writes about William Ford Stanley’s *Descriptive Treatise*, to which we have already referred, a multi-edition

volume that is part scholarly exposition and part commercial catalogue for the prodigious production of instruments that flowed from his factory at South Norwood, Surrey. The proliferation of instrument types during the 19th century – a phenomenon of industrial development, invention, manufacturing capability, commercial exploitation and the distribution of competencies involved in production – was testament to a significant mechanisation of drawing in which knowledge of the process of the geometrical construction of figures increasingly became inscribed in the material assemblage of the instrument itself and thus ‘objectified’. A publication like Stanley’s comes to resemble a natural-historical taxonomy with genera and species, a strange bestiary of mechanical creatures (the Centrograph, the Elliptograph, the Helicograph, the Conchoidograph, and so on), each evolved in relation to its own ecological niche in the realm of drawing. While such elaborated instruments are constructed to produce precise and foreseeable outcomes, at the same time the delegation of knowledge and agency to them can foster dreams of machines whose operation returns to us not the constant repetition of the same but instead the unexpected and contingent, and whose workings have the character of an event. Nat Chard’s ‘instruments of uncertain occupation’ are cases of such post-Duchampian devices, impelled by obscure forces and desires. Iteratively elaborated mechanisms that stage chance, they have one foot in the kind of complex drawing instruments we find in Stanley’s *Descriptive Treatise* and another in the histories of perspective and ballistics.

In framing this issue, we wanted to press upon the question of how we conceptualise instruments and where they are taken to begin and end. While we tend to think of instruments as things that are directly manipulated and that we understand as ‘active’, the result of drawing is the outcome of a complex series of interactions, to which – for example – the specific qualities of the kind of paper (the way it interacts with ink, its resistance to the movement of the pen, its texture, tonality and stability) contribute as much as the instrument in the hand. A familiar historical object like a tee-square is likely to be viewed as somehow more an ‘instrument’ than the material surface in relation to which it moves, but its use implied a ‘true rectangular drawing board’,<sup>11</sup> whose sides would come to be defined by a hard ebony strip, like the edges of the tee-square itself. Equipment, a singular word that is invariably plural, expresses the interlinkage of instruments working together in order to constitute a world. Thought in this way, the idea of the instrument extends outward into the more general environment of drawing, an environment patterned by manifold physical, technological and ideational interrelations (recipes and procedures for doing things themselves being instruments).

With this complexity in mind, we sought also to be attentive to the specific materiality of contemporary digital devices and instruments and to the kind of media transformations that occur as drawings pass through – or emerge within – the operations and effects they enable.

This breadth of approach to the concept of the instrument is reflected in the contents of this issue. We begin with Philip Steadman’s exploration of the use of the camera obscura by the 18th-century Venetian painter Canaletto (Giovanni Antonio Canal). Key to the argument is a series of sketches of locations in Venice drawn in a notebook that is now held in the Gallerie dell’Accademia. By overlaying these drawings on contemporary photographs, Steadman is able to demonstrate a degree of accuracy in their delineation that would require the support of an optical device. Turning to Canaletto’s painting *Campo Santi Giovanni e Paolo* (1735–38), he shows how the artist was able to combine drawings taken from more than one location to produce what is in effect an early form of photomontage. We stay with cameras and with questions of visual position in Emma Letizia Jones’ study of the *Messbildkunst* (‘art of measuring images’) developed by the Prussian architect and surveyor Albrecht Meydenbauer in the second half of the 19th century to enable measured drawings, such as plans, to be made from photographs. Working in the wake of J.H. Lambert’s *Die freye Perspective* (1759), as it was transmitted through the instruction of Berlin’s Bauakademie, Meydenbauer’s photogrammetry used the geometrical analysis of an array of photographic perspectival images to ‘restitute’ the orthographic form of structures. Meydenbauer would leave behind an archive of around 20,000 photographs, a record of the city and its surroundings as an organised collection of discrete urban objects that, Jones observes, contrasts with the dizzying metropolis disclosed in his 1868 panorama with which the article begins. In Ahmed Belkhdja’s piece, which follows, we are again seeing through the apparatus of the camera, but now it is directed toward a computer monitor. Starting with a series of colour transparencies that the Japanese architect Itsuko Hasegawa took of representations of her early projects, the author builds an argument that these ‘drawing instruments’ – the early computer modelling software and screen interface, coupled with the camera that permitted the image to be effectively fixed (better than the contemporary printing technologies of the day) – allowed the visualisation of a particular concept of ‘distance’ that was fundamental to her idea of architecture and that she sought to achieve in her work. From this we move on to Nat Chard’s instruments, already discussed. Here too the mediation of the camera is positioned as essential to the experience of what is drawn, although in this case it is the speed and resolution of image capture that are key.



Next comes Fabio Colonnese’s consideration of squared paper as an instrument of drawing. While his focus is upon Italian material from the 15th and 16th centuries – he discusses complex uses of the grid to organise the relation between architectural elements by architects including Filarete, Francesco di Giorgio Martini, Bramante and Peruzzi – his wide-ranging account extends to the argument that, after early experiments, it would be in the context of large projects of landscape and territorial scale that the grid would come to the fore and exert its particular capacities as a structured surface of representation and instrument of design. We then pass to Ross Anderson’s discussion of the teaching of perspective technique, which reflects upon a remarkable and enigmatic drawing produced for didactic purposes by Friedrich Gilly, which was later owned by his pupil Karl Friedrich Schinkel. Referring to the scenographer Adolphe Appia and the painter Caspar David Friedrich, Anderson discusses how the rigorous construction of perspective would remain, albeit occluded, a component of the characteristic affective atmospheres of the landscapes of German Romanticism. Next Javier Girón explores the motif of the sun as a drawing instrument via the projection of shadows. Girón argues that the Vitruvian *vestigium* (plan), understood like a footprint in terms of pressure and weight, was conceptually transformed in 17th-century Jesuit thought into an optical condition – that is, understood as a shadow cast by the divine emanations of the sun as they pass through the diaphanous body of architecture. This leads toward a cultural history of the parallel projection of volumes, with its intricate deliberations regarding the nature of an eye required to comprehend such a projection. It was, Girón claims, the 19th-century disarticulation of the question of the observer’s position from the understanding of parallel projection that allowed the figures it produced to be recognised as shadows cast upon a surface of representation by a distant sun. We continue with axonometric projection in Sayan Skandarajah’s *Inside/Outside Kyoto* project, which refers to the extraordinary 17th-century views of the city on folding screens, in which scenes of buildings and urban life are revealed through openings in golden clouds. Working with point cloud files produced by photogrammetry, the project – with a view to these historic forms of representation – explores a poetics of gaps, indeterminacy and incompleteness in the depiction of the city. We conclude the long form articles with Jonathan Foote’s close reading of Borromini’s graphite drawings, which are vigorously rubbed and smudged, distressing their paper support and producing powdery crepuscular penumbræ that envelope and obscure the linear elements of the architecture. Foote argues for a sympathetic correspondence between the materiality of these drawings and that of the construction of the buildings that they

depict – *tevolozze* (recovered, typically broken, ancient bricks held within a thick mortar matrix) covered with *stucco romano* (a mixture of lime and marble dust). Interspersed with the long articles is a sequence of shorter ‘interpolations’. As well as the pieces by Sue Palmer, Neil Bingham and Laura Harty already mentioned, these include a consideration of Sir John Soane’s ‘upper’ drawing office by Helen Dorey, which invites us to think of the office itself as a complex pedagogical instrument; a report by Pablo Garcia on the *Zeiss Stereoautograph*, a vast and intricate early 20th-century photogrammetric drawing machine that enabled detailed maps to be made from the paired images produced by a stereoscopic camera; a consideration by Philip Steadman of a camera lucida owned by the engineer Isambard Kingdom Brunel, which is now held in Drawing Matter Collections; a presentation by Rosie Ellison-Balaam of an object of optical play by the Italian designer Enzo Mari; and a documentation of Paddi Alice Benson’s material explorations of the digitally controlled laser cutter as an instrument of drawing.

In the collections at the Soane Museum there is a curious object that the architect acquired in 1822, apparently believing that it had once belonged to Sir Christopher Wren. It takes the form of a walking stick with a bulbous rosewood handle within which is mounted a magnetic compass. When the handle is unscrewed from the cane, a pair of hinged and graduated 30-inch rods is revealed, which can be unfolded to make a single 5-foot rule. Moreover, the compass – which forms the cap of the handle – can be removed to expose a set of instruments nested below, comprising a pair of dividers, an ivory scale, a pencil in a brass mount, and a ruling pen (one item is missing). There is no record of Soane himself ever using this, and it is likely to have remained within the house as an imagined relic of the great predecessor whom he believed to have owned it. Still, it is interesting to think about, not least because of the suggestive consonances between tools of drawing and building that it intimates. Many mechanical drawing instruments developed as reduced versions of the equipment of building construction, giving us a vision of the drafting table as a miniature building site with all the tools of construction arrayed across it. The cane bears upon this relation, but from the other direction. It is a holder of instruments, but at the same time turns out to be a kind of instrument itself, its magnetic compass top providing orientation and the stick a support for the way a construction might be paced out on site (the 5-foot folded rule secreted within it approximated two paces). So, just as the architect might imaginatively pass across a drawing of a plan while ‘walking’ the legs of a divider across a sheet of paper, the building site itself might in turn be walked across and measured out with cane in hand.

- 1 George Adams, *Geometrical and Graphical Essays, Containing a General Description of the Mathematical Instruments Used in Geometry, Civil and Military Surveying, Levelling, and Perspective*. 2nd edn, corrected and enlarged by William Jones (London: J. Dillon and Co., 1797), 15.
- 2 Edmund Stone, ‘The Translator’s Preface’, in *The Construction and Principal Uses of Mathematical Instruments, Translated from the French of M. Bion, Chief Instrument-Maker to the French King*. 2nd edn (London: J. Richardson, 1758), v.
- 3 Walter Woodburn Hyde, ‘The prosecution and punishment of animals and lifeless things in the Middle Ages and modern times’, *University of Pennsylvania Law Review and American Law Register*, vol. 64, no. 7, (May 1916), 696–730. Derek Collins, ‘Nature, cause, and agency in Greek magic’, *Transactions of the American Philological Association*, vol. 133, no. 1 (Spring 2003), 17–49.
- 4 Bruno Dagens, ed. and trans., *Mayamatam: Treatise of Housing, Architecture and Iconography*, vol. II (New Delhi: Indira Gandhi National Centre for the Arts, 1994), 617–619.
- 5 Klaas Ruitenbeek, *Carpentry and Building in Late Imperial China: A Study of the Fifteenth-Century Carpenter’s Manual* Lu Ban jing (Leiden: E.J. Brill, 1993), 21.
- 6 Vincenzo Scamozzi, *L’idea della architettura universale*, vol. I (Venice: Girolamo Albrizzi, 1615), 49.
- 7 ‘C’était la main de l’homme qui était la seule machine de l’esprit.’ Titlepage to William Ford Stanley, *A Descriptive Treatise on Mathematical Drawing Instruments, their Construction, Uses, Qualities, Selection, Preservation, and Suggestions for Improvements* (London: Published by the Author, 1866).
- 8 Vitruvius, *De Architectura*, I. 2. 2. Wilbur Richard Knoff, *The Ancient Tradition of Geometric Problems* (New York: Dover, 1986), 15.
- 9 [John Farey], ‘Drawing Instruments’, in David Brewster et al., *The Edinburgh Encyclopaedia*, vol. VIII, (Edinburgh and London: William Blackwood, etc., 1830), 121–132 (122).
- 10 John Ruskin, *The Elements of Drawing: In Three Letters to Beginners* (New York: John Wiley & Sons, 1876), 21. On Scarpa’s rubbing out, see Carolina Dayer, ‘On becoming petrified: the erotic gaze in architectural conception’, in Mark Dorrian and Christos Kakalis, eds, *The Place of Silence: Architecture/Media/Philosophy* (London: Bloomsbury, 2019), 113–125.
- 11 From William Halfpenny, *Magnum in Parvo or the Marrow of Architecture* (1728), cited in Maya Hambly, *Drawing Instruments: Their History, Purpose and Use for Architectural Drawings* (London: RIBA, 1982), 31.