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Instruments of Uncertain Occupation — Nat Chard

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What is the disciplinary core of architecture? We are familiar with its status as a practice but when architecture is discussed it is mainly on the terms of other disciplines in the social sciences, arts and humanities, and science. Architecture touches these but is none of them. In schools of architecture the subject is cut up into parts that relate to these other disciplines – its social implications, its history and theory and the various technologies involved in its manufacture and operation. The act of being an architect, however, is in the bringing together of all these things. In architecture schools this happens in the studio and is enacted through design. One of the reasons that architecture has struggled to establish itself as a discipline in its own right, despite its venerable reputation, is that as a practice it relies on tacit knowledge. Other disciplines gain their authority from articulating explicit knowledge; or, in the case of the artist or the poet, their mysterious ways have a relational rather than a practical responsibility. Architecture operates in both realms at the same time. While architecture students sit through lectures that relate to the arts and humanities or to science, the core of their education is learning in the studio from experience, constructing personal or tacit knowledge.

In his consideration of tacit knowledge, Michael Polanyi observes that we know more than we can tell.[1] If other disciplines rely on their methods of constructing knowledge and then their ability to make that knowledge explicit in such a way that they can discuss their realm on their own terms, how can architecture, which is so dependent on tacit knowledge, operate on its own terms? This is a central question for the work discussed in this paper and originates from an inquiry into how to articulate the multiple uncertainties involved in the performance of architecture. The motivation for the work presented here has been to value those occurrences that go beyond what is anticipated in the programme as a source of the pleasure we find in architecture. Before addressing this, however, we must ask why this work might matter beyond its academic and practical aims.

For most of architecture's existence its disciplinary status has not been a topic of debate. More recently this has changed. Over the last 50 years, under the guise of 'accountability', politicians have devised strategies to gain substantial control, and simultaneously divest themselves of responsibility, by measuring everything that professionals do and setting performance targets. Such activities require a method and, consequently, attributes become valued for their quantifiability rather than for any value intrinsic to what is being measured. Attributes, however profound, that cannot be measured lose their value. For a practice without explicit

Larger illustrations and captions on pp. 14–36

disciplinary registers, this means that architecture is now assessed on the terms of other disciplines (this is also the case with architectural research). A practice and discipline unable to be explicit about the core of what it does cannot participate in these politics on its own terms. As a consequence, the core contributions that architecture can make to society have no voice and can be lost to external discourses.

This development leaves architecture without a set of terms on which it can play at the politicians' table. How can architecture speak on its own terms so that its potential is not subsumed? How can it declare its purpose and do so with the level of integrity on which a democratic society depends, when it lacks its own voice? These are questions outside the scope of this paper, yet they identify where work that attempts to establish a means of creating and discussing architecture-specific knowledge might contribute beyond the academy or in its application to architectural design. Some encouragement in addressing this question can be found when Marjorie Perloff explains:

> David Antin's definition, in the mid-seventies, of poetry as 'the language of art', a form of discourse which, rather than 'saying one thing and meaning something else', returns to the literal but with the recognition that 'phenomenological reality is itself "discovered" and "constructed" by poets'.[2]

The instruments that I will discuss in this paper attempt to discover and construct such realities.

Constructing architectural knowledge

Polanyi cites our ability to recognise faces as an example of knowledge we cannot tell. To counter this, he mentions police identikit methods, and suggests that:

> we can communicate, after all, our knowledge of a physiognomy, provided we are given adequate means of expressing ourselves. But the application of the police method does not change the fact that previous to it we did know more than we could tell at the time. Moreover, we can use the police method only by knowing how to match the features we remember with those in the collection, and we cannot tell how we do this. This very act of communication displays a knowledge we cannot tell.[3]

Is it possible to make tools for architecture that provide an adequate means of expressing our tacit knowledge, or engage our tacit knowledge in a way that makes sense to others? The drawing instruments examined in this paper are built with the ambition of helping us construct tacit knowledge and with the hope of being able to express that to others through the agency of the instruments, without it having to be translated into explicit knowledge.

The larger project learns from didactic instruments of explicit knowledge including anatomical and botanical models, planetaria and their projectors, as well as geometric forms and mathematical models. The most helpful examples, however, have been the habitat dioramas found in natural history museums. The initial interest in these came from their practical requirement to map an image on to a curved picture plane (I will return to this later), but they also provided myriad other gifts. One of these was the realisation that, through their careful construction by a group of scientists and artists, they could present explicit knowledge in such a way that visitors to the museum could tacitly (and unreliably) reconstruct that knowledge for themselves. In the best examples a rich spatial ecology

is set out that makes sense for the casual observer even if they cannot articulate the basis on which that sense rests. Rather than being told the answers, the visitors discover the knowledge for themselves in such a way that their imagination is implicated in the construction.

Examining the instruments of explicit knowledge might appear antithetical to studying conditions of indeterminacy and uncertainty, yet the lessons have been manifold, both instrumentally and relationally. If the instrument is carefully constructed and is charged with a sense of purpose it acts as a seduction, leading one not only to engage with the apparatus but also to treat its performance seriously. There is also the implication of method, which confers a sense of authority. The careful and consistent methods of the chronophotographic work of Étienne-Jules Marey and Eadweard Muybridge, which produced revelatory insights into human and animal physiology, also provided a legitimising mask for their exploration of other desires. The didactic instrument and method thus have the capacity to help both discover and construct phenomenological realities.

What might the equivalents of scientific didactic devices be – equivalents that embody architectural knowledge or help enact architecture? Architectural models can perform in widely ranging ways, but for the purposes of this discussion I want to highlight the history of didactic models that explain mechanics (of elements such as trusses) and statics. With regard to the latter, the Musée des Arts et Métiers reserve collection in St-Denis, just outside Paris, has a number of plaster and wooden models that tested and explained the geometries of stereotomy, explaining how various arches and domes might be formed and assembled. Architectural drawings may be divided into absolute and relative projections. Absolute drawings include plans, sections and elevations, in which the projection is abstract and independent of a single viewing position. Perspectival drawings, on the other hand, are relative to an observer who holds a point in time and space and provide a representation of that observer's optical experience. There are many tools for both types of drawing but for this paper those instruments that enable either relative drawings or the translation between absolute and relative drawings are the most relevant. To project perspective drawings from plans and sections tools such as the *centrolinead* or the *perspectografo* were developed,[4] while to make absolute drawings from views of the Château du Pierrefonds, in 1866 Auguste Chevallier built a panoramic camera that allowed him to make a photogrammetric survey from the camera's photographs.

Earlier, during the Renaissance, the development of projective geometry led to a range of didactic architectural devices and practical tools. These ranged from Filippo Brunelleschi's experimental perspective viewer to a variety of instruments related to the projection of munitions by cannons. Several of these, including the *radio latino* and a number of triangulating instruments, were used for projection (by those manning the cannons to calculate aim and range) and for 'reception' (by the military engineers constructing the geometry of the earthwork defences).[5] The reason for mentioning this example will become clear later, as the drawing instruments under discussion shift from optical projection to the projection of matter, and how the reception of that projection might be enacted in a critical manner. These brilliant inventions helped metrify their fields of operation with a degree of certainty by embodying knowledge that had already been constructed. The understanding of projection and linear perspective allowed discussion about the nature of the physical object and how it might be experienced, but what of the more nebulous performances of architecture – those aspects that are harder to grasp, let alone tell? The measured architectural perspective

was based on a geometric understanding of the world, but presumptions of such universality of experience would come increasingly to be questioned.

In 1927 the Russian rationalist Nikolai Ledovsky set up a series of psychotechnical experiments at the Vkhutemas school of architecture in Moscow. He claimed his experiments were based on those of Hugo Münsterberg, from the Harvard Psychological Laboratory, whose early experiments had concentrated on perception and sensation. Ledovsky's experiments included the *U-glazometr* and the *Plo-glazometr* to test the eye's accuracy in measuring line angles and planes respectively, and the more elaborate *O-glazometre* and *Prostrometr* for testing the volumetric and spatial properties of form.[6] The instruments had timber frames to locate the painted surfaces, mechanisms and charged vessels that were the active parts of the experiments. They were more overtly spatial than the instruments from Münsterberg's Harvard laboratory (which became widely known through their exhibition at the 1893 World's Columbian Exposition in Chicago). Nevertheless, Ledovsky's devices had the appearance and apparent authority of scientific instruments. While these experiments acknowledged the importance of our psychological engagement with space, Ledovsky's colleague at the Vkhutemas school, Viktor Balikhin, considered them too rationalistic and disregarding of that part of our consciousness that is touched by artistic practice.[7] By trying to find absolute measures in his psychotechnical experiments, Ledovsky was paradoxically trying to make the particular universal.

Relative representation and indeterminacy

Architects are trapped in a dilemma when they are asked to provide for something that their client wishes to happen in a certain place. The instrument of prediction is the programme, which sets out what is proposed to happen and how to allow for such events or actions in the architecture. The programme is necessarily reductive, for it is subject to both, on one hand, the impossibility of predicting circumstances and changes of ambition and, on the other, the variety of ways in which different individuals engage with the world. Indeed, for many of us this engagement is inconsistent from day to day, fluctuating with our moods and situation. Yet it is these indeterminate conditions, beyond what can be predicted in the programme, that contribute so much to our experience of the world. Similarly, by placing an emphasis on geometry and pictorial accuracy, the typical architectural perspective representation ignores conditions of perception brought by the observer. In architecture the relational structure of interpretation is complicated by the operational and legal imperative that the architect's drawings are understood similarly by all the agencies that come into contact with them – the injunction is that they all interpret the drawings in the same way. It is helpful, therefore, to step outside architectural representation for a while, not into a purely artistic world where relational poetics are completely open, but into attempts at rigorous ways of addressing the deeper personal contributions we bring to the meaning and character of architecture.

In the 1770s the German physician Franz Mesmer developed a theory of animal magnetism, a flow of energy transference between all living and inanimate things.[8] His story is complicated, but one of the reasons he struggled to gain recognition for his theories was the invisibility of the phenomenon and its consequent lack of representability. It was hard for his audience to find a point of communion with this secular theory. With the advent of photography, however, new realms of scientific analysis opened up, giving insights into previously unseen conditions. In addition to the physiological revelations of Marey and Muybridge, whose cameras were able to record a sequence of temporal instances with a clarity never seen before, the British physicist Arthur Mason Worthington was able

to take relatively high-speed flash photographs of the splash of a drop of milk, illustrating conditions ungraspable by the naked eye. Beginning in the 1840s, photographers such as William Henry Fox Talbot, Jean Bernard Léon-Foucault and Auguste-Adolphe Bertsch photographed (respectively) plants, bodily fluids and minerals through microscopes revealing previously hidden worlds to a larger audience,[9] while shortly afterwards telescopic photography revealed both the detail of the earth's moon and all sorts of astronomical occurrences, such as the transit of Venus across the sun. This revelatory capacity of photography, along with the apparent veracity of the images, made it an ideal medium for those with a fascination for phantasmagoria, resulting in work that ranged from poetically inventive speculations to cynical and manipulative practices.

In December 1895 the German physician Wilhelm Conrad Röntgen discovered what he called X-rays and made an image of the bones of his wife's hand that with normal vision were hidden by their surrounding flesh.[10] This repeatable process not only caught the public's imagination but also rebuilt its confidence in strange photographic procedures. The presence of such rays also suggested the possibility that other sorts of similar emanations might exist and added plausibility to a range of photographic processes that were capturing strange phenomena. One of these was the French physician Hippolyte Baraduc's photographic plates, catching what he claimed to be people's thoughts and even their soul.[11]

Dr Baraduc was a clinician at the Salpêtrière Hospital in Paris, a specialist in nervous illness and a student of Jean-Martin Charcot, a French neurologist and professor of anatomical pathology. Charcot is best known for his work on hysteria, although his clinical reputation is based on a wider study of neurology together with the impressive list of students he mentored, including Sigmund Freud and George Gilles de la Tourette (after whom Tourette's syndrome is named). As with Charcot, Baraduc is now best known for his work that now has the least credibility in medical circles, but it is that which is of relevance to this discussion. His book, *The Human Soul: Its Movements, Its Lights, and the Iconography of the Fluidic Invisible* was first published in 1896, shortly after Röntgen revealed his X-rays.[12]

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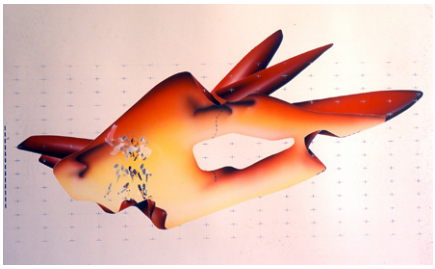
Baraduc called his photographic plates iconographs (X-ray images were called radiographs) and his practice fluidic photography (Fig.2). Some of them included figurative content with auratic registrations revealing the thoughts, anxieties or, in the case of the photographs of his dead wife, the departing soul of their subjects. These were taken with cameras, but many of his iconographs were taken with a simple light-tight container holding a sheet of light-sensitive material with no lens. He had previously tried to detect the fluidic invisible (his development of Mesmer's animal magnetism) with magnetometers and electrographs before settling on fluidic photography. He was a contemporary and sometime collaborator with Louis Darget, a French Commandant, and together they made images of thoughts from a photographic plate attached to a headband.[13] Jules Bernard Luys was a neurologist at the Salpêtrière who, with his colleague Émile David, started taking fluidic photographs following those of Baraduc and Darget. These gained greater attention through Luys' reputation.[14] In 1897 another French doctor, Adrien Guébhard, who had an additional degree in physics, made demonstration photographs following the publication of Luys' and David's research. In these prints he showed how the same results could be obtained with a combination of a faulty developing solution and the calorific action of the epidermis.[15] There is no pretence in this paper that Baraduc's iconographs were registrations of ideas or the soul – rather, what seems helpful from this work is that the speculation on the content of these images made such content discussable.



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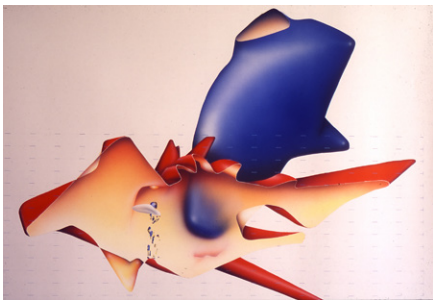

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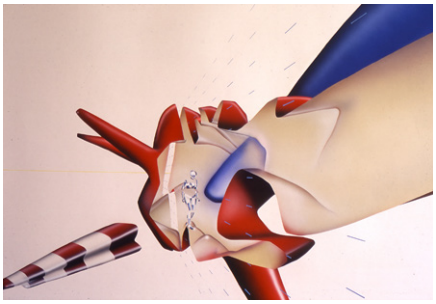

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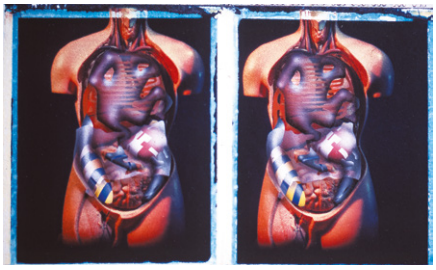

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When Muybridge's chronophotographs untangled the legs of galloping horses, the images were plausible partly because people were familiar with horses and their anatomy. It was therefore straightforward to make sense of the sequence of instances contained in Muybridge's images. We are less familiar, however, with what ideas or, indeed, the human soul might look like, and our imagination has to work to reconcile the auratic figures with what an image of an idea or a soul might be. The auras produced in Baraduc's iconographs might be the outcome of several processes or emanations, yet as artifacts they provide something to attach speculations about the nature of the soul or of ideas to, establishing a relation that Mesmer was missing.

Prelude to the drawing instruments

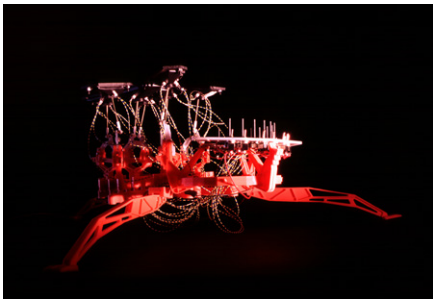
The architectural programme sets out what we can be confident will happen in the architecture we are designing. The drawing instruments that are the subject of this paper set out to explore what we cannot predict, happenings that are contingent on chance, coincidence, attitudes, turns of events, or are just too complex to predict. They also address the way that we, as occupants of architecture and the city, are implicated in their character and meaning. Two projects that precede the instruments help clarify the interest in this relational structure. The first was a speculation concerning two simple spaces (a hall and a staircase) whose conditions were generated by the desires and anxieties of their inhabitants, providing them with a share of authorship and giving the architecture its meaning as much from its occupation as from the work of the architect (Figs 3–7). A series of drawn studies hypothesised how we might develop a different spatial consciousness in such spaces. The second, which had several iterations, looked at the same issue from the opposite end. Instead of wondering how to make an architecture that is available for its occupants to take possession of, these body projects asked how we can take possession of architecture and the city as it already exists and is presented to us. Both architecture and the city make many claims about the closeness of their relationship with the human body. These projects implanted an internal architecture within the body that would alter its performance in relation to fundamental sites of connection with the city – via digestion and waste, heating and cooling, hygiene and so on – so that one could change the city for oneself, while another person might occupy the same place but experience it in a completely different way, depending on the internal architecture's settings. It would only be a person's consequent behaviour that would in any way change the city for others, unless everybody was inhabited by such architecture and the city adapted in turn. *Instrument One*, the first of a series of drawing instruments, was constructed to speculate on what the third version of the body architecture might do to the city of Copenhagen, where I was living at the time. The sets of drawings for both projects were helpful in considering the respective issues, yet they were more illustrative, showing what was already known, than exploratory. While their quest felt vibrant, the manner of drawing seemed at odds with the subject of the inquiry.

Projection and reception in ten types of drawing instrument

All of the instruments learn from the core aspects of the most common relational architectural drawing, the perspective. Their small innovations are to make the resulting image contingent on the particular circumstances and characters involved in their situation. They all project from a station point, have horizons, and register their image on a picture plane.

The picture plane

The picture plane is the surface on which projected content is received. Since at least Leonardo da Vinci, artists have manipulated the picture plane, usually curving it in plan but sometimes in section as well, to make their images appear more true to life. A measured perspective with a flat picture



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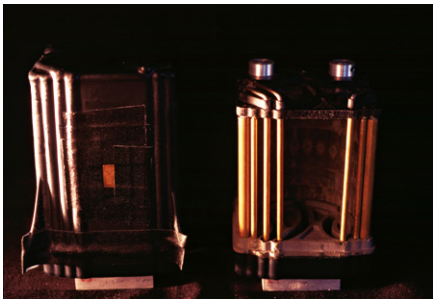
plane will appear distorted except when viewed from a position that exactly equates with the station point (the point of projection, or the eye of the observer), a condition discussed and addressed by Leonardo through his three-column rule.[16] If bending the picture plane can make the image more true, it can therefore act critically, and by adjusting it in one way or in another for your friend, you can affect the resulting image on your own terms. The picture planes on all the instruments fold in some way. In the early instruments they provide a range of articulation; in the later instruments, as the agency of folding is better understood, the folds are bespoke to the content being addressed.

In 1934, during the Great Depression, James Perry Wilson, an architect who graduated from Columbia University in 1914 and then worked for Bertram Goodhue in New York for almost 20 years, lost his job. He took up a position as a diorama painter at the American Museum of Natural History (AMNH), where he brought the rigour of architectural perspective projection to diorama painting. The methods of projection used prior to Wilson were described by Francis Lee Jaques, another talented painter at the AMNH, in his paper 'The Artist and the Museum Group' in the 15 April 1931 edition of *Museum News*. In this, Jaques sets out how he would project a flat picture plane on to the curved shell of the panorama. Wilson's innovation was a 'dual grid' method of projection, which involved producing oil paintings to establish an accurate record of colour and taking a series of photographs from a single position on a tripod in order to make up a panorama from which he would generate the projective geometry.[17] The 35mm cameras he was using had flat film planes (an equivalent of a flat picture plane), meaning that the resulting panorama was necessarily faceted (a facet for each photograph). To translate the faceted picture plane into one that was smoothly curved on plan, Wilson introduced a virtual gridded semicircular picture plane, centred on the viewing position of the diorama, which was also the camera position. Conceptually, this plane sat between the photographic panorama and the diorama shell. If the co-ordinates of the grid were projected back to the station point and out to the diorama shell, those lines would establish a distorted grid on the shell and another on the photographs. When one cell on the photograph was translated on to the corresponding cell on the diorama shell, Wilson could then compensate for both the geometry of the shell and the faceting of the photographic panorama. In this way, he was able to project an image in which the angle of view from the ideal viewing position would equate exactly to his view of the site from the camera tripod.



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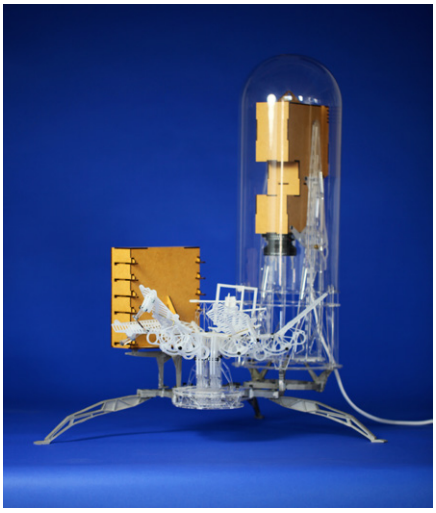
There is not room here to go into the intricacies of Wilson's method, but in order to study the whole process I built three cameras particular to Wilson's Cold Bog diorama at the Yale Peabody Museum. Michael Anderson, the chief preparator at the Yale Peabody and the authority on Wilson's work, arranged for access to the original site, a sphagnum moss bog in Connecticut, as well as organising the removal of the glass from Wilson's diorama in the museum so that the cameras could register both. Ruth Morrill, who had helped Wilson paint the Cold Bog diorama, accompanied us to the bog site. The original survey was made on 17 June 1949 and so the site visit to take the photographs with the new cameras was also arranged for 17 June 2001 (Figs 9, 10). Although the mathematical basis of Wilson's 'dual grid' method was understood before building the cameras, developing and building them provided a far deeper grasp of the potential of the folded picture plane than an abstract mathematical understanding would allow.

When we view a conventional perspective drawing or painting there will be an ideal viewing position, yet we are so familiar with the idea of perspective and the frame that from wherever we view the image we compensate and absorb the picture as if it were viewed frontally. With anamorphic



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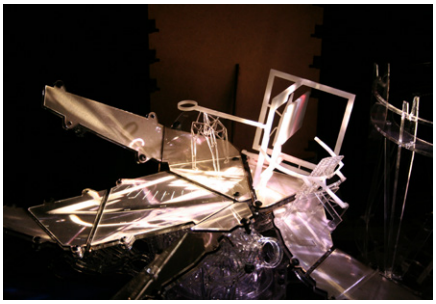

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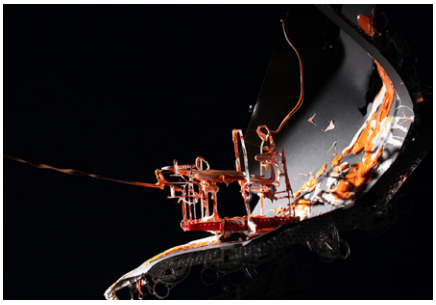

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projections, where the picture plane is not perpendicular to the line between the station point and the subject of the image, the distortion of the image is unfamiliar and to make sense of the picture we are tempted to find the point of projection (and as a result become spatially implicated in the image) because from outside this ideal position the picture makes less sense. The pictorial surface of a panorama surrounds the observer in a way that is roughly equidistant from their eye and consequently requires no distortion of the image to make it appear realistic. Diorama shells, however, rarely have a pictorial surface that is equidistant from the viewer, and so the perspectival projection typically involves anamorphic distortion. One might expect this to make the viewing position highly specific. This is the case when the perspective is forced (exaggerated) and the foreground scenery is also made anamorphically, as in Wilson's Coast Redwood diorama (1957, AMNH), which has a viewing aperture of restricted width. With most of Wilson's diorama backgrounds, however, the picture works from most positions as you move around. One reason for this may be that perspectivally they are a composite of many vanishing points (like a panorama) and wherever you are looking from, the part of the picture you see frontally will make sense in perspectival terms.

The lessons from studying Wilson's techniques for the drawing instrument picture planes were to do with the degree to which the picture plane could be manipulated and still make sense, and the point at which the image would collapse for the observer. *Instrument Two* and *Instrument Three* have a model in a box that is illuminated (Figs 11, 12, 13). The box has a wide-angle lens taken from a five-by-four monorail camera at its base that projects the image of the model on to a folding picture plane below. The model is an architectural persuasion. The person drawing with the instrument can fold the picture plane to accept that persuasion in a critical manner. A second model, identical to the one in the box except for its scale (which is adjusted to compensate for the cone of projection), sits on the picture plane and casts a shadow on the same surface as the projection. The folding picture plane holds a piece of photographic paper captive in order to register both the projection and the shadow of the second model, as a way of making the drawing. In Marcel Duchamp's painting *Tu M'* (1918) there is a pictorial depth where figures diminish in perspective, while shadows of a bicycle wheel, hat rack and corkscrew sit on the material surface of the painting (rather than land on the objects depicted within its perspectival depth). This is technically what is happening with the shadows from the second model on the instruments, except that the familiarity between the figure of the projection and that of the shadow suggests that they exist on the same terms. In folding the plane to accept the image, the person drawing is implicated in the content of the drawing. The paradoxical shadow that resides in the drawing appears to have the possibility of making sense, yet that sense can only be constructed by the observer, implicating them as well.

The critical capacity of the folding picture plane worked exactly as intended, perhaps even better. Normally this would be a good thing, but when working with conditions of indeterminacy and uncertainty this apparent success seemed a failure, akin to the frustration with the earlier more illustrative drawings in that the instruments were proving more than venturing. Nevertheless, they, along with *Instrument One*, had confirmed the critical potential of the folding picture plane. The images produced by *Instrument Two* and *Instrument Three* were also figurative – they were to do with things rather than the performance of things, closer to Baraduc's photographs of people with auras than his iconographs of just the aura.

Projection

The disappointment in the early optical instruments lay in the method of projection, and more particularly in the reliability and repeatability of

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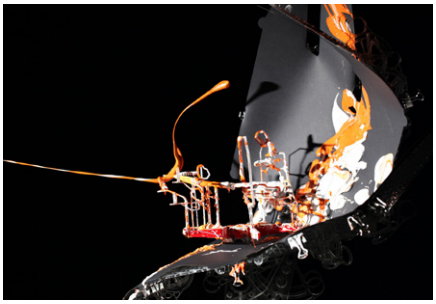

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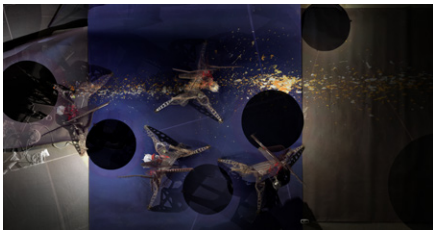
optical projection (normally the very qualities desired in an experiment). A new medium of projection was required that was unreliable, to mirror the unreliability of the way that we occupy architecture. A switch to latex paint rather than light provided such a medium. This was chosen as it is a non-Newtonian fluid, like blood, so that the digital and analogue techniques employed by forensic scientists to work out the events that caused splatter might also be employed to work out what happened in a paint throw.[18] *Instrument Six* and *Instrument Nine* chase the potential of floating shadows in mid-air, but all the others from *Four* onwards develop the technique of throwing paint. Also consistent among these instruments is the set-up, each instrument being made up of several sub-instruments that carry a paint catapult, an architectural model and a folding or folded picture plane. In each, a throw of paint indexes a particular circumstance while the model is an architectural model that acknowledges that it will be occupied by flying paint standing in for a human presence.

An elastic-band-powered catapult throws the paint. As the instruments evolved these were redesigned each time to modulate the nature of the throws. When trying out *Instrument Four* (essentially a media test) it was evident that something was happening during each throw, but at a speed that was too fast to register (Fig.15). As with Arthur Worthington's studies of the splash of a drop of milk, high-speed flash photography showed what was happening to the paint during a throw and the photographs were at least as revealing as the splatters of paint. Equally important, the flash and camera were set off manually, a split second after the catapult trigger had been pulled. A combination of an unpredictable biting point for the catapult trigger and a short remote cable for the camera would leave the person making the drawings stretched to the limit, trying to judge the exact moment to release the shutter and fire the flash. Before this could happen, the catapult was charged with latex paint and aimed towards the model, with a hope of what might happen. The picture plane was folded to capture the splatter coming off the model once it had been hit by the paint and then the paint was thrown and camera exposed with the hope that a certain something (set up with the aim) would happen, but an even greater anticipation that something more than that would transpire. The desires that impelled the making of the drawing and the anxieties attending the process gave rise to sublime sensations of indeterminacy that were the concern of the process and drawings. After the paint had been thrown there was the question of whether the initial desire had been realised; what else had happened; what the splatter had registered on the picture plane; had the camera caught the flying paint, and if so, what did it reveal (Figs 16–19)?

With practice, the camera came to record one in three or four throws of paint. The sequence of photographs revealed the suitability of the medium, for while it was possible to aim the trajectory of the paint in line and length with helpful accuracy, the character of each throw was unique.

Instrument Ten

All of this is leading to the discussion of *Instrument Ten*, a collection of four instruments that relate to the design of a pair of chairs. A larger ambition in the research is to learn about the nature and potential of architecture and embody that knowledge in things in such a way that tacit knowledge can be shared (however unreliably) rather than forced into explicit knowledge and reduced to text. The aim of the chairs is to keep tacit knowledge active. Their purpose is to provide the kind of framing of objects learned from museums while locating them in a situation that remains charged – within the sight and reach of those sitting in the chairs. They provide a site for ideas that are in gestation, where the inquiry is still active and the nature of things still uncertain. The curatorship of the chairs is non-disciplinary, but instead gathers didactic items of explicit and tacit knowledge in such a way



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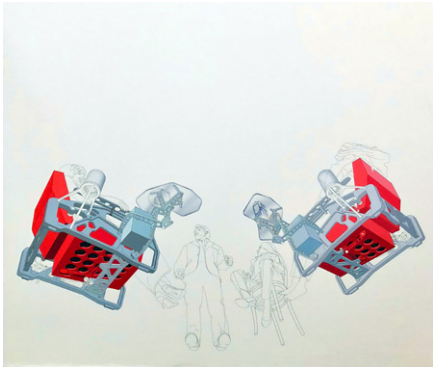

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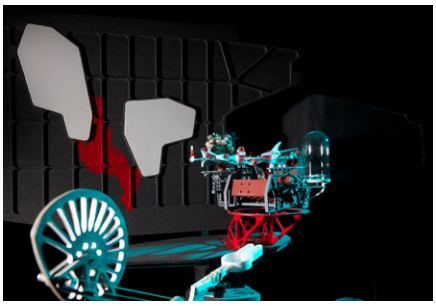

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as may fuel thoughts on the work in hand in the studio (largely when sitting in the chairs). That is their programme. The role of the four instruments that comprise *Instrument Ten* is to open up that ambition to unforeseen possibilities or other perspectives (Fig.21).

The model

The one-sixth scale models of chairs that sit on each instrument are figurative, while the figures that sit in the chairs are abstract paint deflectors. If there were a model of you in one of the chairs, at one-sixth scale it would make very little difference if that model were of one of your friends (Figs 22, 23). The deflectors provide an opportunity to characterise those sitting in the chairs in a way that registers with the scale of operation of the flying paint as well as providing a capacity to adjust their performance. The models in *Instrument Four* and *Instrument Five* were far more tuned to the paint, including elements that might have various forms of memory. Comb-like elements that learned from the forms of pasta that try to hold as much sauce as possible might catch the flight of paint, only to drip on to the picture plane after a subsequent throw. Other small hoops with their edge in line with the vector of the throw would catch the paint and form a meniscus that would then burst, again perhaps after a subsequent throw, translating into an entirely different character of splatter. The dilemma for this construction is that, just as providing for occurrences in the programme can lead to prescription in the architecture, anticipating the behaviour of the paint in the models could prescribe its performance. As a result, the models in each subsequent instrument became more figurative. The combination of figurative chair and abstract, flying paint related to people was an attempt to capture the benefits of each in appropriate places.

Sciagraphy

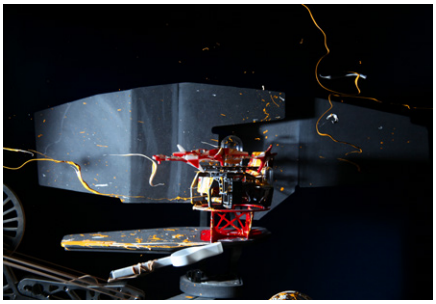
With the optical projections in *Instrument Two* and *Instrument Three*, the folding of the picture plane distorts the projections and shadows of the original figure. When the paint hits a model in the later instruments there are two sorts of shadow – the void behind the model where the flight of paint is obstructed and the splatter that is the consequence of the collision between the paint and the model. While the design of *Instrument Four* and *Instrument Five* imagined that the former (rather like the optical shadow) would provide the helpful registrations, through their use it became evident that the splatter was far more interesting. Instead of being captive to the shape of the model, the nature of each engagement, or collision, had a unique character (registered as a dispersion on the picture plane). As with Baraduc's auratic photographs, the images capture the content more than the thing, including those aspects that exist outside the figurative pictorial realm.

Learning from these observations, after *Instrument Five* the folding picture plane was situated alongside the trajectory of paint and next to (instead of behind) the model in all the subsequent instruments. One consequence of this was that it made the capture of the deflected paint more sensitive to folds in the picture plane and so these became more subtle.

High-speed flash photography and slow-motion filming

Earlier, the discussion of the importance of the experience of taking the high-speed flash photographs identified the camera's role in the broader representational capacity of the project. Another attraction of high-speed flash photography is its use in scientific research, exemplified by Worthington's work and later that of Harold Edgerton at MIT. The capacity of these photographs to reveal the unseen also resonates with Baraduc and Darget's practices. The practice provided another opportunity to

use a didactic method from the world of explicit knowledge to construct tacit knowledge. Another such method is high-speed filming (shot at just over 4000 frames a second), which was always tempting, but due to the experiential 'risk' of the flash photography – viewed as a positive aspect of the set-up – this was avoided until the last throws of paint with *Instrument Ten*, by which time most of what could be learned had been exhausted.



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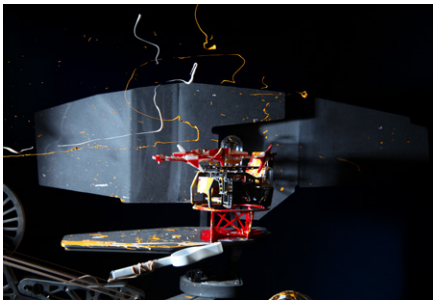

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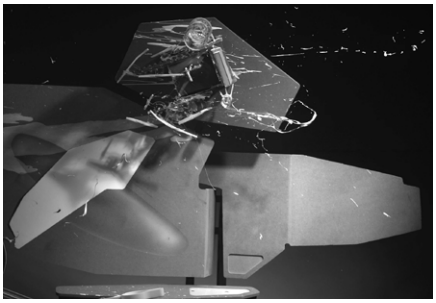
The high-speed flash photographs tell a parallel story to the splatter. The variations in the character of the flight of paint, even when the same amount was thrown with the same catapult settings, provide nourishment to imagine what they might discuss. As well as adjusting the various settings of the catapults, these characteristics were also sensitive to the viscosity of the paint and the character of the paint cups (Figs 24, 25, 26). Most of the instruments employed culinary measuring spoons, both hemispherical and with vertical-sided cups to hold the paint at the end of the catapult. Unique and bespoke paint cups were 3D printed for each of the four instruments that make up *Instrument Ten*, a number of which were dual-pronged to allow two colours of paint to be thrown simultaneously.

The photographs are less mysterious than the paint markings on the picture plane. There are examples where flows of paint wrap around parts of a model and you can see the paint getting stretched out at the point of collision. The sharpness and material presence of the richly coloured paint in these images provokes an imagining of literal episodes of spatial encounter, while the uniqueness of each throw encourages an analysis of the differences. This part of the work was not anticipated at the outset but has provided some of the richest experimental material.

The drawings

The pieces discussed in this paper are described as drawing instruments, which emerged partly out of a frustration with the inquisitive capacity of conventional forms of architectural drawing. The term 'drawing' is convenient, for if they were given a more precise identification it might prescribe their interpretation. The drawings made by the instruments that utilise optical projection are easier to talk about, for they are of recognisable things with recognisable characteristics (such as figurative shadows) and the nature of their content is held in the degree and manner of the distortion of these things. They sit in a tradition of anamorphic painting where such distortions allow the registration of a presence beyond the normal perceptual spectrum. They rely on the observer to translate a deformation of a figure as analogous to a process of transformation. In my case, the hope is that they can instantiate a particularity or critique that makes something that is given (the projection) more particular to whoever is working with the instrument.

The paint splatter on the picture planes is less accessible. It is less recognisable than the optical projections and less seductive than the frozen images of flying paint. All three forms of representation are caught in a paradox of trying to reveal a condition whose totality is beyond description – one that, if it could be identified and articulated clearly, would fall out of the realm of interest in the project. It is a form of research that attempts to enrich and enliven the question rather than provide an answer – its desire is to sustain the desire of inquisitiveness. When the question is how architecture can provide for and draw out the pleasure from those situations that we cannot predict, or those sorts of engagement that we cannot imagine, there is not an explicit answer. If the drawings make an explicit prediction, they collapse the construction. It is therefore more helpful to suggest what the drawings do, rather than say what they are. As with Baraduc's fluidic photographs, it is a representation of something



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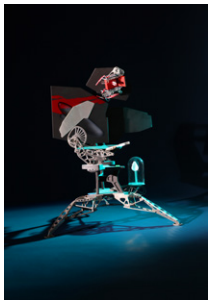

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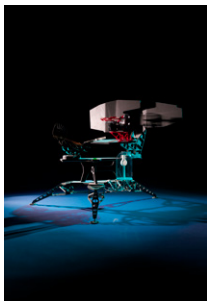

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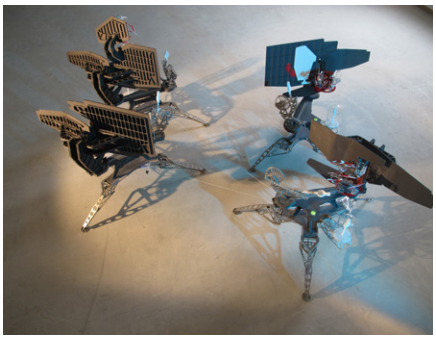

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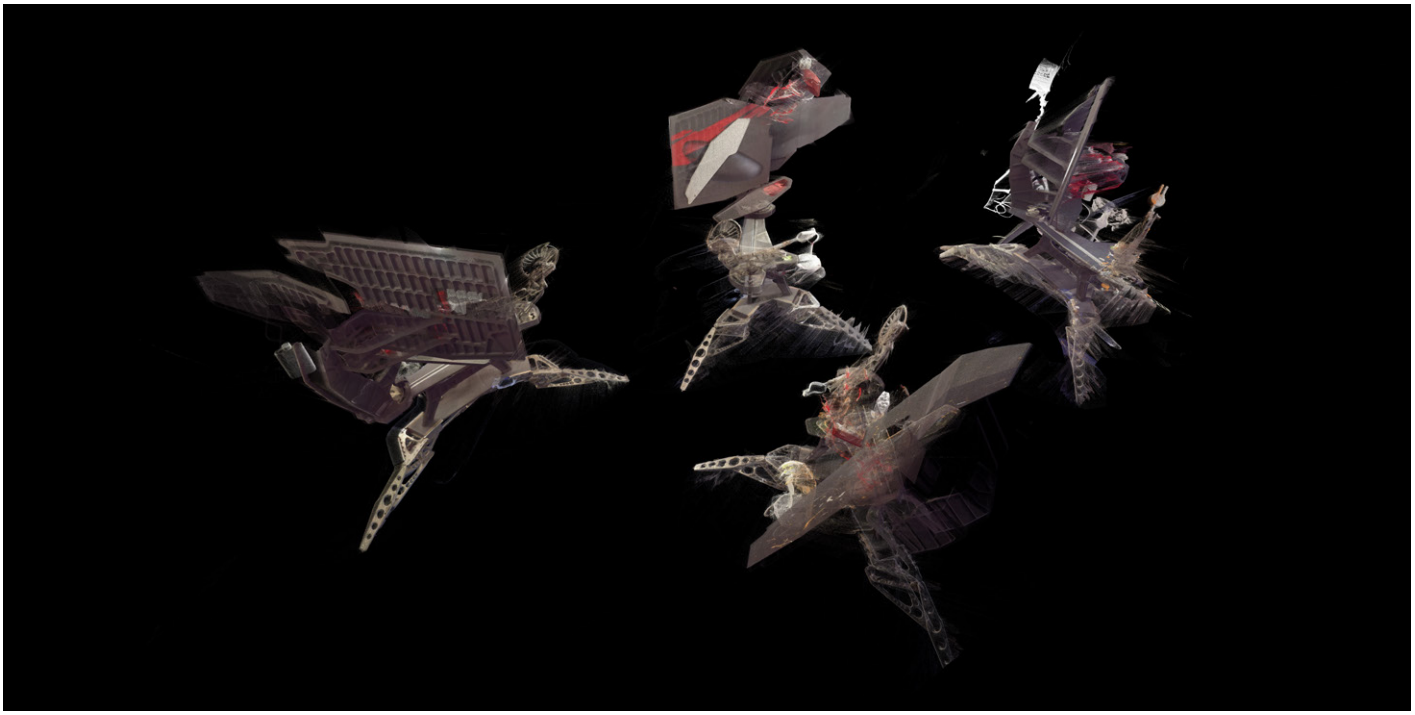
that we have not seen – but the attempt to picture this invisible condition makes the content available for consideration in a way that escapes logical conjecture. They are images that we can understand but cannot tell of what that understanding consists.

Knowledge

How do the instruments create and express knowledge? As with the Bog Diorama cameras, working out how to build the instruments is a productive realm of conjecture, while drawing with them provides a most edifying experience from which to build tacit knowledge. For those who might observe the instruments and their production of drawings, photographs and films, they provide a provocation and perhaps a seduction to consider the issues at stake in the work while providing just enough to hold on to. They do not, however, try to persuade. If normally evidence is employed to put an end to a matter, these instruments and their production are the evidence presented to keep an issue alive. This is the realm in which architecture operates, not one of solutions and closure but a constantly evolving set of circumstances and situations.

1 Michael Polanyi, *The Tacit Dimension* (Chicago: Chicago University Press, 1966, repr. 2009), 4.
2 Marjorie Perloff, *The Poetics of Indeterminacy: Rimbaud to Cage*, 3rd edn (Chicago: Northwestern University Press, 1999), 35.
3 Polanyi, *op. cit.*, 5.
4 Susan C. Piedmont-Palladino, ed., *Tools of the Imagination: Drawing Tools and Techniques from the Eighteenth Century to the Present* (New York: Princeton Architectural Press, 2007), 66–69.
5 Jim Bennett and Stephen Johnston, *The Geometry of War 1500–1750* (Oxford: Museum of the History of Science, 1996), 56–70.
6 The nomenclature for Ledovsky's instruments is taken from Anna Bokov, *Avant-Garde as Method: Vkhutemas and the Pedagogy of Space, 1920–1930* (Zürich: Park Books, 2020), 256. Selim O. Khan-Magomedov, *Pioneers of Soviet Architecture, The Search for New Solutions in the 1920s and 1930s* (London: Thames and Hudson, 1983), 143, does not include the hyphens in the names and lists the *O-glazometre* as the *Obemometer*.
7 Khan-Magomedov, *op. cit.*, 136.
8 Clément Chéroux, 'Photographs of fluids', in *The Perfect Medium: Photography and the Occult*, eds Clément Chéroux and Andreas Fischer (New Haven: Yale University Press, 2005), 114.
9 There are examples of these and the early telescopic photography in Corey Keller, ed., *Brought To Light, Photography and the Invisible, 1840–1900* (New Haven: Yale University Press, 2008).
10 Chéroux, *op. cit.*, 114.
11 In George Didi-Huberman, *Invention of Hysteria: Charcot and the Photographic Iconography of the Salpêtrière* (Cambridge, MA: MIT Press, 2003), 92, Baraduc is described as a psychiatrist. The understanding of his role at the Salpêtrière in this section is taken from Didi-Huberman, Chéroux and Rousseau, as none of them individually gives a full account.
12 The understanding of Baraduc's aims in this paper is taken from a facsimile reprint of the 1913 English translation of Hippolyte Baraduc, *The Human Soul: Its Movements, Its Lights, and the Iconography of the Fluidic Invisible* (Paris: Librairie Internationale de la Pensée Nouvelle, 1913), by the Andesite Press, no date given.
13 Pascal Rousseau, 'Psychography: from spirits to thought photography', in *Imponderable: the Archives of Tony Oursler* (Zurich: LUMA Foundation, 2015), 483–494.
14 Chéroux, *op. cit.*, 127.
15 *Ibid.*, 132.
16 Erwin Panofsky, *Perspective as Symbolic Form*, trans. Christopher S. Wood (New York: Zone Books, 1991), 78–81.
17 The understanding of Wilson's 'dual grid' method is taken from Ruth Morrill's paper 'A dual grid system for diorama layout' *The Curator*, December (1996), 280–87, and also an interview with Morrill on 17 June 2001. Morrill helped Wilson paint some of his diorama backgrounds at the Yale Peabody Museum and was married to Ralph Morrill, chief preparator at the Yale Peabody, who constructed scenic foregrounds to the dioramas in which Wilson painted the backgrounds.
18 Martin Matisoff and Larry Barksdale, 'Mathematical and statistical analysis of blood splatter', *The Forensic Examiner*, vol.2, no.1, Spring (2012), 26–33.

1—



3D digital scan of the four instruments that make up *Instrument Ten* from above. Scan by Thomas Parker.
All images by Nat Chard except where otherwise noted.

2—

‘Nocturnal photography of black points, small entities of subtilising force (soul germ) without apparatus, plate near head.’ From Hippolyte Baraduc, *The Human Soul: Its Movements, Its Lights, and the Iconography of the Fluidic Invisible* (Paris: Librairie Internationale de la Pensée Nouvelle, 1913). Public domain.

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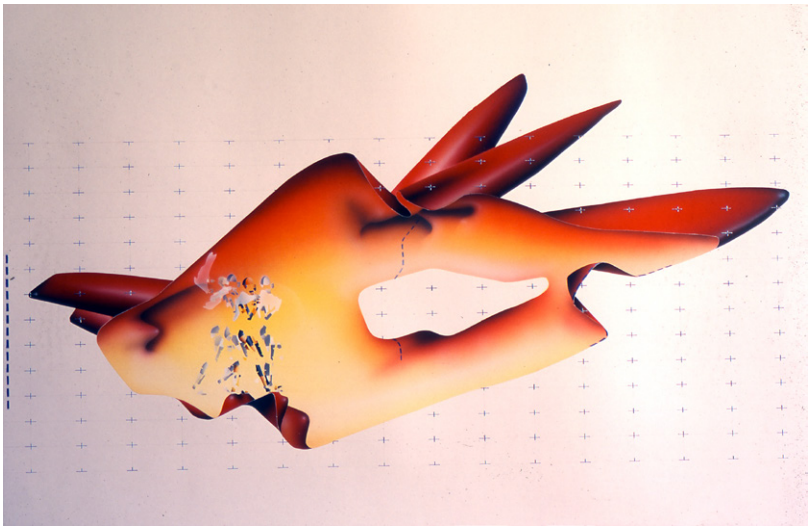

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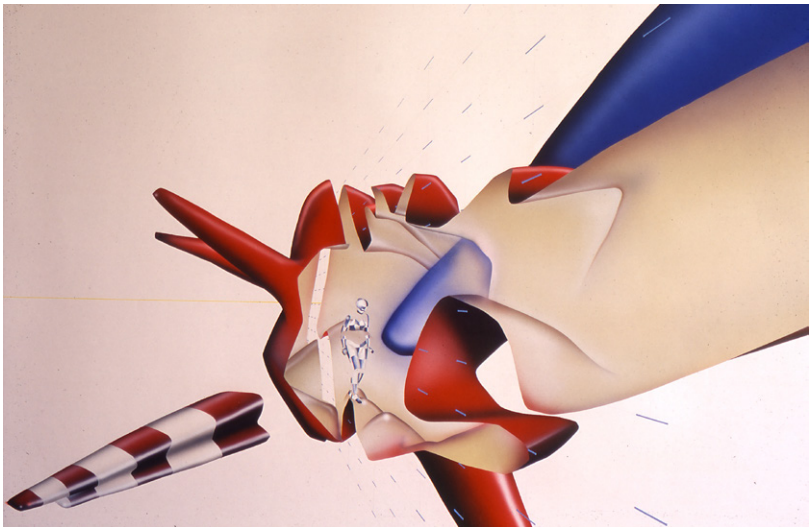

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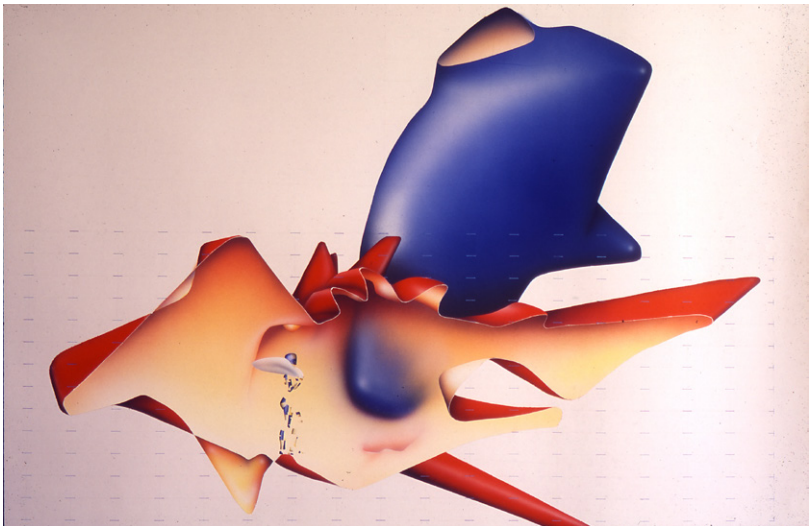

3— *Hall and staircase* frame one (airbrush).
4— *Hall and staircase* frame two (airbrush).
5— *Hall and staircase* frame 2 cut-away perspective (airbrush).

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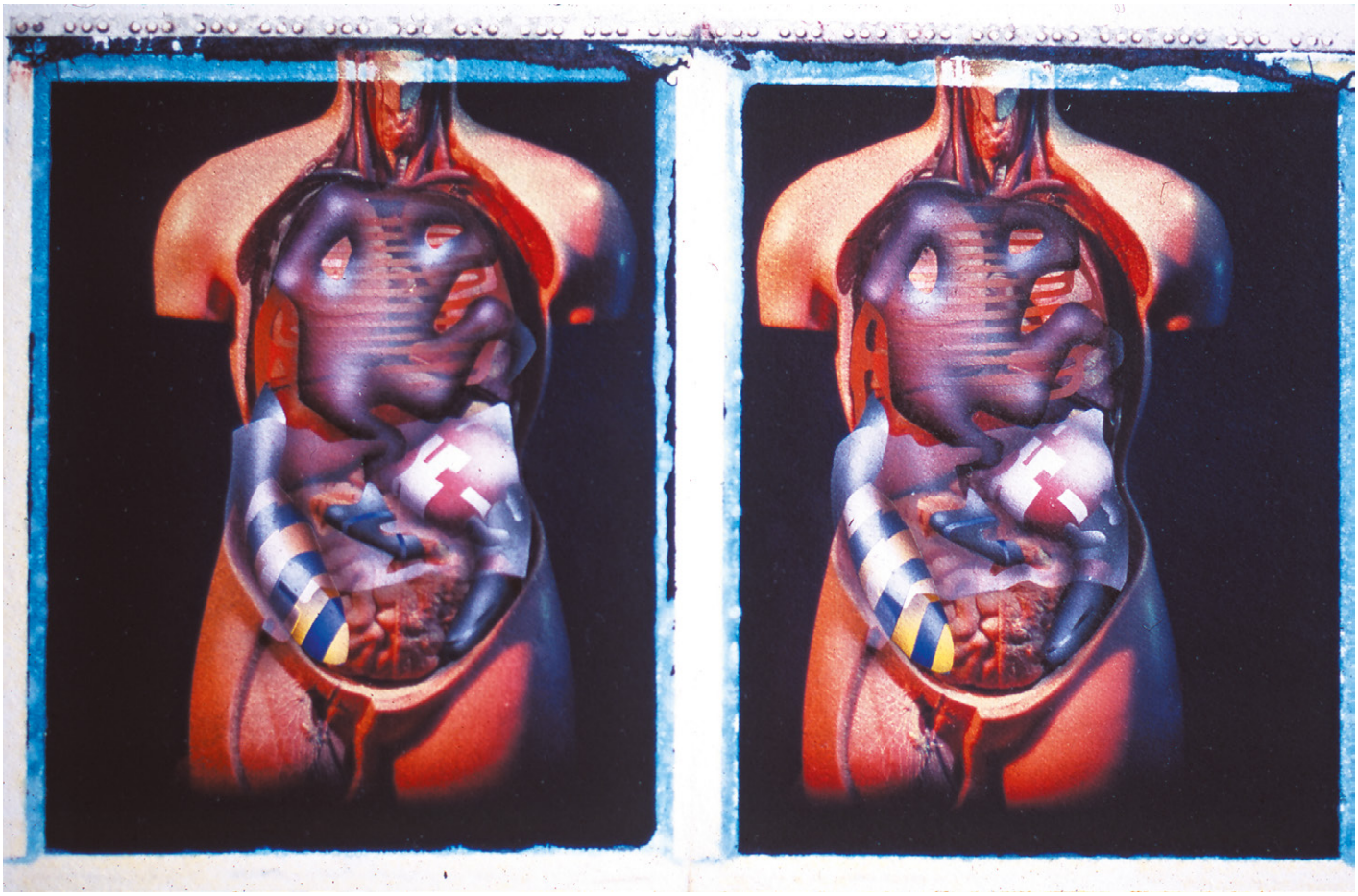
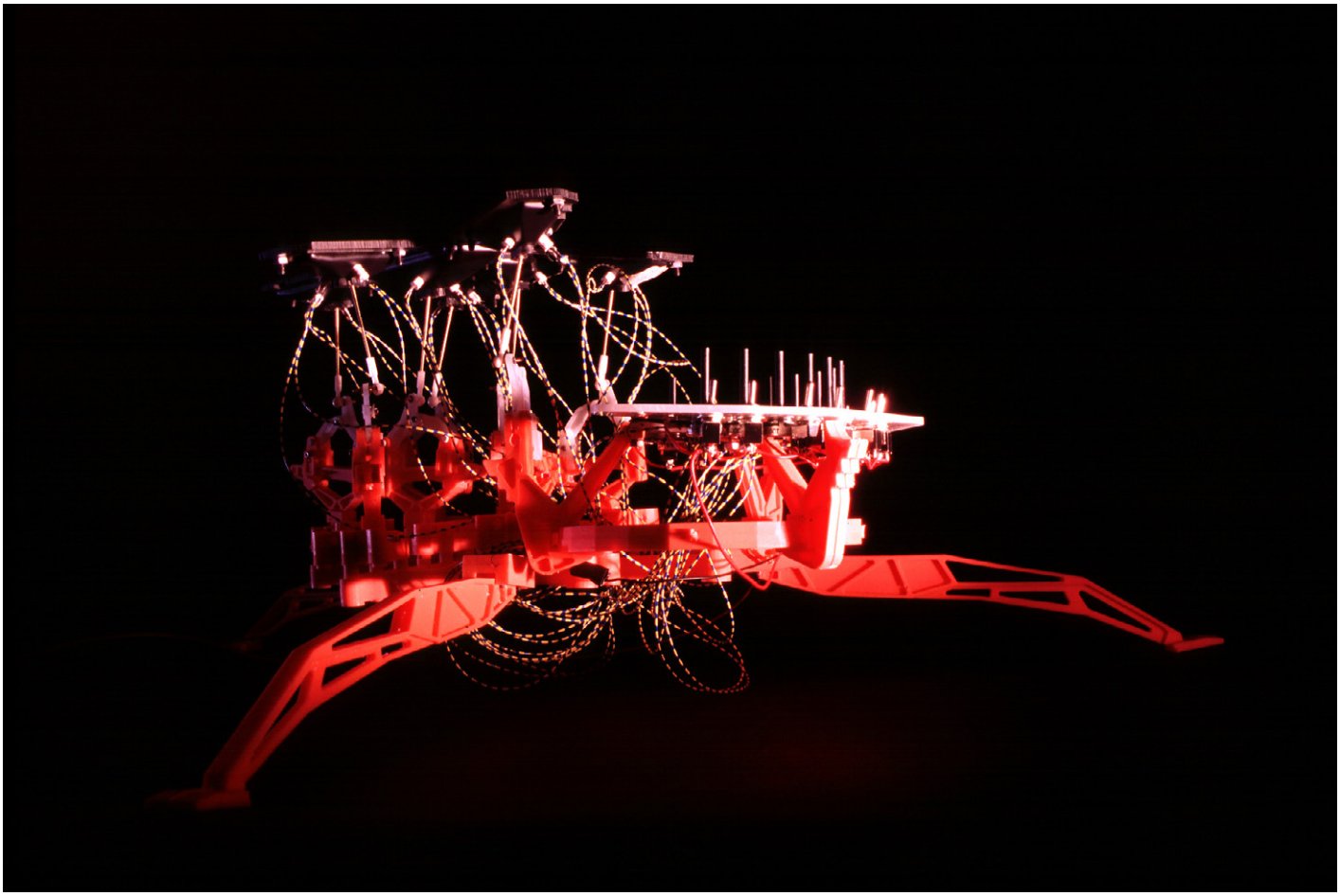


Second body project layer 8, stereoscopic pair (airbrush on Polaroid transfer).

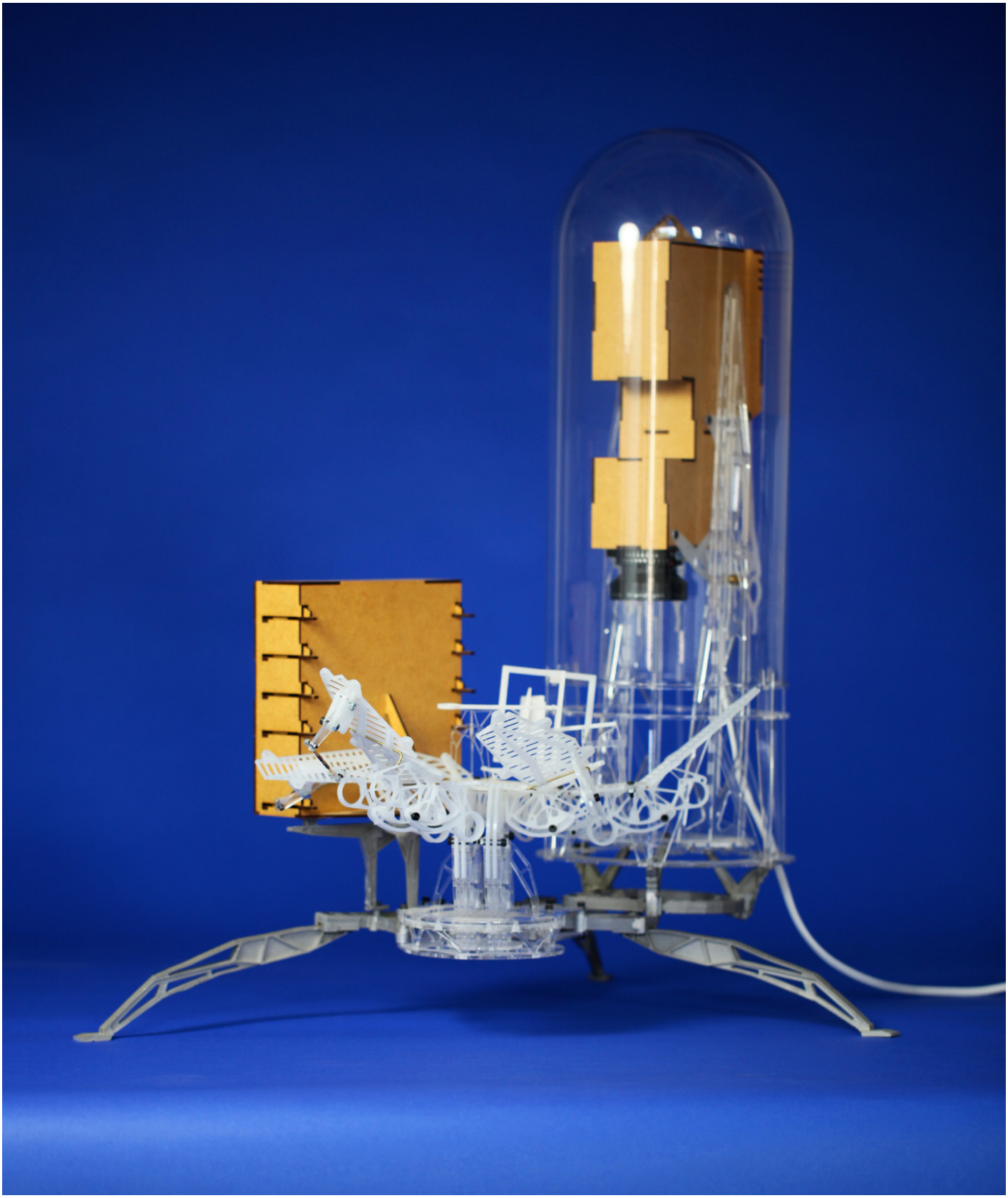
X-ray drawing of second body project (airbrush on inkjet print).



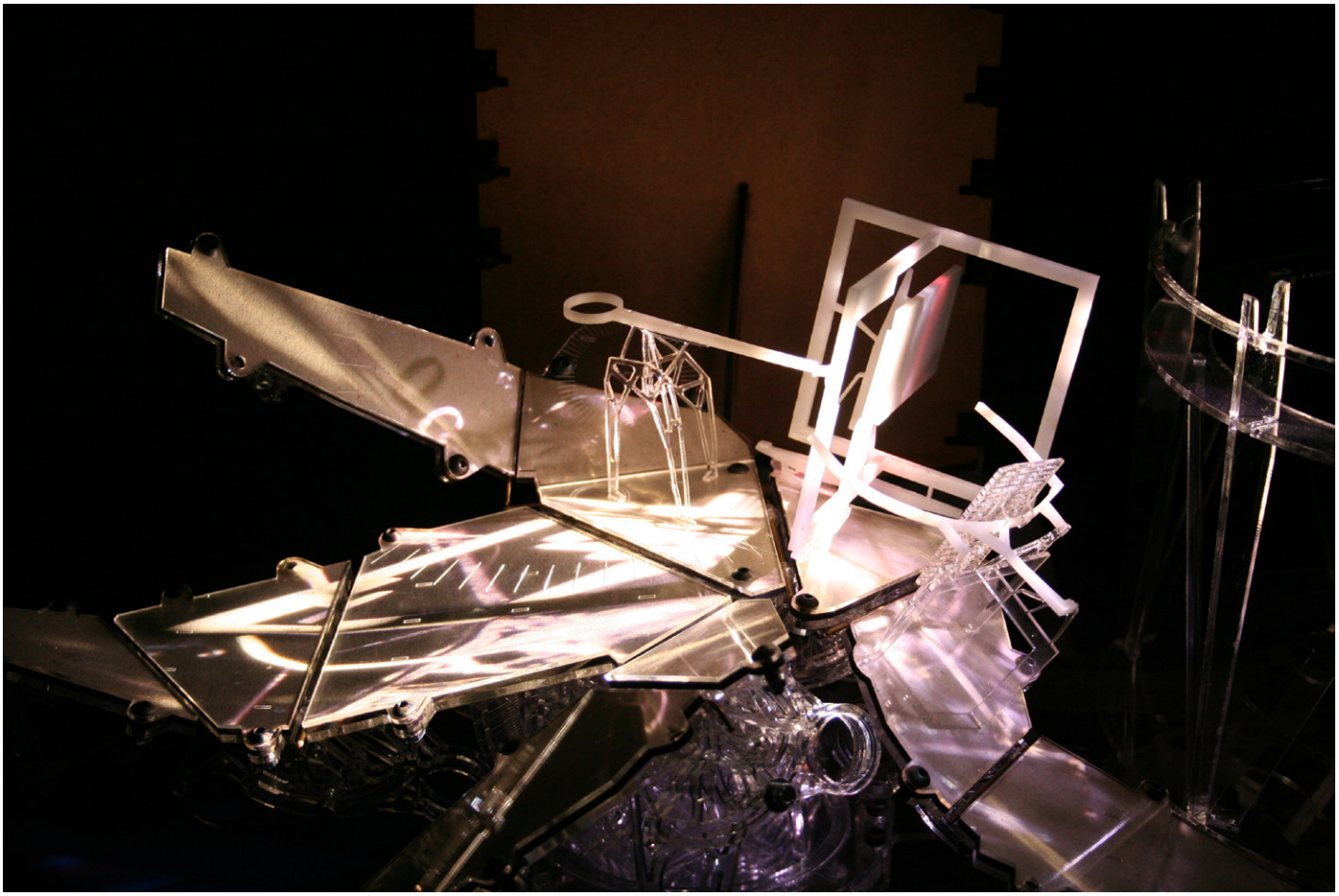
Instrument One

Bog cameras specific to James Perry Wilson’s sphagnum moss bog diorama at the Yale Peabody Museum. Their film plane is a scale model of the diorama shell and the pinhole is in the (scaled) ideal viewing position relative to that (upside down) plane.

Sphagnum moss bog survey with Ruth Morrill and Michael Anderson with bog cameras in foreground. June 17, 2001. Two dedicated bog diorama cameras are used to produce stereoscopic pairs and a third test camera with Polaroid film and the same focal length and aperture as the bog cameras is used to check exposure times. James Perry Wilson made his photographic survey of the site on June 17, 1949.



Instrument Three.



Projection of model onto folded picture plane of *Instrument Two*. Note second model (identical to the model being projected except scaled up to compensate for the cone of projection) that sits on the surface of the picture plane and registers its shadow on it, rather than within the perspectival depth of the projection.

Drawing produced by *Instrument Two*. The image is resolved on photographic paper and is produced by the projection of an illuminated model in a box onto a folding picture plane, on which a model identical (but at a compensated scale) to the one in the box sits.

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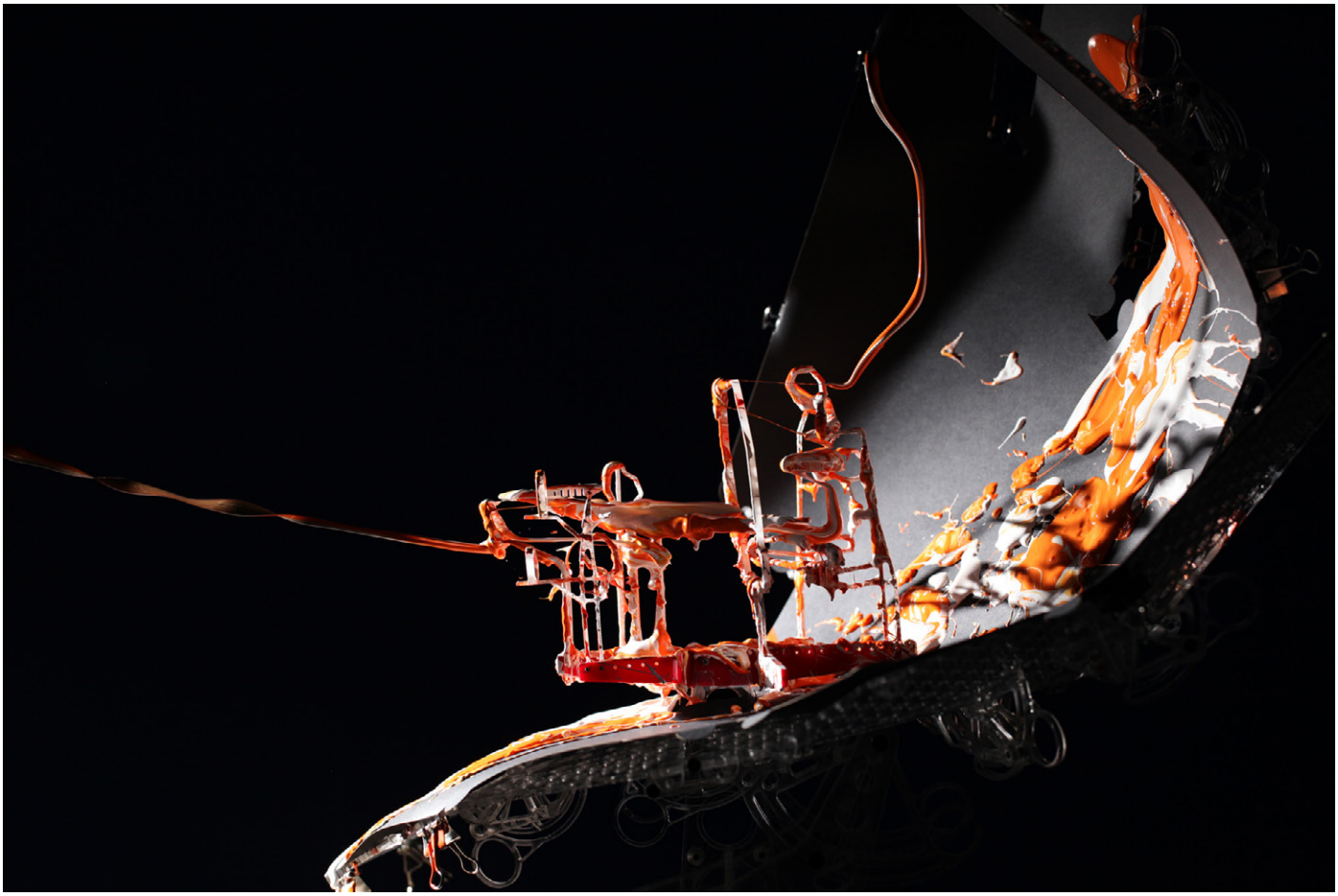

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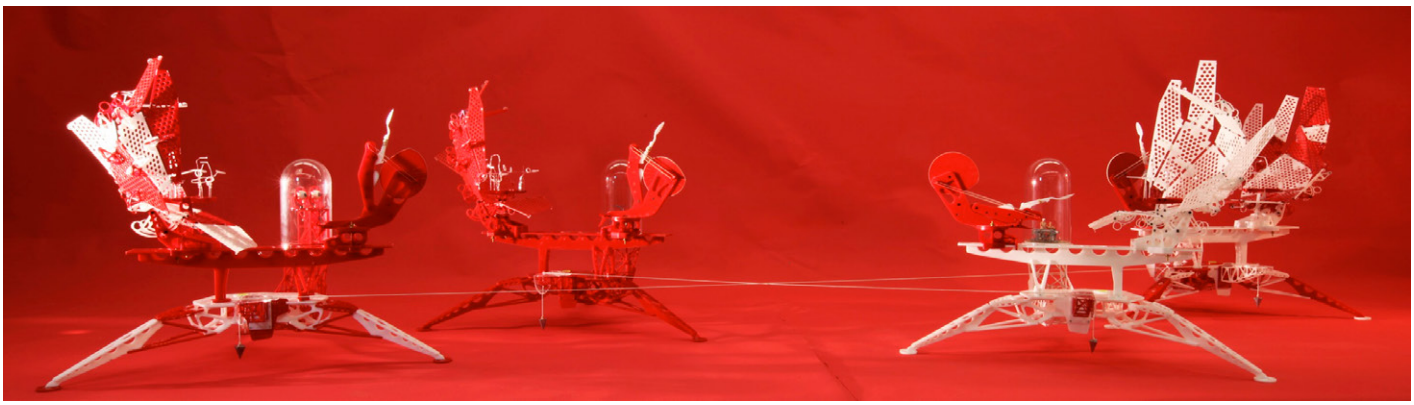
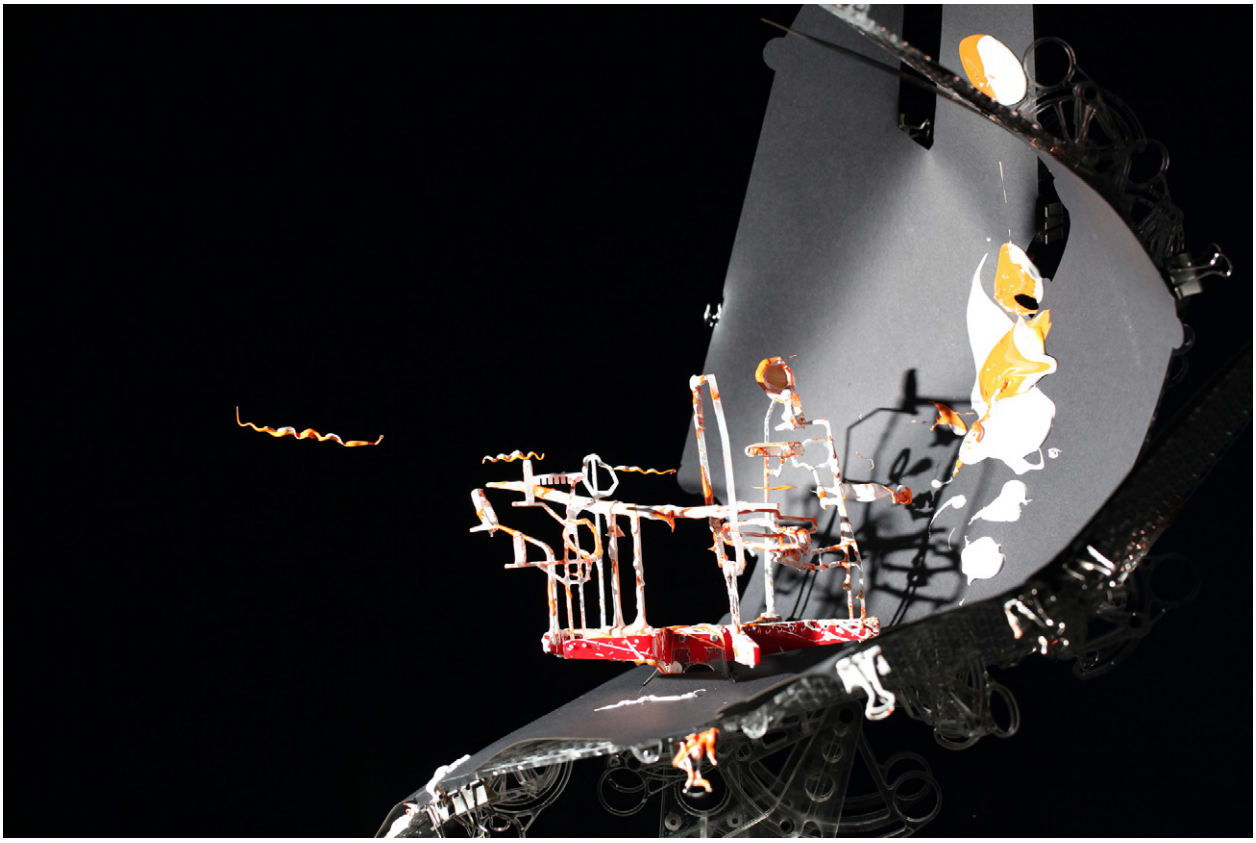


14— *Instrument Five* paint throw. Note the paint half-forming a meniscus on the top right element of the model.
15— The four instruments that make up *Instrument Five* before any paint is thrown. These instruments are shown without the paper covers on the folding picture planes, which collect the paint splatter.

16—



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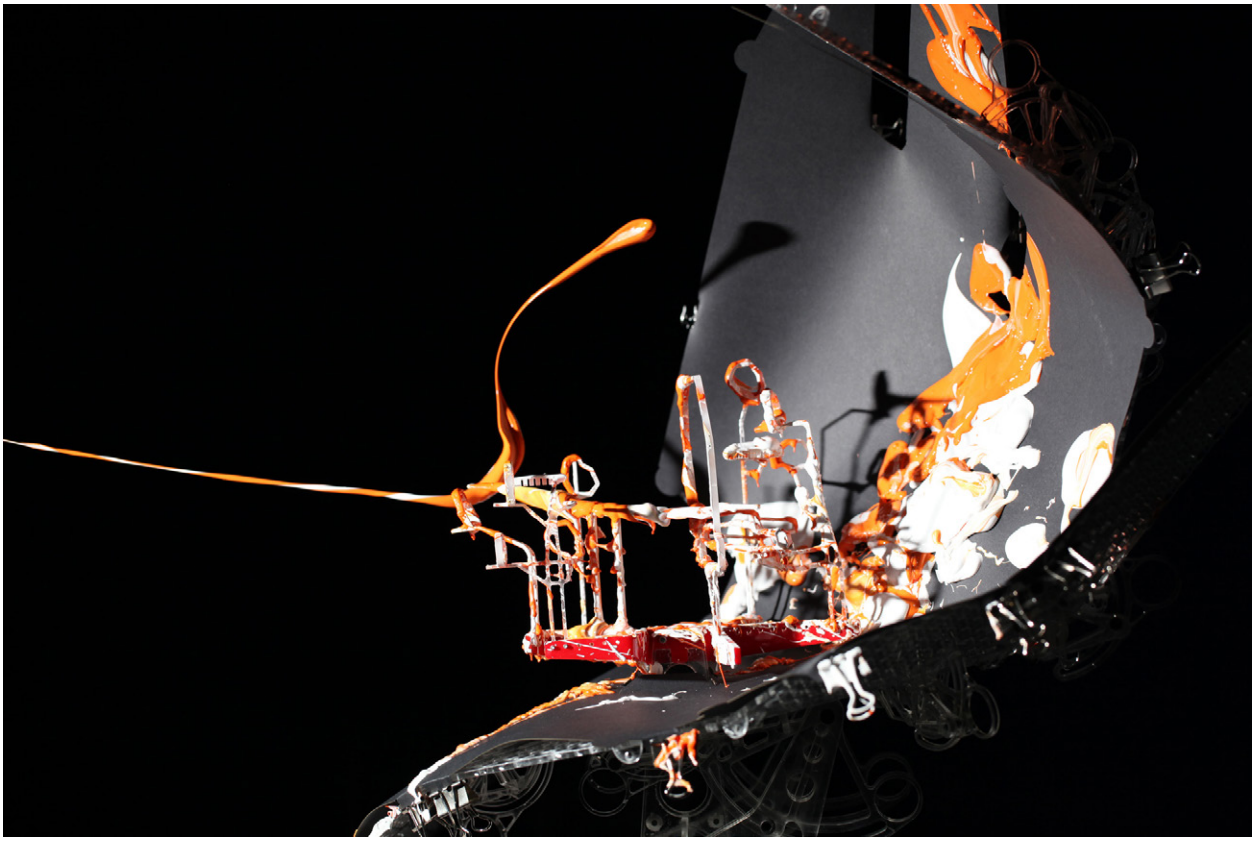
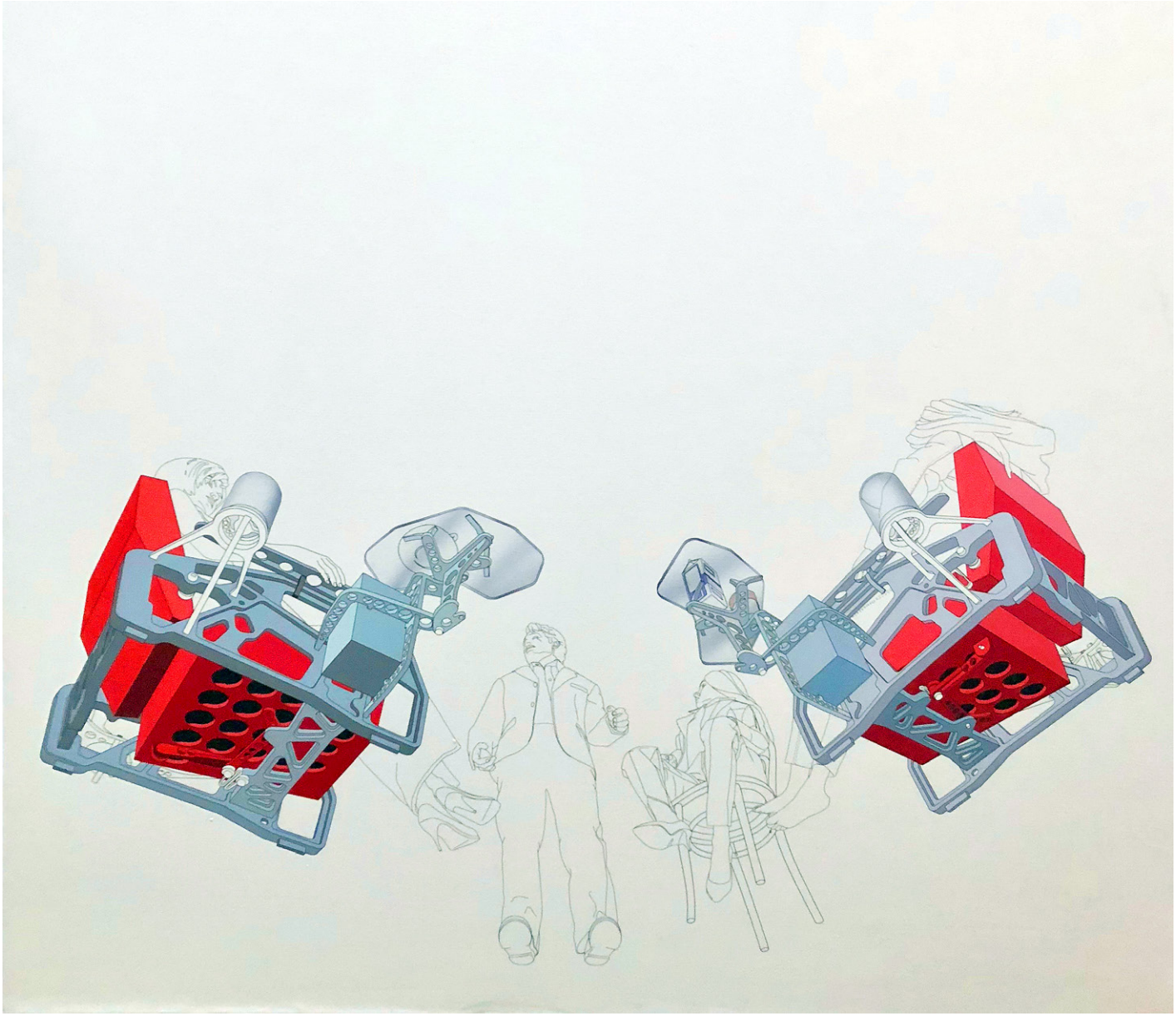


16— *Instrument Five* paint throw. Note the folded patterns in the paint in this throw.
17— *Instrument Five* paint throw. The contrast with Fig. 14 and Fig.16 shows how each throw, while accurate for direction, has a unique character and figure.

Instrument Five drawing, where the picture plane is sited behind the model relative to the paint throw.

Instrument Seven drawing where the picture plane is sited beside the model relative to the paint throw.

Instrument Ten set-up for throwing paint after one instrument has projected paint at another. This plan view gives an idea of the trajectory of the paint relative to the receiving picture plane of the instrument that is top centre in the image.



View underneath chairs discussed in *Instrument Ten* (multimedia).

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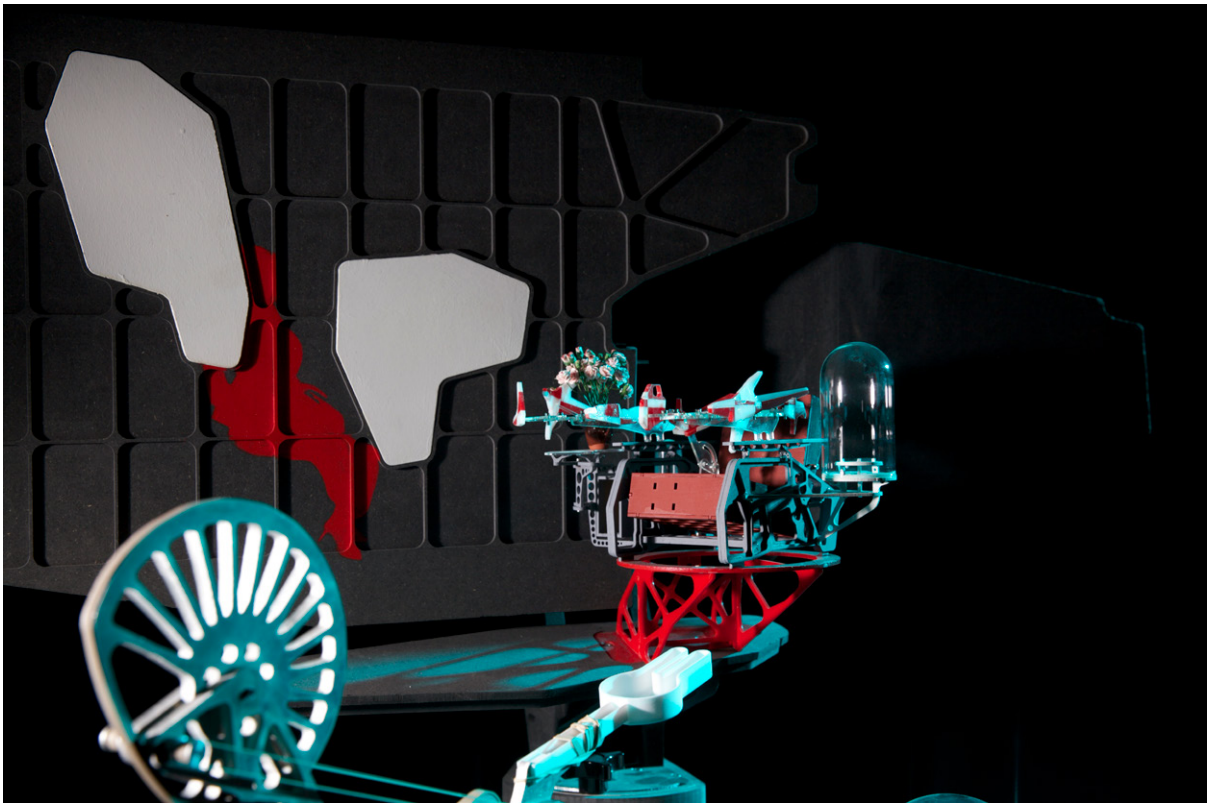

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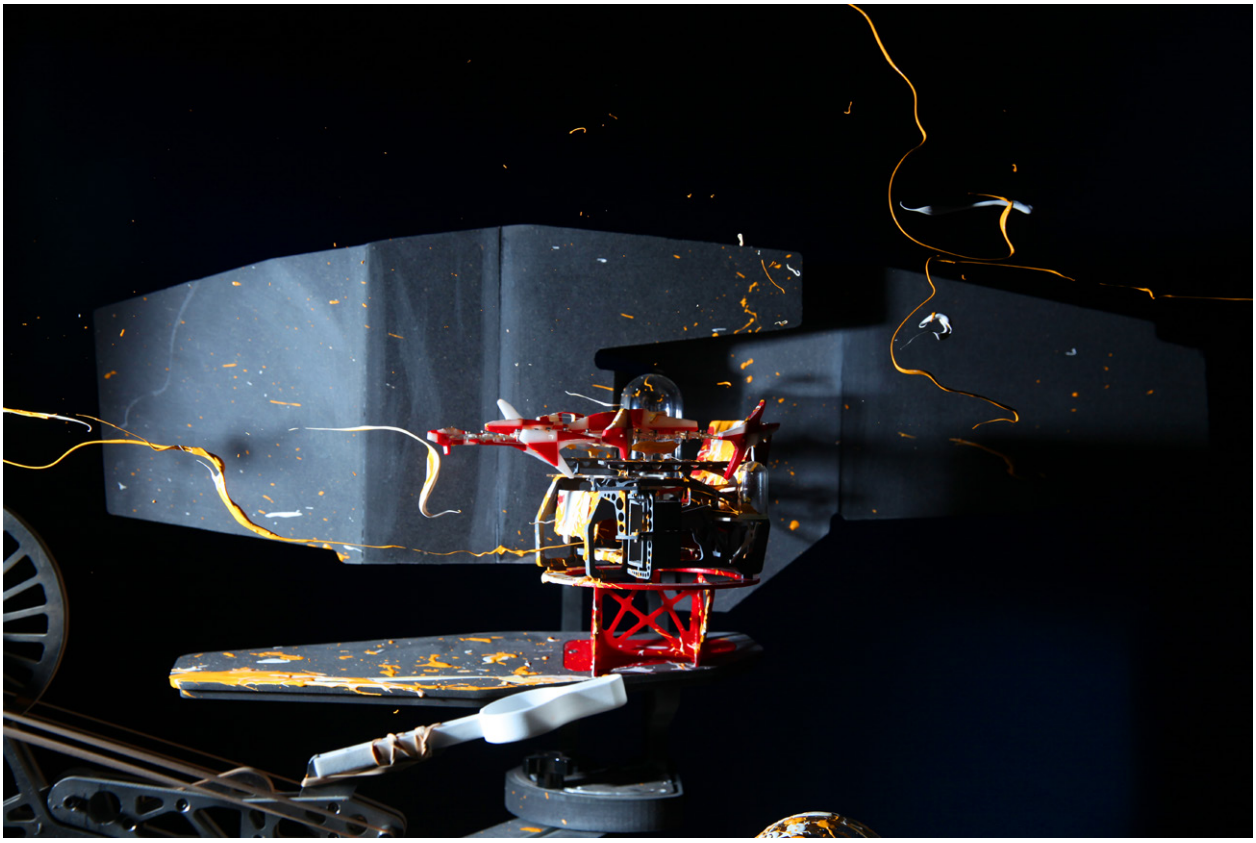
22— Model of chair and paint deflectors on *Instrument Ten* before paint throwing.
23— Model of chair and paint deflectors after paint throwing.

24—



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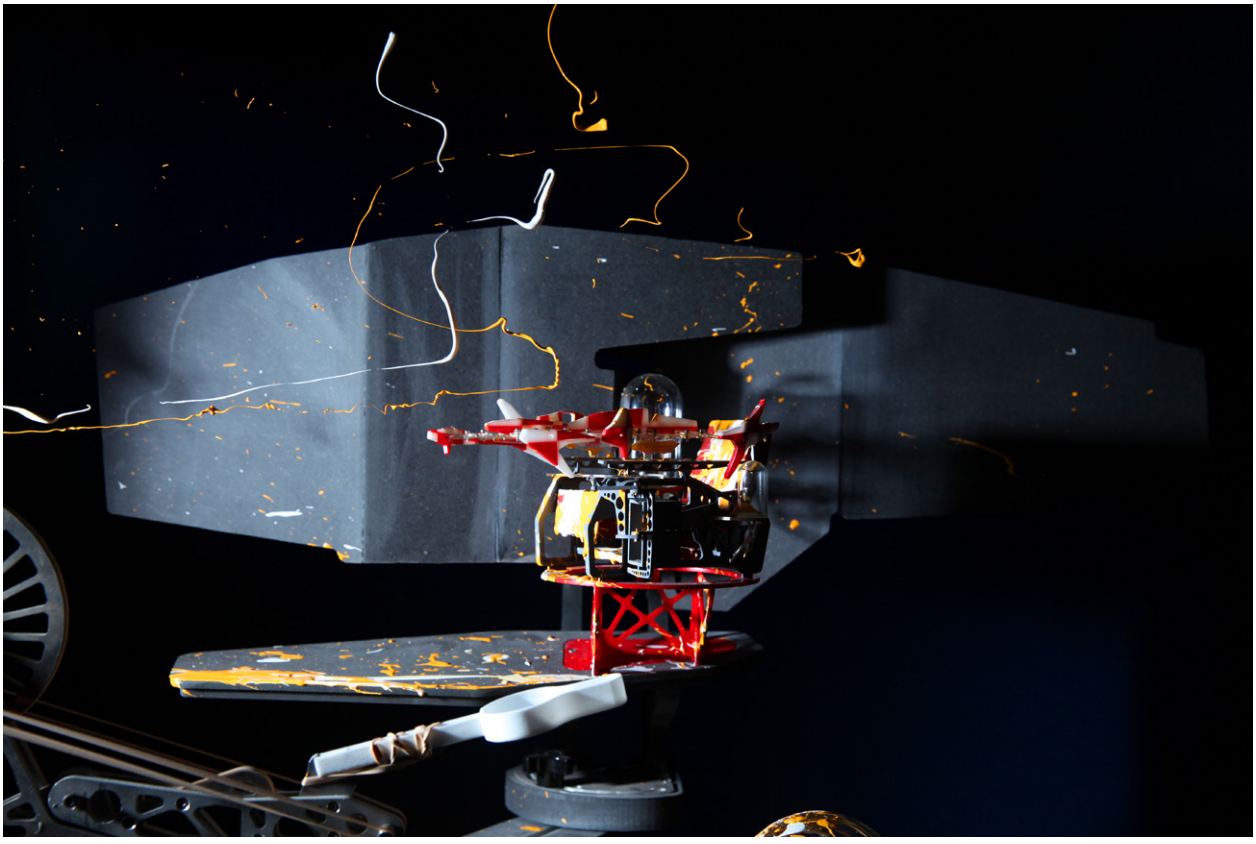
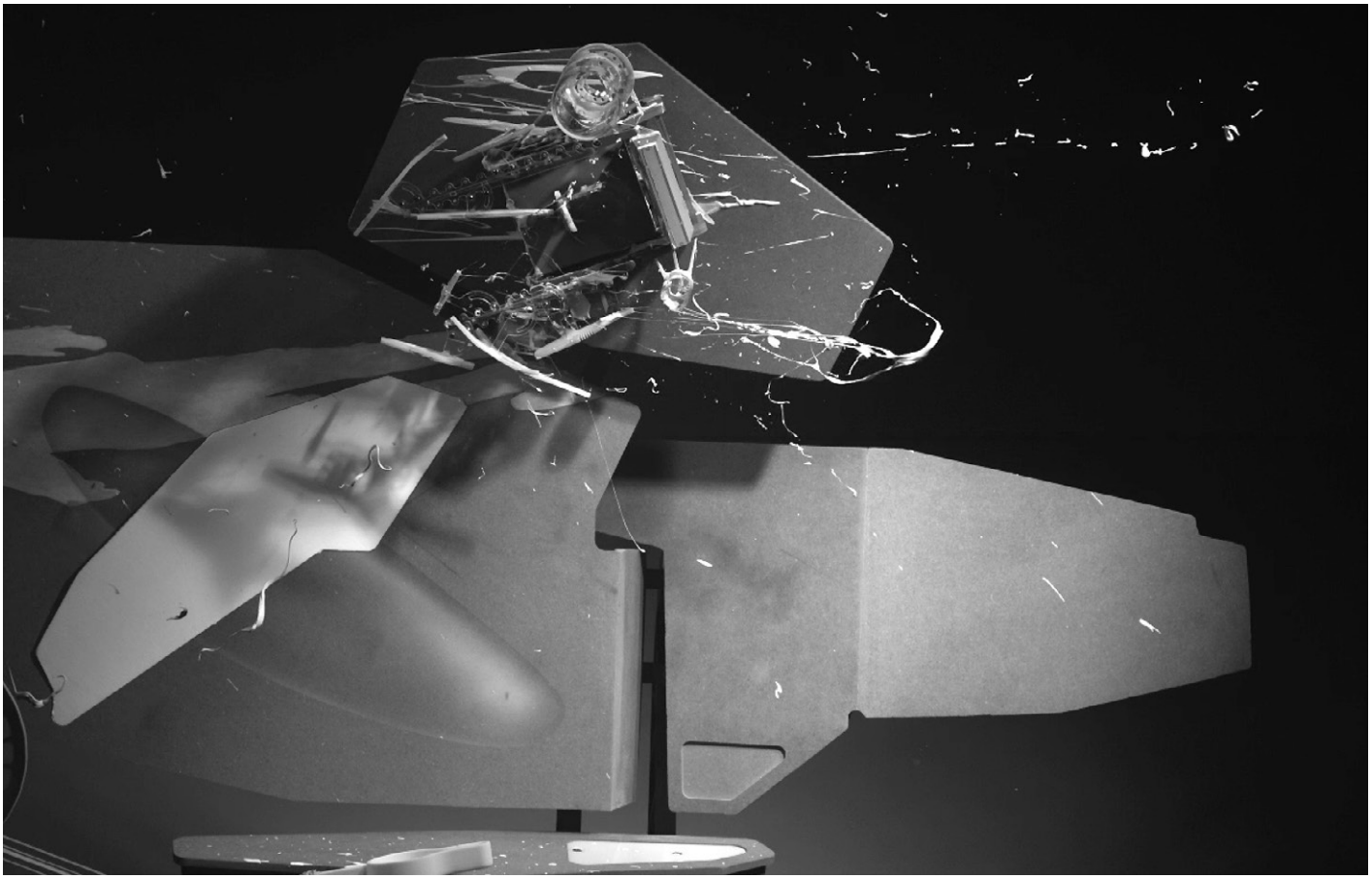


24— *Instrument Ten*, latex paint in flight. Latex paint is a non-Newtonian fluid, like blood, for which forensic scientists have analogue and digital techniques to divine some aspects of the events leading up to the blood splatter at a crime scene. As the throws of paint happen faster than the eye can register, such an opportunity was appealing in advance of using high-speed (Slo-Mo) filming.
25— *Instrument Ten*, paint in flight. Note the two colours of paint with resonant but not identical figures.

Bespoke paint throwing cups. Each of the four instruments that make up *Instrument Ten* have one or two dedicated paint throwing cups. Each one is shown here from above and below.



Still from one of the slow-motion films of *Instrument Ten* in action. Note how the character of the paint changes after its collision with the chair.

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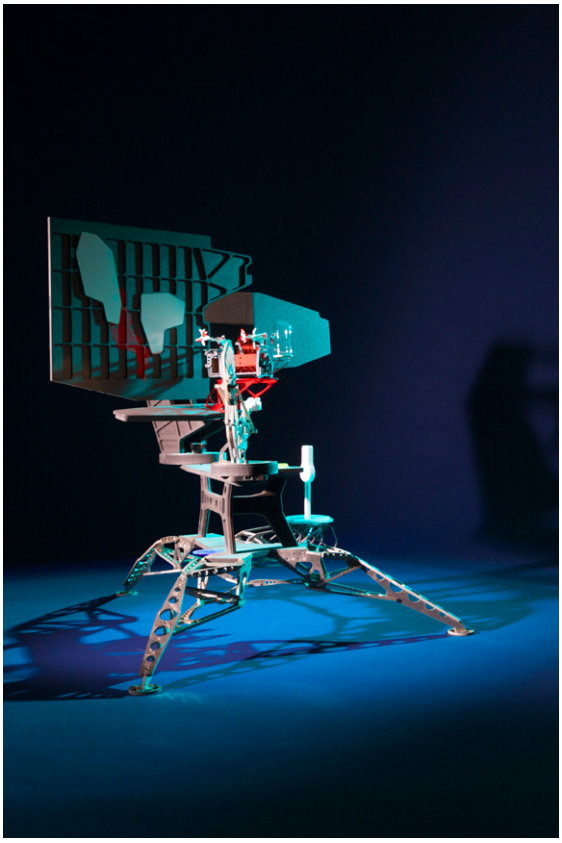

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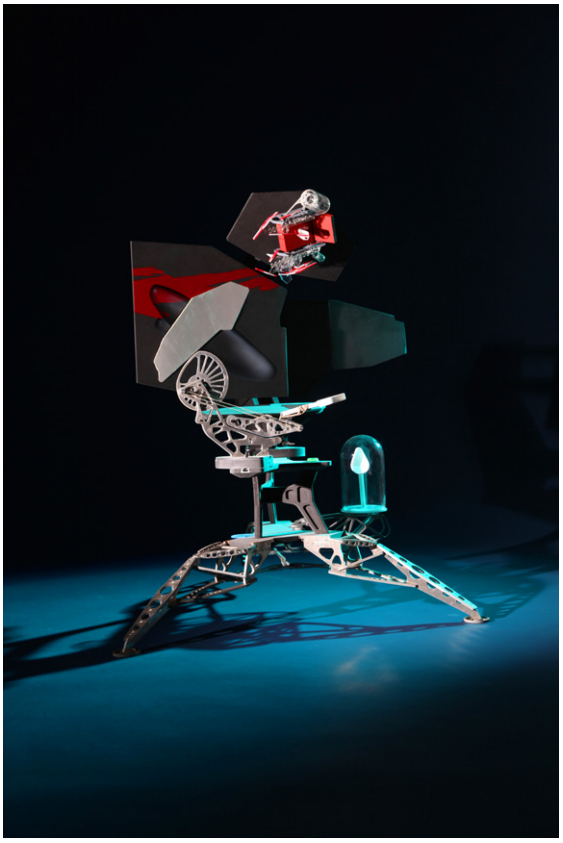

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The four instruments that make up *Instrument Ten*.

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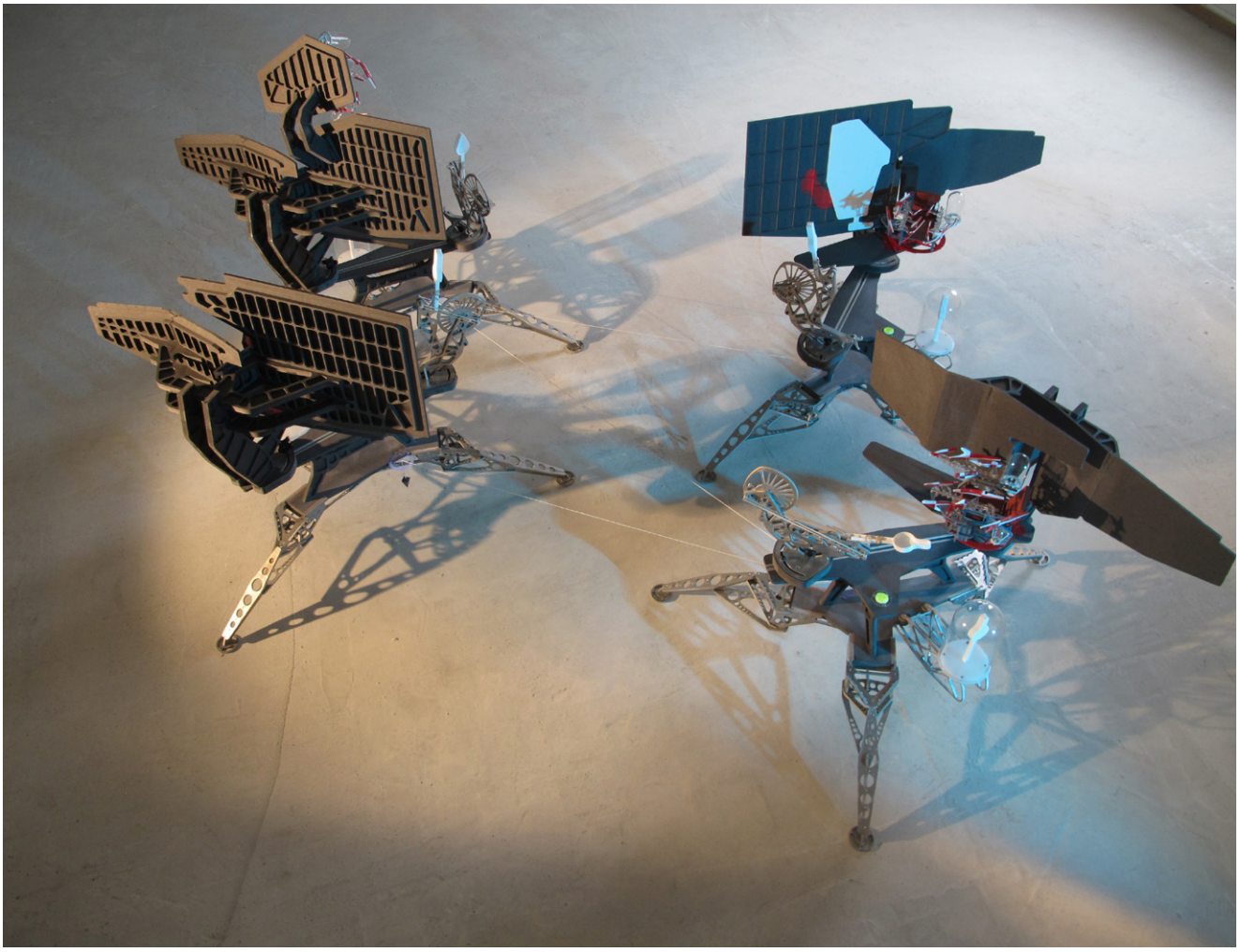

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32— The four instruments that make up *Instrument Ten*.
33— The four instruments that constitute *Instrument Ten* positioned to throw paint at each other. Scan and Photogrammetry by Thomas Parker.