



Solid Vision, or Mr Gropius Builds his Dream House

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Solid Vision



or Mr Gropius Builds his Dream House

Shantel Blakely



Above and overleaf: Walter Gropius, Gropius house,
Lincoln, Massachusetts, documented by Louis Sutro
View from Baker Bridge Road

Just over a decade ago a handheld slide viewer was found at the back of a closet in the Boston home of the late engineer Louis Sutro. A shallow, rectangular box made of enamelled bent sheet metal, the viewer enclosed a pair of lenses at one end, an opaque panel at the other and a single button to illuminate a lightbulb inside. A label on the side identified Sutro as the maker. In the same cardboard box were a number of stereographic slides – pairs of near identical images, bound in small sheets of glass, their edges sealed with foil tape, that resolved into a three-dimensional scene when inserted into the viewer.

The images themselves all featured a house Walter Gropius built for himself in Lincoln, Massachusetts. Gropius – the charismatic, opinionated architect who founded the Bauhaus and led the school through its manifestations at Weimar and Dessau – had been brought over from Europe by Joseph Hudnut, dean of Harvard's Graduate School of Design, to become the new head of the architecture department. The Gropius family – Walter, his wife Ise and their adopted daughter Ati – had arrived in Massachusetts in the spring of 1937. They had few resources, having left almost everything behind when they had fled Germany three years before. But local philanthropist Helen Storrow was persuaded to both provide a plot of land in Lincoln, about 30 minutes' drive from Cambridge, and fund the construction, not just of the Gropius family home, but of the neighbouring house for another Bauhaus *émigré*, Marcel Breuer, who had also been hired by Hudnut. Gropius and Breuer assisted each other in the design, and the construction moved fast. Following a brief stay in nearby rental accommodation, the Gropiuses moved into their new home in the late summer of 1938.

The stereographs were taken six years later, again on the invitation of Hudnut, by a research team charged with documenting the house. Sutro was the designated photographer and note-taker, but he was not just any photographer. He had received a bachelor's degree in engineering from Harvard and in the late 1930s had studied vision and photography at the Dartmouth Eye Institute, whose founder Adelbert Ames was the leading vision scientist of the time (and whose research came to the attention of several architects during the 1940s, including Gropius). After the war Sutro then worked at MIT in various laboratories, including the Research Laboratory of Electronics, where he assisted the neurologist Warren McCulloch in building an artificial retina. He would remain at the lab until the 1980s, when he applied the physiological principles of vision to the optical system of an unmanned robot destined for Mars.¹

As a form of documentation the stereograph arose from the convergence of a series of discoveries about vision in the mid-nineteenth century, just as photography itself was being invented. Much earlier, philosopher-scientists – among them, Da Vinci, Galen and Euclid – had all noticed that the two eyes see slightly different pictures, but the first to make a thoroughgoing demonstration of binocular vision – or the fact that the brain fuses two image inputs into a cohesive three-dimensional view – was Charles Wheatstone, who presented his findings to the Royal Society in 1838. It was also Wheatstone who observed that his drawings of an object, as seen from each eye, could be rendered as a single three-dimensional figure by a device that kept the two images separate during viewing.

*You shall no longer take things at second or third hand, nor
look through the eyes of the dead, nor feed on the
spectres in books,
You shall not look through my eyes either, nor take things
from me,
You shall listen to all sides and filter them from your self.*
Walt Whitman, 'Song for Myself', 1855

He called it a *stereoscope*, Greek for 'solid vision'. After his sometime rival David Brewster published the dimensions and proportions of a stereoscope for photography, working stereoscopic viewers were soon in production in London, Paris and the US.

A person who is deprived of binocular vision by injury or disease can only see things in a flat plane. Oliver Wendell Holmes, the Boston surgeon and inventor who coined the term 'stereograph', described one such patient who thought of things as 'touching' the eye, just as things touch skin.² For those who suddenly lose the capacity to use both eyes, the change can be dramatic. Neurologist Oliver Sacks, a student and connoisseur of stereography, describes a brief period when he lost his sense of space after a short stay in a small windowless room. 'Beyond my open door was the door of the ward opposite; beyond this a patient seated in a wheelchair; beyond him, on the window-sill, a vase of flowers, and beyond this, over the road, the gabled windows of the house opposite – and all this, 200 feet, perhaps ... seemed to lie like a giant Kodachrome in the air.'³

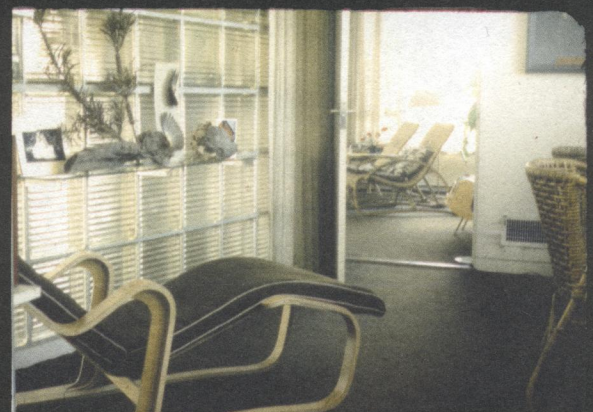
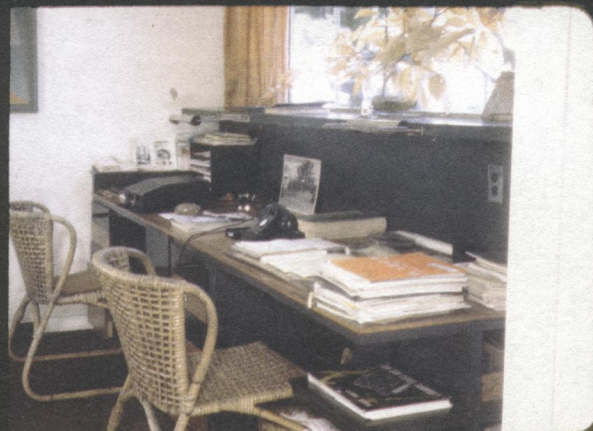
There are other clues for gauging depth: the overlap of nearer objects on farther ones, the different sizes of objects closer and farther away, and motion parallax – the tendency of things to shift in relation to one another, according to their distance from a moving viewer. As art historians have noted, draughtsmen have long used perspectival depth and strategically placed fragments to intimate a deep and wide space. For example, in his eighteenth-century *veduta* of the Piazza del Popolo, Piranesi depicts a partially visible carriage on the right edge of the engraving and a partially exposed house on the left. Depth is further inscribed in the rendering of the twin church domes at slightly different sizes, and in the way the fragments at the edge of the frame imply a continuation of the objects, and by extension the space.⁴

The side-by-side photographs in a stereographic pair, seen without the aid of a viewer, are in a sense twin *vedute*, ostensibly alike but for the different-sized fragments of things at their edges. This relationship is especially apparent when stereographs are posted on the internet, with the image pairs animated into a gif that seems to enact a slight rotation of the eyes.⁵ However, the reproduction of binocular vision, as achieved through an actual stereographic viewer, is more potent than any gif or virtual reality, which mostly relies on forced perspective and motion parallax. In the real world of the stereo viewer, objects and materials read loud and clear, with a heightened sensual emphasis on the specific, distinct qualities of surfaces and the shapes of things.

While the technique may be unique, Sutro's stereographic photo essay on the Gropius house is still a work of architectural photography, not least because he structures the set of images around a physical encounter with the building. Sutro begins by viewing the house as approached from the road, framing it with leafy branches as if it were a clearing seen from the woods. This picturesque flavour is further reinforced by the absence of any car, despite the driveway curving up the gentle incline to the door (the garage, off to the left, is concealed by a convenient maple). Each exterior view continues to be framed as an axonometric, shot from a low angle, including at least one edge where two planes of the building meet, which makes



Northeast corner, viewed from front garden;
southeast corner, viewed from back garden;
northwest corner, viewed from orchard



Vestibule; office, north wall;
office, south wall

the vertical a stable reference axis and enhances the photographic description of volume.

A crisp white rectangular block when seen from the road, the Gropius house was almost immediately nicknamed 'the sugar cube' by the neighbours. Yet the building does not look entirely alien. It was constructed of wood, in a version of New England's 'balloon-frame', and clad with vertical boards. The glass-tile panels, slate-grey paint on the steel deck railings and columns for the covered walkway are also analogous to the dark shutters on any Massachusetts colonial house. One might have expected avant-garde extremism from the founder of the Bauhaus, but if Sutro's stereographs suggest an affinity for an American suburban-pastoral, he may well have been presenting the building exactly as Gropius had hoped. As the architect later wrote:

When I built my first house in the USA – which was my own – I made it a point to absorb into my own conception those features of the New England architectural tradition that I still found alive and adequate. This fusion of the regional spirit with a contemporary approach to design produced a house that I would never have built in Europe, with its entirely different climatic, technical and psychological background.⁶

In many ways, Sutro's photography operates in the same way. Although his chosen medium was radical, the images he captured are not nearly as ground-breaking as other images from more explicitly avant-garde photographers, notably the 'New Vision' practised by László Moholy-Nagy and his Bauhaus students like T Lux Feininger, as well as by non-Bauhaus photographers such as Albert Renger-Patzsch. One New Vision acolyte, the American architect and photographer Robert Damora, even created his own set of images of the Gropius house, producing a series of black-and-white photographs that employed high-contrast lighting and strongly diagonal compositions to generate dramatic perspectives. But if the New Vision mantra was to reveal what was hidden in everyday experience – the so-called 'optical unconscious' – Sutro's project, in contrast, was to understand and depict normal, wide-awake vision, the 'optical conscious'.

And it is as a set of almost everyday images and experiences that the sequence of Sutro's images continues. On entering the sugar cube it soon becomes evident that this is a house of relatively small rooms (unlike the neighbouring Breuer house, whose interior would offer telescopic views from the large living room into a number of adjacent rooms). Here, in Sutro's views of the Gropius house interior, the spaces are defined by the detail of their material textures. For example, the first view of the entrance and vestibule is generously washed with daylight from a panel of wave-patterned glass blocks. A coconut mat is shown set flush in the polished cork floor next to the plaid-patterned curtain that divides the vestibule from the double-height central atrium. Other finishes also extend out towards the eye, like the edge of the open entrance door, the lines of the vertical boards (which echo the exterior cladding) and the chrome railings of the stair.

The family's collection of furniture and art, shown in a number of the stereographic photographs, includes pieces by Josef Albers, Marianne Brandt, Herbert Bayer, Marcel Breuer, László Moholy-Nagy and Alexander Schawinsky. So many examples of Bauhaus furniture crowd these rooms, in spaces seemingly tailored to their very dimensions, that it might seem like a showroom for 1920s furniture design; but as anyone who takes a tour of the Gropius house soon realises, the house is not designed around a canon, but around the habits of its inhabitants. Each room has a story or ritual and furniture is

subordinated to these narratives, with a Breuer stool becoming as discreetly operational as the wall-to-wall carpet and acoustical plaster.

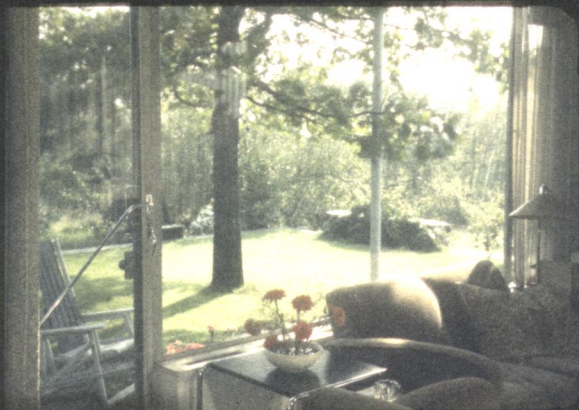
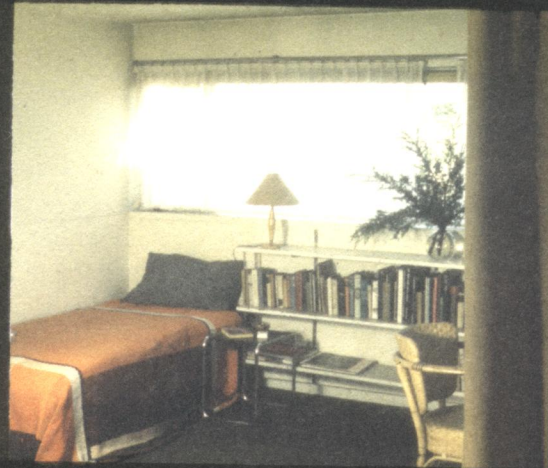
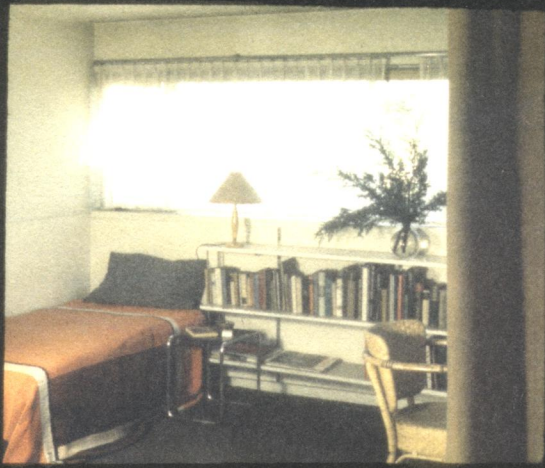
Sutro's stereographs also have an interesting tendency of shifting the focus from objects as things to the effects, parts and qualities they bring to the scene: rather than the formality of a museum-like setting, we see the home and the routines of everyday living. Nowhere is this more evident than in the image of the office, reached through a door on the right as you enter the atrium. Here Sutro depicts two rattan chairs side by side at a grey desk, which features piles of journals and papers, a paperweight and a black rotary telephone. Propped at the back is a print of one of Damora's photographs, showing the western facade of the house, and on the wall is hung a painting by Alexander Schawinsky. The desk itself – made of brown- and black-painted wood, fitted with task lights from Marianne Brandt's metal workshop – was one of the few pieces brought over from the Bauhaus at Dessau, and the room was more or less built around it. Gropius would draft all of his correspondence by hand (sitting in the chair closest to Sutro's lens), while his wife Ise would occupy the second chair, typing up these scrawled notes on more formal headed paper.⁷

Another image of the office shows a parallel series of objects sitting on a shelf attached to the glass-block wall on the opposite side of the small room: fronds from a dried plant, two bird wings mounted on a card, an abandoned wasp's nest and a piece of driftwood. These facilitate the perception of the curve in the wall plane that would otherwise be given by the line where the wall meets the floor, which is hidden by a reclining chair made by Isokon, the company Gropius worked for in London. A bookshelf is barely visible at the far left edge, and the freestanding book caddy (called the 'donkey', and also manufactured by Isokon), is part of a second reading area that is barely visible in the depths of the slide, in the adjacent living room. Other images show this space more clearly, with its day-bed and full-height bookshelves. An assortment of reclining chairs is also shown, placed near a small hearth with a narrow slate mantel. Below one window there is a built-in radio cabinet and on the bookshelf the stereograph allows the viewer to detect two books on painting and another on bird flight.

The bird-watching in Lincoln must have been exceptional – Sutro's stereographs of the living room show it almost collapsing into the surrounding landscape. The window itself covers most of the wall but is actually relatively square. This is not the widescreen expanse of an immersive 'glass house', as exemplified by Philip Johnson in his thesis house in Cambridge (the Ash Street House of 1946) and again more dramatically at New Canaan (the Glass House of 1949). Instead, the ruling metaphor here is television, not panavision.

Indeed, Sutro's images of the living room suggest that the proportions of its spaces were well suited to the 2:3 camera frame. Sutro then animates this frame by juxtaposing foreground objects and furniture against the backdrop of the landscape. In a series of notes that he wrote to accompany the images, Sutro's own mind wanders between these elements: 'The zinnias in the vase were picked from the flower bed you can see behind the stone wall to the left. If you have trouble trimming the edge of your lawn, you will do well to imitate Prof Gropius, who has made the stone wall flush with the lawn so he can run his lawn mower over it.'⁸

The kitchen, across the atrium from the main entrance and behind a discreet door, is equipped with all the conveniences of the time, including a dishwasher (almost unheard of then) and durable countertops of a material inspired by laboratory work benches,



Ati Gropius' bedroom;
view from living room;
guest bedroom



South elevation, viewed from back garden;
porch; west elevation, viewed from orchard

with stainless steel edges. The ceiling is similarly spare, equipped with chrome-tipped bare lightbulbs and painted the same grey-pink colour as the Bauhaus gallery. By all accounts, Ise Gropius disliked cooking, and so the kitchen was designed with a maid in mind – a live-in maid, lodged in a small apartment immediately behind the cooking space.

More to Ise's liking was the hosting of dinners. Spectacular meals were served in the dining room, where guests were limited to the number who could fit around a small white table, seated in lightweight bent metal chairs designed by Breuer. As guests arrived, the table would be hidden by a curtain hung from an inset ceiling track, separating living and dining rooms. At a chosen moment, and with an overhead spotlight turned on, the curtain would be swept open and the guests ushered in to admire the table that Ise had set and decorated, adding flowers and other coloured accents to inexpensive black-and-white Bakelite dishes.

Upstairs, the spaces continue to reflect the way the Gropiuses liked to live, in particular Walter and Ise's preference for sleeping with their windows open, but bundled up against the cold in warm nightwear. Hence there is a separation of spaces for sleeping and dressing, using a built-in vanity and interior window, which forms the centre of another of Sutro's slides. In this stereograph Sutro deliberately keeps the curtains open, creating a glow of overexposure that gives a somewhat naturalistic depiction of the foreground, which is focused on one of two pendant light fixtures and a vase holding stalks of milkweed. Other elements in the room and image continue this balance between hard and soft, mechanical and textile objects, notably the contrast between the shiny black vanity surface and a fluffy white bedspread, or between the expanse of the glass mirror against the smaller constellation of cosmetics crowded in front of it.

Sutro did not have the benefit of a wide-angle lens, but his stereographs still manage to show how the glass partition in the bedroom catches and holds daylight on the interior, in much the same way as the glass-block wall downstairs. These partition planes seem to have especially caught Sutro's eye, and he continues to juxtapose their surfaces with other, more incidental objects – for example, when seen through a stereographic viewer, the dried pods of a milkweed bouquet really stand out. In other photographs downstairs the surrounding landscape works in the same way, offering both organicism and detail, very much in contrast to the near absence of these values in conventional architectural photography, or even in Damora's more avant-garde photographs of the same building.⁹

By drawing the viewer into a close reckoning of things, surfaces and reflections, Sutro's stereographs also capture the freer architectural style that Gropius and Breuer adopted at Lincoln. This offers an obvious, softer contrast to their earlier work in Germany, notably their interiors for the Bauhaus buildings in Dessau, which were defined by the use of strong abstract patterns, typically set at right angles. Gropius even gave this later style a theoretical characterisation related to his research on psychology and vision – an investigation summarised in the essay 'Is there a Science of Design?' (1947), typed up for him by Ise at the desk of their house in Lincoln, and collected in his book *The Scope of a Total Architecture* (1955).

'I consider the psychological problems, in fact, as basic and primary, whereas the technical components of design are our intellectual auxiliaries to realise the intangible through the tangible', Gropius writes in this essay, completely subjugating the very thing that had ostensibly driven his work, his whole ethos, in Germany.¹⁰

For the American Gropius, as distinct from the German Gropius, psychology always held sway over technology. His principal conduit to an American physio-psychology was Earl C Kelley, a professor of secondary education at Wayne State University in Michigan, whose *Education for What is Real* (1947) offered in just over 100 pages a polemic against rote learning, conventional grading and testing. Gropius was so struck by Kelley's argument that he quoted him at length – beginning with 'sensation comes from us, not from the object which we see'¹¹ – and would also use *Education for What is Real* as the only book on his Harvard course syllabuses.¹²

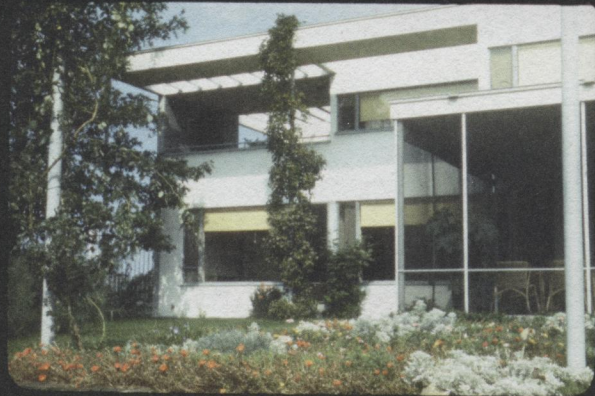
In part a summation of pre-existing touchstones of progressive education, *Education for What is Real* was also, in large measure, an interpretation of the account of vision given by Adelbert Ames. Educated as a lawyer at Harvard in the early 1900s, Ames had turned to painting after serving in the First World War. It was as a painter that he first started to look at the mechanics of vision, collaborating with his sister, Blanche Ames, also a painter. Seeking the ultimate in verisimilitude, the two envisioned a mode of painting with a central focus and blurred edges, and invented a form of photography based around two superimposed images.¹³ Increasingly absorbed by the study of vision, Ames then moved on from painting and with a physicist from Dartmouth and a lens designer from Eastman Kodak he began to study the eye through the construction of various models. Taking measurements of Ames' own eyes as a base reference, the team used cameras to study aberrations by approximating specific types of ocular misalignment. Their research revealed that the eyes of humans with normal vision vary widely in their anatomical dimensions and proportions, including variation in the position of the focused image in front of, behind or crossing the plane of the retina.¹⁴ This complexity and mystery belied the layman's understanding of the eye as a passive receiver of information, and soon drew the attention of ophthalmologists, winning support for the formation in 1936 of the Eye Institute at Dartmouth.

Over the next decade, Ames and his colleagues produced a series of sensational demonstrations at their institute. The most famous of these, admired by both scientists and artists, was the 'Ames Room' – a constructed space whose outlines were carefully distorted in depth and lateral extension so as to induce an optical illusion in which a man walking from one corner to another appeared to physically shrink.¹⁵ The Ames Room was widely published and reconstructed at more than one location in demonstrations given to scientists and philosophers during the 1940s. Architects also made contact, including Frank Lloyd Wright and Wallace Harrison, who is reported to have consulted with Ames on his design of the United Nations building interior.¹⁶ For these architects Ames' research offered the prospect of being able to manipulate, even design, the experience of a space, regardless of the observer's prior knowledge of what he or she was actually looking at.

These indeterminacies between knowledge and perception fascinated Kelley. In *Education for What is Real* they form the basis of his call to rethink education, not least because they challenge the assumption that a student perceives the material presented to them in the same way that their teacher imagines it. For Gropius, the repercussions of this research were equally radical. Was there now some kind of underlying subconscious design 'language', he mused in 'Is there a Science of Design?' Gropius thought that experiences in everyday life suggested as much. Or as he put it, consider how, when driving in icy weather, one blinks in response to a splash of



Pantry and kitchen;
dining room table;
master bedroom



South elevation, viewed from back garden;
porch; west elevation, viewed from orchard

melting snow on the windshield. 'Though our intellect tells us that the windshield protects us, the reaction to ward off practical danger for our eye reoccurs every time.'¹⁷

Gropius' fascination with this kind of reflex, and with the interface between the conscious and the automatic, was something he shared with enthusiasts of cybernetics. This in turn establishes a direct connection between him and Sutro; the photographer would work for many years in the MIT laboratory run by the neurologist and cybernetician Warren McCulloch, who would undercut established notions of the brain as a passive collector of information from the eyes, revealing instead a complex system of feedback in which an unexpected ladder of simpler movements and responses mediates conscious judgements.

While other Bauhaus affiliates, notably László Moholy-Nagy and György Kepes, would delve in varying degrees into cybernetics, Gropius would continue to focus his attention on the application of its findings to architecture and design education. And it is in this light that we should understand his perennial, unfulfilled appeal for the introduction of a basic skills course at the GSD, beginning in the 1940s, not simply as an echo of the similar *vorkurs* courses Josef Albers had run at the Bauhaus, but as a testbed for his increasing fascination with elementary psychology. 'If design is to be a specific language of communication for the expression of subconscious sensations', he wrote, 'then it must have its own elementary codes of scale, form and colour. It needs its own grammar of composition to integrate these elementary codes into messages which, expressed through the senses, link man to man even closer than do words.'¹⁸

Put another way, in order to work, the architect must understand psychology. In some cases this might even mean embracing illusion. Drawing upon another everyday scenario in 'Is there a Science of Design?', Gropius elaborates on this idea by asking the reader to imagine a balcony 20 storeys high. If the visitor looks down through the railings they will get dizzy, but this reaction can be prevented by simply covering the railings with cloth or paper. As Gropius affirms, 'our equilibrium is re-established through the illusion of safety although nothing has been added in fact for greater physical safety'.¹⁹ At the house in Lincoln he actually employs the same strategy to counter any sense of agoraphobia that might be provoked by the large living-room windows: 'if some vertical planes were erected

All stereographs © Gropius House
Stereographs Collection,
courtesy the Frances Loeb Library,
Harvard University Graduate School of Design

on that open space like wings on a stage, such as shrubs or fences or walls, the illusion of safety would be reinstated, and the dread would disappear; for the eyes of the person groping in

space now find a frame of reference to support them'.²⁰

Even the more general form of the 'sugar cube' as seen from the road, as well as the interplay of light and materials in the interior, are also consistent with Gropius' recommendations on how a building should appear.

*From far away its silhouette should be simple so that it can be grasped at a glance like a symbol even by an ever so primitive spectator as well as a man passing in an automobile. When we come closer we distinguish protruding and receding parts of the building, and their shadows serve as scale regulators for the new distance. And finally, standing close by, no longer able to see the whole edifice, the eye should be attracted by a new surprise in the form of refined surface treatment.*²¹

The actual footprint of the Gropius house is a T-shape, due to the addition of a slate-floored screened porch at the rear. Further complicating its ostensibly pure form are two single-storey wooden vine trellises, that extend from both sides into the surrounding landscape. The main volume is also cut to form a semi-enclosed first-floor deck – one wall painted pink to cut the glare of white – that is shielded from the road by a solid wall but reached from the ground by an external spiral staircase. The configuration of these elements is particularly evident in Sutro's stereographs of the back of the house. All of this offers a degree of tectonic intrigue, over which the eye and stereographic lens is free to wander, in marked contrast to the far more sugar cube-like blocks of the Dessau masters' residences.

To those who pass by on the road, therefore, the house is solid, earthbound, closed, private. It is communicative but sealed into a singular impression, like a symbol, and it anticipates the kind of looking that is exemplified by a conventional photograph. But from the back, in contrast, the house extends upwards. It is carved and exposed. Here, the eye can wander in and out of its recesses, following the objects on display, as it can just as easily wander between interior and exterior views. This side of the house anticipates the thoughtful looking that is exemplified and made available by Sutro's stereographs.

This is the side that invites us to ask what we think we are looking at, and what we are looking for, in the house that Gropius built.

A recommended stereographic viewer, the 'Lite Owl', can be purchased here, <http://shop.londonstereo.com/LITE.html>

1. 'Louis Sutro', *Needham Times*, Thursday 6 January 2005, <http://rogersutro.com/tribute/LouisSutro.cfm>.
2. Holmes adds, 'We clasp an object with our eyes, as with our arms, or with our hand, or with our thumb and finger, and then we know it to be something more than a surface. This, of course, is an illustration of the fact, rather than an explanation of its mechanism'. Oliver Wendell Holmes, *The Stereoscope and Stereoscopic Photographs* (London: Underwood & Underwood, 1899), p 17.
3. Oliver Sacks, 'Stereo Sue: Why Two Eyes Are Better Than One', *The New Yorker* 19 June 2006, p 67.
4. Giovanni Battista Piranesi, *The Piazza Del Popolo* (etching), in *Vedute di Roma* (around 1750), <https://www.metmuseum.org/art/collection/search/362729>. www.let.leidenuniv.nl/Dutch/

Renaissance/Facsimiles/Piranesi-VeduteRoma1760/source/piranesi-vedute10.htm.
5. See, for example, the posted set of stereographs by Timothy H O'Sullivan, 'The Civil War Part 3: The Stereographs', *The Atlantic*, 10 February 2012, <https://www.theatlantic.com/photo/2012/02/the-civil-war-part-3-the-stereographs/100243>.
6. Walter Gropius, 'Introduction', *Scope of a Total Architecture* (London: George Allen & Unwin, 1956), pp 16–17.
7. 'Recollections by Ati Gropius Johansen, daughter of Walter and Ise Gropius', *Architecture Boston*, 16:2 (2013), <http://www.architects.org/architecture-boston/articles/recollections-ati-gropius-johansen-daughter-walter-and-ise-gropius>.

8. Louis Sutro, 'Foreword', 'Twenty Stereographs of the House of Walter Gropius at Lincoln, Mass', typed notes (1944), p 3, Gropius House Stereographs Collection, courtesy of the Frances Loeb Library, Harvard University Graduate School of Design.
9. See, for a comparison, Robert Damora's black-and-white, wide-angle axonometric photograph of the dressing room, which suggests an atmosphere comparable to the room at Dessau. Robert Damora, photograph BRGA82121, Harvard Art Museums, <https://www.harvardartmuseums.org/collections/person/18433?person=18433>.
10. Walter Gropius, 'Is there a Science of Design?', in Walter Gropius, *Scope of Total Architecture* (London: George Allen & Unwin, 1956), p 30.
11. *Ibid*.

12. See Jill Pearlman, *Inventing American Modernism* (Charlottesville, VA: University of Virginia Press, 2007), pp 223–25.
13. Roy Behrens, 'The Life and Unusual Ideas of Adelbert Ames, Jr', *Leonardo*, 20:3 (1987), pp 273–79.
14. 'The average eye is a badly decentered and tipped optical system'; Gordon H Gliddon (Ames's assistant), 'An Optical Replica of the Human Eye for the Study of the Retinal Image', *Archives of Ophthalmology*, 2:2 (1929), pp 138–40.
15. Herman M Burian, 'The History of the Dartmouth Eye Institute', *Archives of Ophthalmology*, 40:2 (1948), pp 163–75.
16. Roy Behrens, *op cit*, p 279, n 49.
17. Walter Gropius, *op cit*, pp 31–32.
18. *Ibid*, p 33.
19. *Ibid*, p 32.
20. *Ibid*.
21. *Ibid*, p 44.