“By Air, I commonly understand that thin, fluid, diaphanous, compressible and dilatable Body in which we breathe, and wherein we move, which envelops the Earth on all sides to great height above the highest mountains.”


In architecture these days, the term *rendering* usually refers to the production and composition of images using techniques borrowed from the field of computer graphics. This was not always so. Not long ago, rendering meant applying an additional layer of tone and color to complete one drawing before starting another. Rendering was not the production of the image but the application of a final layer, a technique that translated the drawing from a two-dimensional abstraction to an image with distance and depth between objects themselves, and between the objects and the surface of the representational plane. Recently, I was asked to participate in a series of workshops and discussions on the English picturesque, and it occurred to me that a twenty-first-century reading of the picturesque approach to drawing was as suitable an introduction as any to a more expansive understanding of rendering in contemporary architecture.

The picturesque, in this context, refers to an aesthetic category that operates between the beautiful and the sublime, but it also includes a very specific set of representational techniques, and it was the discussion of these techniques that seemed to speak directly to my own considerations and confusions around “rendering” within image culture in architecture today.

Perhaps the least familiar of the half dozen or so terms used by William Gilpin to define the picturesque is *keeping*. Occasionally compared to aerial perspective, “keeping” refers to the representation of distance and depth in images of the picturesque. For a picture to be considered “picturesque,” in Gilpin’s terms, it has to produce the effect of keeping distance between objects in a painting, as the composition moves from front to back and from one object to the next. Keeping can be achieved through a combination of techniques, including the sorting or layering of figures from back to front, the
Sometimes I think I am not much of a historian, but I rather like how fastidiously and enthusiastically Gilpin discusses color washes. It seems we might learn something from the tone and style of these descriptions. If so, what lessons can the twenty-first-century renderer learn from this eighteenth-century watercolorist? What were his tools? What were his assumed materials? What were his texts? As we move further from these discussions of traditional images, consider the following as an attempt to sketch out techniques steering us toward an image of a different kind, the technical image.

In recent years, architects have rendered air using a continually evolving set of techniques borrowed from the field of computer graphics. Sorting, layering, blurring, dodging, smudging, and erasing—to name a few—are not handled on the surface of the paper or the canvas but on an entirely new and different substrate, the raster screen. These techniques are not only analogous to processes found in traditional image making but also are sampled representations of those processes, and thus they operate as abstractions of their traditional counterparts. The effect of air, in this sense, will always come down to a discussion around the technique of air; this is to say, air provides an opportunity to make critical discourse out of what we might take to be mundane software. Because air is present in almost every image, its images are loaded with innumerable technologies full of potential for a critical mode of abstraction to arise. Here, air offers possibilities for modes of attention and decoding that differ from traditional models of interpretation and reading.

It may be obvious, but it bears repeating that every image requires a sequence of steps to organize techniques like those mentioned above. Taking cues from the process mentioned by Gilpin, an example might look like this: (1) sort and layer objects by distance; (2) add texture and detail to those objects; (3) light the scene, providing contrast between objects themselves, and between objects and the ground. Conveniently, these steps correspond with the historical development of the computer graphic processes we now use to generate digital images in architecture.

When you have finished your sketch therefore with Indian ink, as far as you propose, tinge the whole over with some light horizon hue. It may be the rosy tint of morning; or the more ruddy one of evening; or it may incline more to a yellowish, or a greyish call. As a specimen an evening hue is given. The first tint you spread over your drawing is composed of light red, and oker, which make an orange. It may incline to one, or the other, as you choose. . . . By washing this tint over your whole drawing, you lay a foundation for harmony. When this wash is nearly dry, repeat it in the horizon; softening it off into the sky, as you ascend. Take next a purple tint, composed of lake, and blue, inclining rather to the former; and with this, when your first wash is dry, form your clouds; and then spread it, as you did the first tint, over your whole drawing, except where you leave the horizon-tint. This still strengthens the idea of harmony. Your sky, and distance are now finished.

Rather than create a color image from scratch, Gilpin preferred to set down his forms and their relationships to each other in black and white, later enhancing both keeping and “the idea of harmony” with these layers of tints. His techniques required a certain level of detail, which he called “roughness,” to register displacement. Keeping was achieved not by the absence of detail but by displacement and obliteration of detail through processes of addition and erasure, achieved through washing and tinting. The farther the figure was from the representation plane, the more of these processes it underwent. Considered in this light, the addition of these layers and substances to obscure distant figures can be understood as the rendering of that ubiquitous material, air.
The difference between the two processes is that computer rendering offers more numerous opportunities to make visible the steps of an image's production, and it this aspect of the technical image that appeals to me.

The following description of this process may appear overly technical, but there is good reason for this. Notice, for example, how often we use the expression, “the computer needs” or “the computer must”: this is simply a reminder that we are no longer in the world of hands and eyes. We are instead in the world of discrete pixels, which must be coaxed into portraying the appearance of continuity. In the production of a rendering, a 3-D model must be turned into a 2-D image on the raster screen; this is not simply what we see— it is the only thing we see. We take it for granted that the raster screen represents the picture plane. The computer must have a means of assigning each point on the model to a pixel, which is larger than a point, but the smallest unit of the raster image. Most importantly, the computer must assign depth to that pixel, despite the absence of any depth or physical distance in reality. To represent depth, the computer must eliminate values that correspond to points hidden from the POV of the camera aligned with the picture plane. These are calculations that ultimately allow us to make a distinction between a foreground, a middle ground, and a background. What a renderer calls a “z-buffer” is a technique developed by Edwin Catmull in 1974. Catmull described a “subdivision algorithm,” which subdivides the surfaces within a model so that no resulting subdivision corresponds to more than one sample point on the screen. Ultimately, in computer graphics, the z-buffer provides a secondary substrate for subsequent rendering operations; “lens blur,” for example, is not typically created by a simulation of lens optics, but by coordinating a blurring algorithm with an image’s z-buffer. Z-buffers are one of many forms of data generated during the rendering process that can subsequently be imaged. Such an image could be considered an image of nothing but the data of distance.

Like Gilpin’s watercolorist, the renderer must also apply textures to an image’s objects. Tuong Phong at the University of Utah originally developed techniques for adding detail to computed surfaces
in the early 1970s. His work expanded on Catmull’s research, allowing for objects modeled using surface patches to be rendered smooth by altering the way the objects are “painted” on the screen. These shaders split the computer’s graphic representation of the object from its computed, geometric description. Splitting is a distance making operation. The distance in this case allows for the introduction of an ever-growing list of techniques, which continue to displace the geometric object from its graphic representation. Texture mapping, for example, allows for surface color and smoothness to be controlled via external image data. Formalized by James Blinn and Martin Newell, this technique is called “mapping,” because it relates points on a virtual three-dimensional model to a two-dimensional representation of displacement. These mapped images are already split from the original object.

The final step of the process is to light the scene. Before he died, media theorist Friedrich Kittler spilled his last pools of ink on the problem of lighting in computer graphics. As he showed, although these techniques are closely associated with an experience of light, they relate to the physics of light only obliquely. In this case, I can do little more than point to the assumption of a “camera” within the software that was written by Turner Whitted in the late 1970s and early 1980s, called “ray tracing,” and the absence of a camera in the process outlined by a team at Cornell in the mid-1980s, now known as “radiosity.” Ray tracing and radiosity have since remained the dominant modes of calculating light in computer renderings. However, as Kittler pointed out, the differences between the two processes—not just technically but also conceptually—are so vast that they remain almost entirely distinct. Modern rendering engines calculate each separately, making images of both available as output.

According to some, architecture is rapidly approaching an image discourse, as it becomes more and more focused on photographs, renderings, and whichever may lie in between. The techniques that produce these images are typically thought of as shop talk—or worse, passed off as magical tricks of the trade that are best left behind the scenes and never discussed. However, the techniques
of image production represent data that could extend the process of rendering beyond a photorealistic endgame, by creating distance between a form’s traditional geometric description and its computer graphic representation. In fact, the greater the reliance on texture mapping and surface effects, the more removed the image becomes from any source. This is an opportunity to conceptualize what we are doing when we render without appealing to essences, experiences, or habits.

The historic move toward abstraction in painting required awareness not only of the picture plane, but also techniques of layering, displacing, washing, keeping, and rendering. Since contemporary rendering already offers a ready substrate of technical forms, it makes sense to use these techniques productively toward a critical discourse of our own methods for representation. Of air, or of anything else.

1. Super Jury: The Picturesque in Review was held at the Taubman College of Architecture and Urban Planning at the University of Michigan, on February 14, 2014.


5. I am not sure where I first heard this term. I might have made it up, but it sounds like something Sylvia Lavin would say.

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To begin, let’s describe it. We are looking at a painting of a square on a square canvas. It is, at first, a seemingly stable figure-ground, a relationship that could be described as on/off, 1/0, black/white. Only, this painting is not black and white; it is white and white, and therefore it is not stable. As a result, one could also say that there are two squares added together, one on top of the other, producing a layering of two figures; or that there is a square subtracted from another square, forming a doughnut, a figure with a hole in it; or that the figure is not even present, only its shadow, dropped from an object beyond the grasp of the canvas displaying ground alone. The tonal difference in the whites produces a flickering between the figure and the ground: the cumulative effect of layered paint and the slight shift in hue of the two squares of white disengages the forms from the single surface described by the otherwise flat plane of the canvas. Whether or not we agree that the composition is a figure-ground, a figure-figure, or a ground-ground is not important. Important and stable in all interpretations is the notion that this painting is about rendering that difference, which through the faktura of painting—its material tone—produces a distance or a depth between the two. Perhaps, then, it is possible to call this painting a kind of rendering. But this is aspirational, not yet a fact.

Three years before *White on White* (1918), Kazimir Malevich exhibited *Black Square*. In his 1927 book *The Non-Objective World*, he wrote: “The black square on the white field was the first form in which non-objective feeling came to be expressed. The square = feeling, the white field = the void beyond this feeling.” In the same essay, he equated “pure feeling” with “abstraction.” In another essay from the 1916 Moscow edition of his book *From Cubism and Futurism to Suprematism*, he wrote: “The square is not a subconscious form. It is the expression of intuitive reason,” and he continued to define a “new painterly realism, precisely painterly because in it there is no realism of mountains, sky, and water.” To a contemporary reader, Malevich’s ideas seem contradictory. After all, we have come to expect *form* to stand in opposition to *feeling, intuition* in opposition to *reason*, and *abstraction* in opposition to *realism*. But
at the time of the formation of nonobjective art, these concepts reinforced one another. They coexisted in the parallel space of painting, where the construction of the white spectrum of infinity formed a deep emotional and simultaneously conscious world in the viewer.⁵

In *The Non-Objective World*, Malevich provides several examples that help to disassociate “feeling as such” with its descriptor, “actual artistic value,” from the material objects of the real world. For instance, an airplane that now functions “to carry business letters from Berlin to Moscow” first came about as an idea to manifest “the yearning for speed [and] flight,” not the other way around.⁶
Or an antique column, which no longer serves any “technical task in the building,” continues to present artistic value in its “material expression of a pure feeling.”⁷ Stripped of their temporary functions, material forms can be recognized as expressions of artistic feeling that is eternally meaningful and beautiful. But why should artistic objects ever serve a utilitarian function that they ultimately overcome? Malevich argues that painting can shed its relationship to representing the real world immediately and dismiss its value as a “copy of life.”⁸ “The Suprematists . . . have found new symbols with which to render direct feelings . . . for the Suprematist does not observe and does not touch—he feels.”⁹ The “feeling” of Black Square is in no way related to sensing the world or the experience of life. Rather, it offers an instance of the parallel world in pure art. “Painterly realism”—a reduced world of forms, materials, and compositions—operates at the very essence of rendering.

El Lissitzky, a painter, architect, student, and interpreter of Malevich, projected this concept into a technical reality. He famously named *Black Square* the “zero” of art, from which he built a three-dimensional world.¹⁰ He used this zero to establish a theory of “irrational space” where objects float free in parallel projection. In his famous essay “A. and Pangeometry” (1925), Lissitzky redefined the principles of art through Nikolai Lobachevsky’s mathematical theorems of non–Euclidian geometry. Replacing the noun *art* with an abbreviation *A.* , he estranged the word from its common meaning and reassociated it with abstract, mathematical signification. He believed that if Lobachevsky’s theories did not resemble an image of our world, with their proofs of hyperbolic triangles whose angles
added up to less than 180 degrees, then the space of painting could equally disengage from a mimetic representation of vision. This parallel to mathematics allowed him to recast Malevich’s argument on art through geometry. Rejecting the visual pyramid of perspective built on the illusion of a vanishing point set on a horizon line, Lissitzky proposed a theory of parallel projection:

The solidly coloured [square] stamped out in rich tone on a white surface has now started to form a new space . . . If we indicate the flat surface of the picture as 0, we can describe the direction in depth by - (negative) and the forward direction by + (positive), or the other way around. We see that suprematism has swept away from the plane the illusion of two-dimensional planimetric space, the illusion of three-dimensional perspective space, and has created the ultimate illusion of irrational space, with its infinite extensibility into the background and foreground.17

Lissitzky aligned himself fully with the classical notion that a painting ought to construct space, but his *Prouns*, which composed multiple three-dimensional forms, operated without a recognizable architectural enclosure set in perspective or skiagraphically shaded volumes. As Yve-Alain Bois has observed, their geometric construction relied on a special kind of axonometry, “a cavalier’s perspective,” or what we commonly refer to as parallel projection.12 When Malevich called out, “I have ripped open the blue lampshade of color limits, [and] exited into the white; after me, comrade-aviators, swim into the void; I have established the semaphores of suprematism,” he described this horizonless, infinite space for the parallel movement of all forms.13 The aviator takes over from the cavalryman: he moves toward the vanishing point, displacing the horizon line ever farther back, opening up the cone of vision to parallel construction. Taking the flatness of the canvas as a plane of reference, Lissitzky hoped to expand the depth of the composition by projecting the square in either direction, in and out of its surface. Here, oblique geometric forms represent the production of depth without relying on any
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indication of the real world.

In a 1976 essay, Bois describes the monochrome paintings by Malevich as “conception[s] of representation of space,” and each of Lissitzky’s Proun works as “an index of the world to come.” Both painters rendered objects and the space beyond; the former to present concept alone, and the latter to put that concept to use, bringing the formerly abstract and parallel world available to painting alone into life. Lissitzky’s suprematism is applied, and therefore allows us to make the final jump into architecture.

Consider the ink and wash drawings made by Joseph-Louis Duc following his receipt of the Prix de Rome in 1825. The detail rendering of the Corinthian order in the Colosseum is an elevation of the column capital and entablature from which an oblique projection is constructed at 45 degrees toward the bottom right corner of the drawing, following the academic Beaux Arts method. This axonometric image filled with wash gives the otherwise flat orthographic drawing the appearance of depth and renders it legible as three-dimensional form. M. Jules Pillet, who wrote the technical manual of this method, opened his discussion on shadow construction with the following observation: “The shadow of an object on a plane is nothing more than the oblique projection of the object on that plane.” The shadow then, as an “oblique projection,” is a kind of axonometric drawing cast against the vertical plane of the elevation.

From the point of view of the draughtsman constructing the long elevation of the Colosseum, the curving wall behind the columns doubles as a drawing plane inside of the orthographic drawing. Its convex surface performs the function of an abstract and immaterial canvas: it receives the projections of the oblique shadows. Following Lissitzky’s interpretation of Malevich, we can define this as the zero moment in the composition. Objects can be represented both in front of and behind its coordinates. In this way, the surface that receives the shadow, whether flat or convex, appears to work as the canvas of a proto-Proun. Lissitzky provides an anachronistic connection between Malevich’s suprematist painting and nineteenth-century academic rendering. It is thus possible to read White on White through the lens of a Beaux Arts drawing. As such, the white square would be a shadow of an object that is hovering in front of the surface of the canvas.

Lissitzky’s incorporation of parallel projection in painting offers the link to understand the abstract capacity of architectural rendering. Perhaps if one were to write the history of rendering, locating White on White as a form of its modernity would shed light on the potential of this pervasive form of image making.

3. Ibid., p. 74.
7. Ibid., p. 76.
8. Ibid., p. 78.
9. Ibid., p. 94.
11. Ibid.
Mountains are full of wonder. They are primordial symbols of time, glacial time, but also a record of the subtle fluctuations in seasons, changes in the sky. They are wild, stochastic, unpredictable. They have no discipline. They have no referent. Each mountain’s identity is itself. It does not make sense to speak of errors when one speaks of mountains because they have no formal norm against which to stray.

A house is rarely wonderful. It is mostly a mundane composition of parts, frames, volumes, and walls. It is willful, determined, controlled. Necessarily positioned at some distance from nature, it is regulated through architectural convention. Remember the primitive hut? “It is by approaching the simplicity of this first model that fundamental mistakes are avoided and true perfection is achieved.”

A domesticated object has all the attributes of the original, corrected through a system of disciplinary norms. It is an analogous form, “created not by genius, inspiration, determination, evolution, but by two modest actions (which cannot be caught up in any mystique of creation): substitution (one part replaces another, as in a paradigm) and nomination (the name is in no way linked to the stability of the parts).”

If literary metaphor can turn the Right Whale’s head into a house, how might architectural drawing convention help to domesticate a mountain? Here are our twelve steps.


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1 We inscribed the unmanageable in a bounding box.

2 Subdivided into four quadrants for sanity.

3 Constructed orthographically projected elevations for each part as we understood them.

4 Corrected the new elevations to an orthogonal grid for inventory.
5 Extruded the drawings exactly.

6 Trimmed all shortcomings.

8 Rotated the willing quadrants one-hundred-eighty degrees.

7 Projected the underbelly curves through a cube to remove all defects of character.
10 Called it a house only for the power to carry that out.

11 Turned the plan forty-five degrees whenever possible.

12 Having had no spiritual awakening as the result of these steps, we nonetheless tried to carry this message to architects, and to practice these principles, as we furnished.