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SOME QUESTIONS ABOUT E. H. GOMBRICH ON PERSPECTIVE

1

Here is one way to think of linear perspective: Because it rests on mathematical fact it has singular status among methods of representation. Unlike, say, working up a drawing of a head and its features from simple, geometric shapes, as how-to books advise, it is unvarying and unconditional. It is the geometry of optics, the correlate of actual world and sight, the universal truth of what we see.
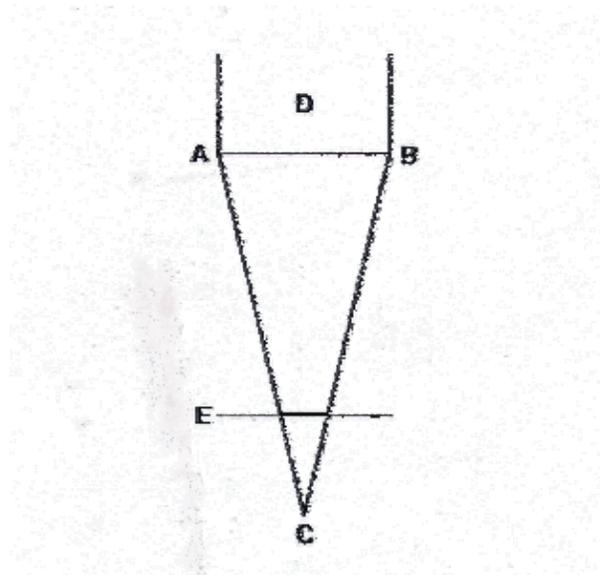

Figure 1. Looking at a building through a window. The diagram is a plan, a view from above. A, B, C, is the visual pyramid, C is the viewing point, D is the building (or base of the visual pyramid), and E is the window (or section of the pyramid), upon which the building is projected.

Here are reputed and by no means negligible grounds for this way of thinking: Closing one eye, I look with the other eye through a window at a building and draw its outline on the glass. My open eye is for this purpose like a camera, a camera is a mechanism for making perspective pictures, and photographs are proof that perspective works. The reason why can be diagrammed as the perspective pyramid spoken of by Alberti and Leonardo [1]. The front of the building is the base of the pyramid, my eye (or a camera lens) is at the apex, called the "viewing point," and the window upon which I

draw is a section of the pyramid, receiving the projection of the building and serving as the picture surface.

If the window is three feet from my eye and the building sixty, these distances can be shown in a perspective plan. If the building is twice as high as it is wide and has a facade of twenty thousand bricks, this proportion and number of bricks can be recorded in a photograph. If by "literal" I mean "pertaining to matters of fact," then I might say with justice that in perspective diagrams and pictures all distances and positions can be literally measured and plotted, all details literally preserved, according to rules of geometry literal in themselves. Since perspective gives literal details of things as I am able to see them, I am tempted to conclude it gives the literal truth of sight.

Let this idea of perspective be termed "literalist." Whether it is adequate or even defensible has been hotly debated for some time, generating an extensive and growing literature, to which this study adds. A notable champion of literalism was Professor E. H. Gombrich, OB, now deceased. Starting with a chapter in *Art and Illusion*, continuing over the years with other writings, he thrust and parried with a variety of ingenious elaborations and qualifications. About these writings there are questions that have not been addressed. My purpose here is to take them up, and to consider the implications. What will emerge is that linear perspective, like other schema of representation, operates not to literally replicate the actual world but as a visual trope.
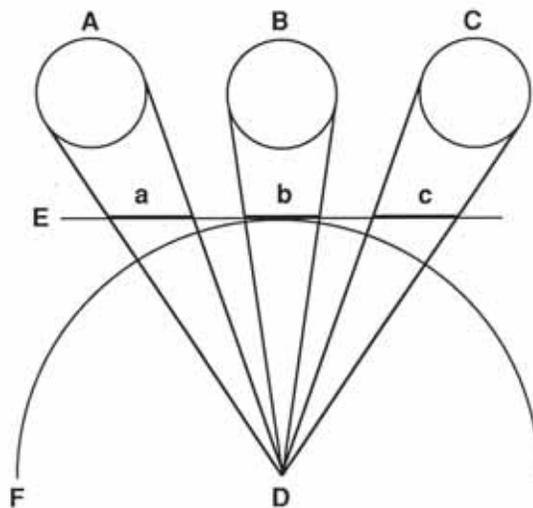

Figure 2 (after Leonardo). The paradox of the columns. A plan. In experience, the columns to left and right are further from the viewing point than is the center column, and therefore appear smaller. On the section, E, however, the columns to left and right project as wider than the center column. This phenomenon is known as "peripheral distortion."

We will begin with a well-known and widely discussed problem from Leonardo's notebooks. It has been dubbed the "paradox of the columns" [2]. Three columns, *A*, *B* and *C*, are shown from above, as circles. The viewing point, *D*, is at the apex of their visual pyramids. In experience, columns of equal size look smaller the further away they are, but here, on section *E*, the projections *a* and *c* are wider than *b*, though further from the viewing point.[1]

The obvious explanation is that an oblique section of a pyramid is longer than a perpendicular one. *b* is perpendicular to its visual pyramid while *a* and *c* are oblique to their pyramids, therefore longer. Pinhole photographs taken of actual columns by M. H. Pirenne confirm this outcome of perspective, known as "peripheral (or marginal) distortion."[2] (As the stretching of forms can be extreme compared to ordinary experience of actual things, the word "distortion" is reasonable as well as sanctioned by long usage, and will be kept here, though a less problematic term would be "distal elongation.")

In *Art and Illusion*, Sir Ernst offers another explanation: Because columns are round and therefore lack demarcations between "front" and "side," we fail to realize that they project in depth as well as in breadth. If they are replaced with square pillars, and the fronts of these pillars are painted red and their sides green, the green sides, extending in depth, are visible on the outer pillars but not the center one. The projections of the outer pillars are in fact wider than the projection of the center pillar, and the same, by implication, holds for columns.[3]
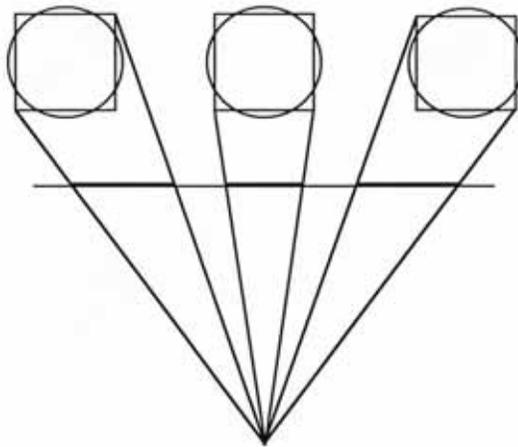

Figure 3 (correcting Gombrich figure 217). Gombrich's explanation. What seems to be peripheral distortion is really a difference in projected width. When round columns are replaced by square pillars, it is plain that the pillars to the left and right project depth as well as breadth while the center pillar projects breadth alone. The same, by implication, holds for columns.

Art and Illusion figure 217, meant to illustrate this idea, contains two mistakes. First, the diameter of the circles representing the columns is the same as the width of the squares representing the pillars. As squares are larger in area than circles that fit within them, the columns are represented as smaller in volume than the pillars. Columns and

pillars unequal in volume are not comparable in respect to the projected width of their oblique profiles. Second, as the sides of the pillars have in any event been left out of the projection, the illustration fails to demonstrate Sir Ernst's thesis. It is replaced here by figure 3, in which the columns and pillars are represented as equal in volume and the sides of the pillars are included in the projection along with the fronts, as Sir Ernst presumably intended.
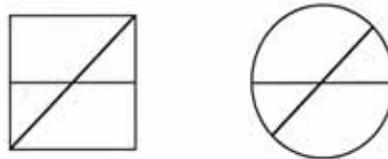

Figure 4. But the diagonal of a square is greater than any one of its sides, while the diameter of a circle is constant. Square pillars and round columns are not comparable.

It is true that the diagonal of a square is longer than any one of its sides, and that the total width of a square pillar will therefore vary according to whether it is seen frontally or in three-quarters view, but the diameter of a circle is the same between any two points on the circle [4]. Provided the viewing distance remains constant, a round column, unlike a square pillar, projects the same width from all quarters. Even if the circles and squares are equal in area, to compare square pillars and round columns in respect to projected width is to compare apples and oranges.[4]
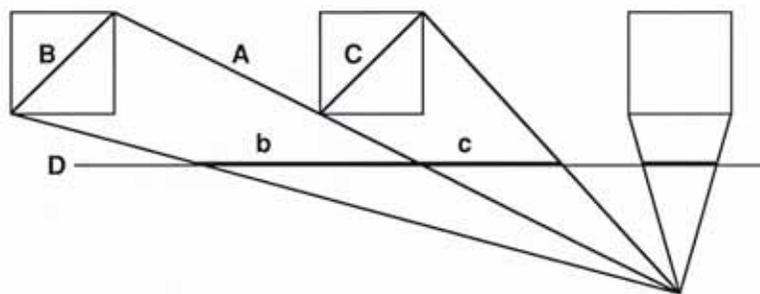

Figure 5. Peripheral distortion confirmed. When three pillars are diagrammed with the viewing point in front of the pillar to the right, the projected profiles of the two pillars to the left are nearly identical. Yet on the section they are radically dissimilar. Peripheral distortion occurs with columns and pillars.

Figure 5 puts Sir Ernst's thesis to the test by showing three square pillars with a viewing point in front of the far right pillar. Breadth and depth can more clearly be plotted with pillars, and from this viewing point the red fronts and green sides of both left-hand pillars can be seen. As their pyramids of projection share a common side in line

A, their profiles *B* and *C* are nearly identical. The difference is about one degree. If, as Sir Ernst contends, variation in the projection of like things is a product of depth combined with breadth, then on the section *b* should resemble *c*. Instead, *b* is much longer than *c*. Because the left-hand pillar is more peripheral to the viewing point than is the center one, its projection is more oblique, hence wider, hence elongated.

Two factors are at issue, Sir Ernst's factor and peripheral distortion. Sir Ernst's factor, applying to things that vary in total width according to whether they are seen frontally or in three-quarters view, applies to pillars, apartment buildings and horses, but not to columns and spheres. Peripheral distortion, applying to columns and spheres, as well as to pillars, apartment buildings and horses, applies to all things indifferently. It is an essential characteristic of linear perspective. Thus in figure 3, differences on the section are partly a product of variation in the projected width of square pillars, partly a product of their relative obliquity to the section, while in figure 2 differences on the section are a product of relative obliquity alone. That is most likely the very reason Leonardo used columns - to avoid the factor introduced by Sir Ernst. Columns isolate peripheral distortion from such-like distractions.

3

In these narrow technicalities lies a crucial juncture, for if peripheral distortion cannot be written off to the dimensions of actual things and the view we have of them, the literalist idea of perspective is imperiled. There is, however, another and forceful argument in defense of literalism. We will enter it with a useful digression. Some perspective drawings and paintings, called "anamorphoses," are distorted on purpose. The *Portrait of Edward VI*, reproduced in *Art and Illusion* as figure 216, serves as an instance. Anamorphoses are grossly elongated perspective pictures with viewing points far to the side. Viewed from in front with both eyes open, they can be close to illegible. Viewed with one eye from the viewing point, often supplied by a peephole, the weirdness disappears. As the picture was constructed in concert with extreme foreshortening, it comes together when looked at in this way. Let such looking be termed "anamorphic looking," and let anamorphic looking be given a role in the matter at hand, for it enables an "anamorphic looking defense."

If we look at the perspective picture of columns diagrammed in figure two with one eye shut, the other eye fixed at the viewing point, *D*, anamorphic looking occurs. Foreshortening of the plane of section compensates for the differing obliquity of *a*, *b* and *c*. In other words, because we see *a* and *c* at an angle, as in seeing an anamorphosis from a peephole, they appear the same as *b*. As the sides of the three visual pyramids indicate, the columns, the picture and a hypothetical "image" on the retina exactly coincide. Peripheral distortion is corrected in appearance, passing unseen. Phenomenally speaking, the columns at least in this single respect seem as they do in nature. The correlation of

things, picture and sight is perpetuated. Such, at least, has been the theory since the days of Leonardo, who first adduced a retinal image.

But where is this shy creature hiding? It is now known our eyes constantly undergo two kinds of movement, a minute involuntary tremor known as "physiological nystagmus," too slight to be readily observed or even for us to be aware of, and larger leaps from point to point, called saccadic. By mounting a tiny picture on a stage affixed to a tiny stalk in turn fastened to a contact lens in a subject's eye, so that the picture follows every movement of the eyeball, the minute tremor can be negated, the pattern of light on the retina stabilized. When this is done perception quickly decomposes into momentary blankness.[5] It's clear that stable pictures as such don't ordinarily lodge on the rods and cones lining the retina, for these nerve cells are incessantly in motion; and that when a stable picture is artificially induced vision collapses. The retina is less a passive screen upon which things are projected as pictures such that we might look at than an outpost of the brain, a scanner at the end of a cerebral stalk, harvesting from the world its intelligible features. As for saccade, they provide further evidence that the visual cortex does not passively receive the external world whole and, so to speak, pre-pictured, as if in a photograph, but, rather, actively construes exterior reality by sequentially aiming at and fixating its salient points, so that vision has its temporal as well as its spatial aspect.[6] An in the visual cortex itself researchers find nothing but vastly complex patterns of neural excitation and repose. If there are no pictures as such on our retinas, neither are there pictures as such anywhere in our minds.[7]

In a recent book on visual perception the history of perspective-as-sight and its abandonment is summarized thus:

> Physics made possible an understanding of light and of the laws of optical transmission in the air and eye. It became clear that vision is not due to the emission of energy from the eye, and it was understand how objects in the external world were represented as images on the retinal surface. The laws of optics were also employed in art through linear perspective. Once the similarity between perspective pictures and optical images was appreciated the problem of perception was conceived in terms of extracting information from a two-dimensional scene. The retinal image was considered to be a static picture, with profound effects upon both theory and experiment. Pictorial representations of objects were treated as adequate experimental substitutes for the objects themselves, with the result that the dynamic aspects of vision were too readily ignored. Because our eyes are in constant motion, the retinal image is an abstraction.[8]

Defending the correspondence of things to picture to sight, Sir Ernst suggests that we look through a window and note how changes in the direction of our gaze fail to substantially change the view. This he illustrates with a photograph of a window on which has been outlined a distant building.[9] Building and outline coincide. One problem here is that when we look at a building through a window it is the building through the window that we see, rather than a picture. Sir Ernst's photograph is a perspective picture of a perspective picture. Another problem is that his suggestion is but a version of the

anamorphic looking defense. Employing one eye to exactly cover things with their picture is theoretically attractive but experientially dubious. If the reader puts the question to the test of experience by closing one eye and using a marker to outline a building on a window, he or she will quickly find that while a drawing is certainly produced, it is most difficult to have the picture and the building exactly line up. Working the drawing left and right requires at a minimum turning one's eyes in their sockets, and this makes the outline constantly slide off the actual thing seen through the window. The difficulty is little helped by using a peephole to hold the eye steady. Even if it were possible to employ one eye to exactly cover things with their picture, we would still be obliged to stop short of equating things to perspective pictures to sight, for physiological nystagmus and saccade ensure that there is never an image on the linings of our eyes. And if literal correspondence of things to picture to sight is the issue, a miss of a fraction is as good as a miss of a mile. Speaking literally, either they are equivalent or they are not.

Nelson Goodman is right to speak of the fixated eye as a "remarkable condition."[10] Only he could have gone further and said it is no condition at all, since the eye is in truth never completely fixated and can never be made to exactly obey the geometry of perspective, neither at the involuntary level of physiology, nor at the voluntary level of conscious will and design. This remoteness of the theoretical idea of the fixated eye from the actual mobility of our looking is reflected in the way we spontaneously behave. In the absence of anamorphic trappings such as peepholes or projections so radically distorted as to command anamorphic looking, we are not spontaneously inclined to close one eye and hold the other in one fixed spot. To do so is to lend ourselves to a contrivance, to play an anamorphic part, to pretend we are a camera, to bodily occupy an abstraction.

Turning to the historical record, our lack of inclination to look at pictures anamorphically is matched by a lack of pictures that demand this manner of looking. Exceptions such as the *Portrait of Edward VI* are sixteenth-century, Mannerist curiosities. Usually, perspective pictures are manufactured by the operation of a perspective machine, a camera, and can be viewed anamorphically but are not, or use perspective while avoiding the constraints and problems of distortion and anamorphosis altogether. Leonardo himself, in making the *Last Supper*, placed the viewing point too high for the spectator to occupy. Raphael, making the *School of Athens*, used a central projection for the architecture, but also placed the viewing point too high. The groups of figures in the *School of Athens* have in any case their own, secondary centers of projection. The two spheres held by figures on the right would be drawn as ovals if subjected to the same projection as the architecture, but instead are drawn as circles, in disregard of perspective laws.[11] White cites paintings and reliefs by Donatello, Masaccio, Filippo Lippi, Mantegna, and Piero della Francesca that disregard the laws of perspective, Edgerton describes a painting by Domenico Veneziano in which the

architectural setting has been arbitrarily lowered, and doubtless there are other examples.[12]

Spontaneously, we forsake the tyranny of the viewing point and look at perspective pictures as we look at other pictures, with both eyes open and in constant motion. Masters of perspective assume this condition. They assume a looking distinct from that required by geometric projection. And once a distinction between anamorphic looking and ordinary looking is admitted it must further be admitted that distortion in the paradox of the columns can ordinarily be seen.

A solution proposed by Leonardo is curvilinear perspective, discussed by me in the study of that name. Here, in this discussion, it will suffice to observe that line F in the paradox [2] demonstrates a congruity of actual dimensions to projected dimensions away from the viewing point. On this curved line representing a hemispherical rather than flat section of the visual pyramid a and c are narrower than b, and this relationship holds whether the viewer's eye is at D or not. A curve, "being always equally remote from the eye," is thought by Leonardo to accommodate ordinary looking while also removing peripheral distortion. All would be well – except another problem intrudes. If projection onto a plane results in peripheral distortion, projection onto a hemisphere turns the straightness of straight things into curves. Square walls are depicted on a hemisphere as shields. One distortion supplants another. The difference between perspective and sight remains.

Acknowledging discrepancies between theory and practice in respect to perspective pictures and our looking at them, Sir Ernst (and Pirenne) seek to preserve a literal correspondence of things to picture to sight by a "compensation" whereby perspective pictures viewed from the "wrong" position are "interpreted" as though viewed from the "correct" one, and seem to "right themselves." Substituting a mental for an optical literalness, this idea can be termed "psychological anamorphosis."[13]

To extrapolate, a looking defined by immediate facts of geometric projection is nonetheless presumed to have facts other than those it presently enjoys. It is thought to step into that which is not an adumbrated aim of consciousness or an object of imagination but an actual here-and-now. Were our sight of perspective pictures confined to a present "viewing point," yet capable of stepping into another "viewing point," as though the immediately present optical array were occurring elsewhere, ellipses could look round when seen with both eyes open and in motion, circles could look round when seen with one eye shut, the other fixed. As figure seven shows, this is not so. It is more subtly the case that perspective conditions are a content of perspective pictures while in no way defining their legibility. That is to say, the legibility of a perspective picture from positions other than the "correct" one, at the viewing point of the projection, cannot be explained by a literalist theory of sight, an anamorphosis of the mind.
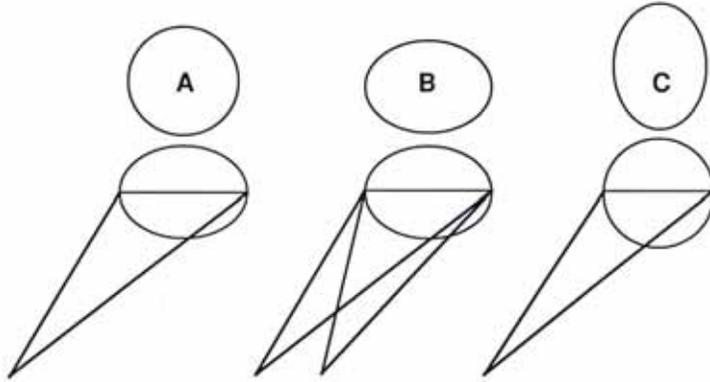
Figure 7. An argument against "psychological anamorphosis."   A horizontal ellipse seen anamorphically, with one eye shut and the other fixed at the viewing point, appears as a circle (A). A horizontal ellipse seen ordinarily, with both eyes open and in motion, appears as a horizontal ellipse (B). A circle seen anamorphically appears as a vertical ellipse (C). To see an ellipse under the conditions of A, a circle under the conditions of B, a circle under the conditions of C, is impossible.

4

Discussing the paradox of the columns, Sir Ernst speaks of square pillars with red fronts that are parallel to the plane of section. The three identical rectangles of these red pillar fronts, he correctly says, are identically projected on the section. Their actual proportions are sustained. Peripheral distortion, he elsewhere writes, ". . . cannot be used as an argument against the isomorphism of parallel planes," since "unlike spheres, circular wire hoops parallel to the picture plane would not project as ovals but as circles."[14]

In *Art and Illusion*, he describes a sequence of unlike planes and curved shapes that appear identical from a viewing point, provided their coordinates are exactly aligned, and calls them "gates" (*Art and Illusion* figure 215). "It was claimed," he elsewhere writes, "that [linear perspective] enabled the artist to represent what has been called 'measurable space.'" But "gates" show that from the viewing point measurable distances cannot be detected, "since not one but an infinite number of related configurations would result in the same image."[15]

Red pillar fronts and gates are "related configurations" by virtue of the laws of projection. Defined by Euclidean geometry, they are conjoint with rather than anterior to perspective; they are artifacts of the procedure. That is what the words "related configurations" mean. But pillars, columns, spheres, apartment buildings and horses, as things in the actual world anterior to a section, are exactly unlike artifacts of perspective in that they are not configurations, related or otherwise. Sir Ernst, arguing that a sequence of surfaces can be coordinated to a point and that two dimensions project perfectly onto two dimensions, only argues the autonomous relation of one perspective artifact to

another. He argues that linear perspective is literally true in that two or more perspective configurations are internally consistent. By means of this hermeticism, the question of how actual things and their perspective picture alternately appear to us is simply put aside, along with the vexing question of peripheral distortion. Perspective as literal truth is divorced from sight as it is manifest in the actual world.

We can agree that if the world consisted of planes parallel to a section, or of a series of gates, or, on the same line of reason, of an Ames experiment in which a bizarre arrangement of sticks and wires is made to look from a peephole like a chair; if, in other words, the world held perspective structure prior to its being so arranged or pictured, then the attributes of wire hoops, red pillar fronts and gates would universally hold sway. Peripheral distortion would not occur. But the world is not structured for flatness, and is not composed on a surface supposedly inside the eye or anywhere else. Its depth is actual and continuous. Linear perspective attempts to capture this depth on a plane by the factualness of the perspective scheme, measuring time and distance. By means of a ground plan and elevation upon which intervals can be plotted relative to a point of view, or by means of a camera employing light and optics, means straightforward and exact, perspective gives to depth the temporal and spatial value of a frozen instant, a section of time and distance. It in fact represents depth as "measurable space." Things and their picture are disposed in this "measurable space" according to literal criteria of picturing that yield a factual investigation of appearances while also yielding the hiatus of peripheral distortion.

If wire hoops are offered to the section obliquely, so they extend in depth, they project nearly identical profiles that vary on the section, exactly like columns and spheres. A chair such that we sit in, unlike an Ames chair, is not organized in relation to a point from which we are compelled to view it. If it is projected from nearby and the projection is viewed in the ordinary way, with both eyes open and in motion, distortion will be considerable and obvious. This distortion can be minimized by a sufficient removal of the viewing point from the section, as Leonardo recommends, and as is accomplished by a modern camera of "normal" focal length, it can be edited out, as did Raphael, but it is built into perspective pictures, a symptom of projecting three dimensions on two according to a geometric rule.[16]

Now Sir Ernst was the first to admit such difficulties. "The case," he wrote, "against the phenomenal world looking like its projected picture on a plane is indeed even more formidable than Nelson Goodman has made it."[17] Yet by speaking of likeness as in the autonomous relations of perspective artifacts rather than in our relation to pictures and the world, he sought, after Leonardo, to sustain a literal correspondence of thing to picture to sight. He stated in *Art and Illusion* that

> One cannot insist enough that the art of perspective aims at a correct equation: it wants the image to appear like the object and the object like the image. Having achieved this aim, it

makes its bow and retires. It does not claim to show how things appear to us, for it is hard to see what such a claim might mean.[18]

Yet perspective is a human work, a human instrument. *It* cannot aim at anything. It is *we* who aim to look at things and perspective pictures, adjudicating their equation. Removing the claim to "show how things appear to us," and treating perspective relations, so to speak, in vitro, distortion is overcome, but only by a removal of meaning. What can a "viewing point" mean if it does not stand for our sight of things and of pictures? And if our sight of things and pictures *is* involved, then do not the formidable difficulties acknowledged by Sir Ernst come to the fore?

At bottom, the idea of literal correspondence involves a confusion of abstractions and actualities, or what Whitehead called "a fallacy of misplaced concreteness."[19] The abstractions of projective geometry are attributed to things while they in turn are thought to inherently bear the qualities of geometric projection. There is a failure to discriminate the primordial concreteness of material things in continuous, actual space, anterior to a section, from the concreteness of reifications - the concreteness of perspective diagrams, perspective pictures and Ames constructions, fixed on a surface or organized relative to a point in space. Representations and things are confused by means of an apparently literal metric. They are considered, not to symbolically stand for one another in respect to certain typical features and stipulated conditions of projection, but to be experientially identical.

5

Phenomenally speaking, things and their perspective picture are drastically unlike. Take, for example, the projection of circular things to an oblique viewing point as ellipses. Examples in art abound. Typically, the ellipse represents the round rim of a bowl or plate, and typically it is considered to be the shape projected on the retina, hence equivalent to sight. To test this assumption, R. H. Thouless conducted an experiment. He asked a group of people to view cardboard circles from the side and match the apparent ellipses from a selection of cardboard cutout ellipses. The experiential context, in other words, was one where the projection of an ellipse of some proportion or other was assumed. The outcome in the very planning was skewed away from unmediated experience of the actual world, absent projections of any sort. Even so, people consistently chose an ellipse rounder and more circular than the one dictated by the laws of linear perspective. Even in a context of anticipating a flat shape, as distinct from the primordial volumetric fullness of the unmediated perception, the shape geometrically projected shape was not the shape perceived. Thouless, wisely declining to engage in metaphysics by employing quotation marks, described this as "phenomenal regression toward the 'real' object."[20]

If perception is not determined by perspective -- if the perspective shape is not what we see -- then perspective would seem to have limited claims on perception. But Sir Ernst was again moved to defend the literal correspondence of perspective to sight, though again at a psychological remove. He responded to Thouless' work of by writing, "I would predict that a painted coin or plate represented as lying on a table would also obey the law of 'phenomenal regression toward the real [sic] object' . . ."[21] That the apparent proportions of a painted ellipse will vary from its literal proportions is likely. Yet the painted ellipse is a figure. To describe the phenomenal import of this figure we would have to choose another figure - an ellipse to describe an ellipse. As with the photograph of a building outlined on a window, Sir Ernst's remark has reference to pictures of pictures. It leads to a regression in respect to an illusory "real" object whereby one representation stands for another, ad infinitum.

The phenomenal import of perspective abstractions must be carefully distinguished from the phenomenal import of the things those abstractions represent. Ordinarily, a plate carries the full character of roundness in whatever circumstantial aspect of it occupies our immediate attention. In the sense that it does not yet have the character of a projected ellipse of any proportion, it has yet to acquire an appearance. Only when it is thought of as a flat shape do questions of proportion and size enter the experiential train. Quantification and qualification as a flat shape, an ellipse of such-and-such size and proportion, are attributed to the plate by virtue of the perspective scheme when the plate is seen or painted in a perspective way. It is this freely chosen act that gives rise to an appearance singularly perspectival.

In "Standards of Truth," Sir Ernst speaks of an "eye-witness principle," or ". . . the negative rule that the artist must not include in his image anything the eye-witness could not have seen from a particular point at a particular moment." Writing that this rule ". . . vindicates the traditional method of the perspectival painter who looks straight on at the landscape he wants to paint and measures the relative size of the objects in the landscape against the upright pencil held in his outstretched arm," and illustrating this with a photograph of same, he argues that pictures and sight are residually literal counterparts and neglects that holding up a pencil is a perspectival act that causes designated size to spring up in the experiential field where formerly it lay dormant.[22] From a sight that is everyday to a sight that seeks description, from walking toward distant trees to imagining a picture with the trees in it, the experiential context changes. The distant trees take on the exact dimension of the projected interval on the outstretched pencil as the terms of perspective are evoked.

The illustration shows two sections, that of the plane occupied by the film when it was exposed, and that lying on the pencil, marked off with the thumb. It shows a section of a section. Like the hoops, gates and red pillar fronts, like the photograph of the building outlined on a window, like the painted ellipse described by another ellipse, it shows the relation of one perspective artifact to another. It shows how the trees would

look if they looked like a perspective picture, it shows how they look when they do look like a perspective picture; what it fails to show is that the interval on the pencil is anterior to this way of looking at trees.

Much the same can be said of circular things, such as plates, when they are thought to have a flat, vertical dimension *before* they are considered as ellipses. Quality and quantity are removed from the experiential context and treated as absolutes, likeness is attributed to the autonomous workings of "the art of perspective," rather than to our understanding of pictures and things, and the innate resemblance of things to a perspective configuration is assumed.

But to see or paint a plate or landscape as having a fixed, vertical interval, as though projected on a plane, is to understand, provisionally, what they look like. Under the provisions of perspective, they look like an ellipse or other perspective designation. To say that the ellipse and the interval on the pencil are formal devices that articulate our looking at the plate and landscape is true but insufficient; we must further recognize that the plate and landscape, gaining likeness to an ellipse or interval on a pencil, are altered. They are now garbed in an appearance - the appearance of a perspective picture. Thus reified, and tending to the concrescence of an abstract figure, they can hardly bear the same phenomenal import as they did initially, for by the process of reification the experiential field is changed. To see the plate or landscape *in* perspective is to see them differently from before. Sight is less confirmed by the geometry than transformed.

Rather than speaking of things, matters of fact or the literal projection of things and pictures to our eye, we are now discussing the role of ideas in sight. We are speaking of form giving content to vision, of notions that shape what we see in the actual world. Rather than speaking of a problem of lability in our looking at things and pictures that demands technical redress, as by Leonardo, or that calls for explanation by a psychological anamorphosis, as by Sir Ernst, we are discussing a lability of the mind in construing forms and actualities that obviates the need for a literal correspondence of things to picture to sight in the first place. Reading perspective form into things, reading perspective pictures as like their ostensible objects, we engage in that most characteristic of human mental acts - a leap of association.[23]

Looking at an anamorphic picture, I find that from the peephole it and my sight of it are in accord, but that away from the peephole it and my sight of it are at odds. Looking at actual things, this is not at all the case, for there is no section between things and myself, upon which they are projected. Nor does my vision embody a mathematical point in space as such, for, as has been noted, the eye cannot be fixated. The possibility of my seeing actual things correctly from one position and distorted from another position is nil. In the context of everyday vision, the question of distortion fails to rise. It rises in a distinctive context, that of representation. Sections and viewing points are not given in sight, they are evoked by linear perspective ideas. Seeing things *as* outlined on a window, I interpose a metaphorical seam, an ideal, figured surface, between the world

and myself, interposing as well questions of distortion, shape, proportion, flatness and measurable distance - questions to which in everyday looking I am oblivious.

Placing one eye at a viewing point in front of a window and looking at a building while drawing its outline, I effect a visual performance. With suitable props and use of my body, my eye, I enact the geometry. Comparison can be made to performance of music or dance, only here direction comes from the perspective construction, and here there is an apparent cleaving together. Under the terms of reference that perspective stipulates, one thing (the perspective image) and another thing with which it is otherwise radically dissimilar (the building) are seen to unite. In this unification, appearance is born. A building that a moment before did not have pictorial size now has a size determined by the distance of my eye from the glass. Between the building, the picture and my occupation of the viewing point, there is not literally, to be sure, but in terms of perspective likeness a near-to-perfect fit.
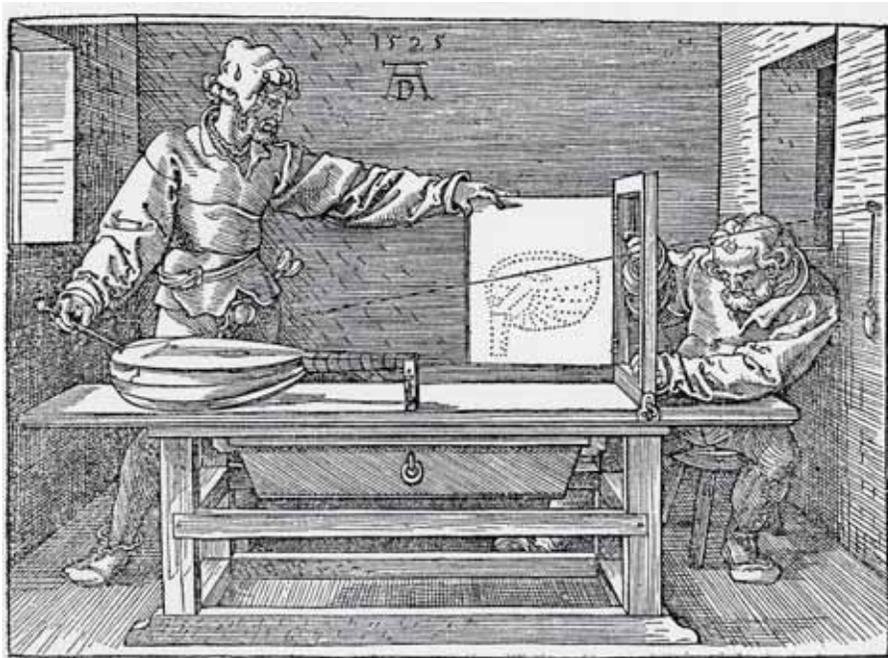
6

Figure 7. From Albrecht Durer, *The Painter's Manual*

Perspective has two aspects, discursive and figurative. By "figurative" is meant "the expression of one thing in terms of another with which it can be regarded as analogous" (Webster). Consider Albrect Dürer's woodcut of two men using a perspective device to fashion the projection of a lute [7].[24] The two men can measure the distances from various points on the lute to the corresponding points on the section, which opens like a door, and to the "viewing point" of the projection, anchored on the wall. Were we present, they could report their findings to us, and we could affirm or deny the accuracy

of their measurements. To be sure, these matters-of-fact have a figurative content. Each point, approximating an ideal, mathematically exact location in space, represents "exact location in space," and the two men, dividing space with their pointer and string, see it *in the guise of* a mechanical apportioning by rule, as we do in sympathy, watching them. Yet here we are in the realm of scientific investigation, or a prototype thereof. Under the rubric of "literal measurement," we reflect on perspective as a rational proposal, open to methodical experiment and conditioned by criteria of inductive or deductive reasoning.

This is the aspect of perspective that offers abiding truths of optical geometry, the one that Sir Ernst, persistently, with wit, erudition, and great resource of argument, has sought to explain and defend.

The other aspect of perspective shows as the connectable dots on the open door. As Sir Ernst rightly says of such figures, we have no means of knowing from looking at them alone what the measurable distances are. Measurable distance is absent in fact, but present as a distinctive plastic quality. No other kind of figure looks the same as a perspective figure. Such figures are visually redolent of the mathematically exact. In that the figure of the lute not only refers to the actual lute but to the underlying, geometric scheme that produced it, the perspective discourse can be seen. The figure looks exactly like a lute in perspective. In that the scheme is not explicit, the figure includes in its contents a proto-scientific method the operations of which lie beyond our immediate ken.

When, in looking at the Dürer, we regard the operation of the perspective device, we think of perspective diagrams and the general perspective concept. We conclude that the figure is a particular result. When we regard the figure, we enjoy the representation of an ostensible object made by a geometric rule. The figure is intelligible in and of itself, yet attains full meaning when we know the concept of which it is a fruit; the concept is intelligible in light of its use to generate perspective figures. Between these two aspects, the criteria of truth oscillate, shifting from standards of discursive reason to standards of form. Actual depth is made into virtual depth, and factual measurement is converted into that figure standing for the convergence of parallels, isotropic space, one-eyed immobile looking and a single, instantaneous section of time and space called "a picture in perspective." By means of this exchange, primary directions of thought are implicated in the expression of each other, gain completeness of meaning in reference to each other, and, in tandem, comprise the whole of perspective.[25]

Which is more truthful, the orthodox, straight-line perspective scheme Dürer's two men demonstrate, or the curvilinear approach Leonardo's drawings and notes suggest? The orthodox scheme respects the actual straightness of objectively straight things like buildings and streets, but it imposes an artificial stasis, with peripheral distortion an inevitable result; a curvilinear scheme respects the movement and binocularity that typify vision, and it eliminates peripheral distortion, but it distorts actual straightness into curves.

In "The 'What' and the 'How'," Sir Ernst defended the orthodox scheme by showing why he is an "unrepentant straightliner." In "Standards of Truth," he said of a panoramic photograph in which a straight avenue is rendered as a parabola that it "infringes on the eye-witness principle" (of depicting only what can be seen along one line of sight at one instant). In "Mirror and Map," he wrote that

> the undeniable fact that our subjective visual experience is not solely determined by the physical or optical world has frequently been used as an argument in favour of relativism and subjectivism in the theory of representation. It must be the aim of any improved theory . . . to give subjectivism its due without making concessions to relativism.[26]

Yet the "eyewitness principle" is no more inalienable to picturing realistically than is an opposite principle of continuous succession. Curvilinear perspective, encompassing multiple lines of sight at multiple instants, represents features of experience orthodox perspective cannot address. A straight avenue drawn with scrupulous accuracy at succeeding angles along succeeding lines of sight as it crosses from right to left will be accurate; and it will indeed be rendered as a parabola. The two schemes serve somewhat different ends, graphically and perceptually. Each is truthful within the context of its employment.

Which of two well-known paintings is more truthful, Dürer's *Large Piece of Turf* of 1503, or the late Gothic Cologne School *Paradise Garden* of ca. 1420, in Frankfort? The Dürer has an implicit viewing point; it is in perspective, and respects the eyewitness principle. Because it shows what can be seen along one line of sight at one instant, some plants occlude and obscure others. The Gothic painting is oblivious to such considerations. Spring and summer flowers bloom together, and things are not ordered in respect to a viewing point. There is little occlusion. Yet in showing at least eleven easily identifiable species of tree and flower spread out on the greensward like specimens on display, the Gothic painting resembles plant identification handbooks with several specimens distributed on the white page, their taxonomic details subtly emphasized. If the purpose is to identify, occlusion can be an active hindrance, the absence of perspective trappings a positive virtue.

It is difficult to grasp how questions of pictorial fidelity can be referred to absolute standards against which unlike pictures may be compared, for the standards change with the pictures. Certain advantages and disadvantages are gained and lost. There is a trade-off of values. In the case of the Dürer and the Gothic painting, aims and criteria of fidelity alter from those of an actual site seen from a particular vantage at one moment to those of taxonomic completeness. In the case of different perspective schemes, aims and criteria of fidelity alter from those of objective straightness to those of subjective curvature.

It is not just that various methods of pictorial realism oscillate between competing criteria, exchanging some qualities and advantages for others, but, more radically, that

the idea of an ultimate veracity of picturing is itself suspect. Content, the motives behind making a form, the requirements brought to its enjoyment or application, the role of acculturation and learning, are inextricably bound together. The truthfulness of the form cannot be defined apart from the purpose of he who fashions it, he who regards it. Yes, we have knowledge of an actual world, exterior to the self and resplendent in its factuality, but realism in pictures is relative: relative to the method of representation, the intent, the reception.

"If [a flat picture of a facade]," Sir Ernst stated in *Art and Illusion*,

> were drawn to scale, let us say 1 inch to a yard, it would clearly result in the same image from a distance of 100 inches as the real building from 100 yards. There is nothing 'conventional' in this fact, which follows from elementary geometry.[27]

In regard to "elementary geometry," or perspective in its discursive aspect, this statement holds. In a diagram, the actual facade can be compared to its projection in the scale of one inch to the yard, and the isometry of parallel planes will guarantee analogous relations. This is consistent with the window-picture of the building with which we began. But in regard to "sameness of image," or perspective in its figurative aspect, this statement is dubious. The actual facade can be regarded with a will to press it, phenomenally speaking, into the perspective mold, but it is not in itself an object of perspective. If we ask how the facade looks in perspective, the adverb "how" reveals the enabling relation of the perspective figure to the facade and the image we have of it. Projected onto a surface standing between us and it: that is *how* the facade looks in perspective. It is dressed as a "figure of sight."

In regard to "conventional," Sir Ernst wishes on the basis of the universal agreement on "elementary geometry" to defend perspective from a supposedly belittling charge that it smacks of the arbitrary, as though conventions were needless complications, added ingredients or figments of a purely mental activity, rather than the very "stuff" from which reality, as an object of description, is made. Insofar as perspective is logical and objective, it is indeed not arbitrary, but insofar as it has a figurative content, so that the facade is *posed* in inches, yards, flatness and shape, it is conventional - it partakes of custom. Conventionality resides in forms that are realized, established usual. Through five centuries of painting, through photographs, movies, advertising and television, perspective has become the dominant *pictorial* convention of our place and time.[28]

Notes

1. This drawing is based on MS. A, fol. 38a, as reproduced in *Les manuscrits de Leonardo de Vinci*, trans., Charles Ravaisson-Mollien (A. Quantin, 1881), page unnumbered. For other versions, with Leonardo's remarks, see Leonardo da Vinci, *The Literary Works of Leonardo da Vinci*, ed.,Jean Paul Richter, 3rd edition (Dover Publications, 1970), p. 63. For a complete

discussion of the paradox and its implications, with citations, see John White, *The Birth and Rebirth or Pictorial Space* (Faber and Faber, 1972), pp. 207-215. M. H. Pirenne, *Optics, Painting and Photography* (Cambridge University Press, 1970), pp. 116-135, gives clear and well-illustrated attention to the problem, as does G. Ten Doesschate, *Perspective: Fundamentals, Controversials, History* (De Graaf, 1964), pp. 41-42.

2. Pirenne, *Optics, Painting and Photography*, p. 124.

3. E. H. Sir Ernst, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (Princeton University Press, 1972), pp. 254-256.

4. Sir Ernst points out (*Art and Illusion*, p. 255) that as the tangents of sight do not encompass the full diameter of a column seen from nearby, we see slightly more of columns further away. This "partly compensates for the decrease in size due to the greater distance." True, but the difference on a perspective diagram is so minor as to be negligible.

5. See Pritchard, Heron and Hebb, "Visual Perception Approached by the Method of Stablilized Images," *Perception: Selected Readings in Science and Penomenology*, ed. Paul Tibbetts, New York, 1969, 191-204.

6. See David Noton and Lawrence Stark, "Eye Movements and Visual Perception," *Scientific American*, June 1991, pages 35-43.

7. See John P. Frisby, *Seeing: Illusion, Brain and Mind*, Oxford, 1980, Chapter 3.

8. Nicholas Wade and Michael Swanston, *Visual Perception: an Introduction*, London and New York, 1991, page 191.

9. E. H. Sir Ernst, "The 'What' and the 'How': Perspective Representation and the Phenomenal World," *Logic and Art*, ed. R. Rudner and I. Scheffler (Bobs Merrill, 1972), n. 4, p. 133; "Mirror and Map" *The Image and the Eye: Further Studies in the Psychology of Pictorial Representation* (Phaidon Press, 1982), p. 194.

10. Nelson Goodman, *Languages of Art: An Approach to a Theory of Symbols* (Hackett, 1976), p. 12.

11. Pirenne, *Optics, Painting and Photography*, pp. 121-123, discusses the perspective of the painting and its spheres.

12. White, *The Birth and Rebirth*, pp. 192ff; Samuel Y. Edgerton, Jr., *The Renaissance Rediscovery of Linear Perspective* (Icon/Harper & Row, 1976), pp. 56-59.

13. "The 'What' and the 'How'," pp. 141-148. Pirenne, *Optics, Painting and Photography,* p. 162, writes: "the fact that many find it difficult to see the deformations theoretically predicted for a spectator who is not at the correct position, must be explained by an intuitive process of psychological compensation which is based both on the spectator's awareness of the surface of the picture, and on his preconceived ideas regarding the components of the scene represented."

[14]. Sir Ernst, as in note 3, above; "Mirror and Map," p. 210.

[15]. Sir Ernst, *Art and illusion*, pp. 250-252, 257; "Mirror and Map," pp. 190-191.

[16]. See as an example the pinhole photograph of a statuette, Pirenne, *Optics, Painting and Photography*, p. 101.

[17]. Sir Ernst, "The 'What' and the 'How'," p. 140.

[18]. Sir Ernst, *Art and Illusion*, p. 257.

[19]. See Alfred North Whitehead, *Process and Reality*, corrected edition (The Free Press/Macmillan, 1979), pp. 7-8.

[20]. R. H. Thouless, "Phenomenal Regression to the 'Real' Object," *British Journal of Psychology* XXI (1931), pp. 339-359, and XXII, pp. 1-30. "If a subject is shown an inclined circle and is asked to select from a number of figures the one which represents the shape seen by him, he chooses without hesitation an ellipse. This ellipse, however, is widely different from the one which represents the shape of the inclined circle indicated by the laws of perspective, being much nearer to the circular form. The subject sees an inclined figure neither in its 'real' shape nor in the shape which is its perspective projection but as a compromise between these." (Part I, p. 339.)

[21]. Sir Ernst, "The 'What' and the 'How'," p. 141. See also *Art and Illusion*, pp. 302f.

[22]. Sir Ernst, "Standards of Truth," *The Image and the Eye: Further Studies in the Psychology of Pictorial Representation* (Phaidon Press, 1982), pp. 253, 260-261.

[23]. Well did Erwin Panofsky speak of perspective as symbolic form, for, as Whitehead remarks, "the human mind is functioning symbolically when some components of its experience elicit consciousnss, beliefs, emotions, and usages, respecting other components of its experience." See Erwin Panofsky, *Perspective as Symbolic Form*, trans. Christopher S. Wood, (Zone Books, 1991); Whitehead, *Symbolism*, pp 7-8. The history of the seminal lecture and its subsequent influence is given, with voluminous citations, by Kim Veltman, "Panofsky's Perspective: A Half Century Later," *La prospettiva rinascimentale: codificazione e trasgressioni,* I, ed. Maria Dalai Emiliani (Centro Di, 1980), pp. 565-584. For the influence on Panofsky of Ernst Cassirer, see Michael Ann Holly, *Panofsky and the Foundations of Art History*, Ithaca, 1984, 130-157.

[24]. See Albrecht Durer, *The Painter's Manual*, trans. Walter L. Strauss, New York, 1977, pp. 391, 393.

[25]. ". . . when we compare the representation through which an object is given to us with the Object (in respect of what it is meant to be) by means of a concept, we cannot help reviewing it also in respect of the sensation in the Subject. Hence there results a gain to the entire faculty of our representative power when *harmony prevails* between both states of mind." (Immanuel Kant *Critique of Judgment*, trans. James Creed Meredith (Clarendon Press, 1928), p. 74.)

[26]. Sir Ernst, "The 'What' and the 'How'," p. 135; "Standards of Truth," pp.258-259; "Mirror and Map," p. 183.

[27]. Sir Ernst, *Art and Illusion*, p. 253.

[28]. This is a slightly edited and augmented electronic variant of the print version.