

**An Exploration
of
Visual Sensations:**

**The Use of
Depth Perception
to Create
Pre-Architectural
Form**

Cover Images.

Top: Color Plate XIV. Rectangular

Figures 2; Red Hues

Monochromatic Parallax

Resolution of Volumes, 4/15/98.

Bottom: Rectangular Figures 2;

Inverted Red Hues

Monochromatic Parallax

Resolution of Volumes, 4/15/98.

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**An Exploration
of
Visual Sensations:**

**The Use of
Depth Perception
to Create
Pre-Architectural
Forms**

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For
Harold W. Rushton
and
Frances E. Rushton,

my
father and mother;

For
your
everlasting
support,
inspiration,
and
endearing
encouragements.

For All My Teachers
of Many Years.

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University

in partial fulfillment
of the requirements
for the

Degree of
Master of Architecture

**An Exploration
of
Visual Sensations:

The Use of
Depth Perception
to Create
Pre-Architectural Forms**

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Animation Button



Movie Button

When you see these icons, double-click with your left mouse button for online version or refer to the CD-ROM printed version to view the animation studies or documentary of the modified camera obscura.

This exploration is one artist's view of visual reasoning through the study of depth perception. The experiment searched for pre-architectural forms through an investigation of geometric rectangular shapes and planar figures in anticipation of finding architectural volumes, that is, three-dimensional objects. I used three parameters to observe: the expected or planned, the anticipated, and the unforeseen.

The pre-architectural sketching style used the disciplines of painting, sculpture, graphic arts, color theory, optics, and photography to formulate an architectural language. First, as artist (painter), I selected the medium of light as the brushstroke, color as the pigment, and photographic film plane as the canvas to capture image abstractions. Second, I used one-point perspective as the viewer's line of sight. Finally, I employed a series of shape abstractions to form a succession of transparent sections that composed the subject matter.

This experiment sought to analyze visual perception by capturing the spatial depth of images, that is, a reproduction of something sculptural in likeness. The challenge was to reintegrate the abstracted *Rectangular Shapes* and *Planar Figures*. In order to achieve this physical abstraction, I created a modified camera obscura. This exploration produced clearly defined *images-as-products* that were interpreted as pre-architectural forms, which allowed me to translate color abstractions into architectural form studies, or *models-as-products*. Thus, the experiment created architectural volumes using light and color in order to draw points, lines, planes, and spatial depth.

Opposite page: Figure. 1.

Color Plate XV, *Planar Figures No. 2*; *Perspective Parallax in Balanced Harmony*, 4/98.

Quotation: Albert Einstein (1875–1955).

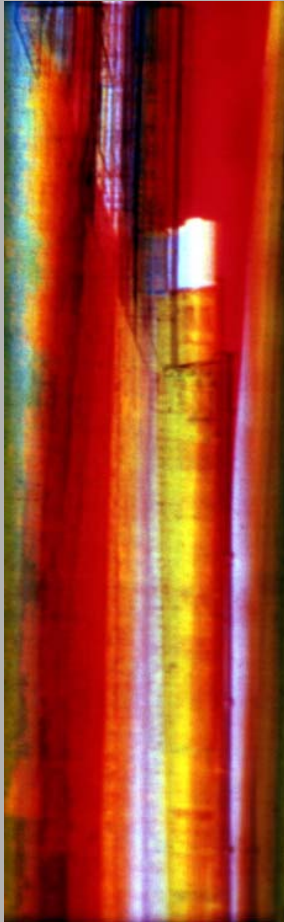


Fig. 1.

*Where the world ceases to be
the scene of our personal hope
and wishes, where we face it
as free beings admiring,
asking, and observing, there
we enter the realm of Art and
Science.*

Albert Einstein
(1875–1955)



Fig. 2.

The stimulus for my investigation of the possibility of “sketching” with light and color as a method in which to study pre-architectural forms came as a result of studying the work of the Post-Impressionist artist Paul Cézanne (1839–1906). In Cézanne’s later landscape paintings (1890–1906), his mixtures of colors, representations of dimensional surfaces, light hitting surfaces, broad brushstrokes, and groupings of colors all serve to create “massings.” These visual effects broadened my personal perspective on the use of light and color in sketching. This led to an awareness of non-linear, non-Euclidean-geo-

metric, one-point perspective. In *Large Pine and Red Earth* (1890–1895),² for example, I could see the artist’s ability to abstract subject matter in order to focus on the language of light. The techniques Cézanne used include diminishing elements, spiraling³ movement, textural brushstrokes, color selection, dimensional shading, and the creation of tactile sensations landscape (Figure 2). Cézanne had the ability to depict depth perception by controlling the direction of the viewer’s visual movement, using texture, shades of color, and meaning to create what I refer to as “visual touching.”⁴ For example, color resonance is another technique used by Cézanne. By placing yellow next to blue, the sensation of green is created. Depending on the intensity of the color dimension (hue, value, and chroma), the green either becomes visually concave or convex, pulling the viewer in or out—i.e., “visual massing.”

I was also influenced by the fact that Cézanne, as an independent artist not beholden to the stylistic requirements of the *École des Beaux-Arts*⁵ or patrons, was able to experiment, allowing himself to be swept away by the emotional energy of what was happening in nature.⁶ This can be seen in *Rocks at Fontainebleau* (c. 1893)⁷ and *Bend in the Forest Road* (1902–1906).⁸ (Figures 3–4.)

When glance turns

To a sky-blue clear day,

When the purple-red sun

Sinks low at sirocco [dusk],

Here nature bestows glory,

Joy, sound to eye and heart,

And we find in color lore,

*The universal truth.*¹

Johann Wolfgang von Goethe

Surmising that one could translate such painterly techniques into architectural sketching, I posed the questions: Can I use similar methods employed by Cézanne to create abstractions for pre-architectural forms? Is it possible to abstract a photographic image to its essential elements? By controlling the direction of visual movement, (meaning the linear perspective), the shade of colors (color perspective), and aspects of texture gradients (textural and aerial perspective), I explored visual depth perception. By controlling the movement of my eye, I was able to interpret the depth in order to extrapolate *images-as-products* and *models-as-products*.⁹ In my investigation, I restricted the study to pre-architectural forms, which is the preliminary work of finding points, lines, planes, and volumes relative to architectural development. (Refer to Figures 13–15 for the selected original photographic images for extrapolation.)

In studying pre-architectural forms, I produced images-as-products and models-as-products, creating conceptual products for the development of architectural pre-designs. Through expressive notes or sketches of abstractions—the images-as-products—this conceptualization of relative forms translated into schematic designs that were to become preliminary concepts for design layouts that could be analyzed as schematic designs for models-as-products. The connections of forms relate to the volumetric extrusion of the spaces to the exterior fabric. While this design process would usually result in study models or perspective sketches, in my project, the images-as-products were the physical recordings of my conceptualization of shapes, volumes, objects, and forms. A series of isolated still-frames became the physical recordings of my conscious interpretation of the phenomenon. The images were abstractions of the three-dimensional volumes that exposed skeletal connections, massings, figure-grounds, and spatial environments. Likewise, the models-as-products were a continuum of the design exploration after the images-as-products had been further translated into tangible impressions. The study models recorded, through further explanation, clarification, and refinement of my deductive



Fig. 3

Opposite page: Figure 2.
Paul Cézanne, *Large Pine and Red Earth*, 1890–95.

This page: Figure 3.
Paul Cézanne, *Rocks at Fontainebleau*, c. 1890.



Fig. 4.

reasoning, the concept's completion. The use and translation of the images-as-products into models-as-products are discussed further in Chapter six.

In creating the images-as-products and the models-as-products, I realized that my role as the artist was to accept the unexpected and not to allow the determinant factors to rule, but rather to let the work tell me how to proceed. This anticipatory posture is the foundation of exploration and discovery, as evidenced in the works of revered architectural scholars and practitioners, such as Marcus Vitruvius Pollio (c. 90–20 B.C.), Filippo Brunelleschi (1377–1446), Leon Battista Alberti (1404–1472), and Leonardo da Vinci (1452–1519). In the present investigation, I humbly explored

the notion of depth perception from an optical perspective using the camera obscura as the principal tool and with the work of these masters as an essential resource. The present study proposes for consideration the development of one method of pre-architectural visualization. Through the use of sectioned, two-dimensional shapes projected onto transparency film, a series of shape-abstractions has been produced as photographic constructs, providing a means for architectural visualizations.

The project began with the question of volumes and depth perception. A method of projecting photographic images of volumetric shapes onto transparency slides was used to study their characteristics and relationships. This investigation, prompted by the work of the early Renaissance scholars mentioned above, sought to elucidate the principles of the one-point perspective and its optical translation. I used a similar method to translate tangible objects into optics (the language of light) and then into captured paintings. As Brunelleschi observed, “Now, the painter had to select a single point from which his picture was to be viewed, a point precisely determined as regards height and depth, sideways extension and distance in order to obviate any distortion in looking at it (because a change in the observer's position would change what his eye saw.)”¹⁰ I recog-

Figure 4.

Paul Cézanne, *Bend in the Forest Road*, 1902–6.

nized that typical two-dimensional form constructions were mere outlines and lacked the notion of inner space (Figure 5). Therefore, I searched for a means to capture the three-dimensionality within the shape-abstractions, in a fashion similar to the masters. In order to find this approach, I explored the following:

- 1) the three-dimensional sketching,
- 2) the perception of shapes to forms,
- 3) the subject matter for the transparent sections: the extraction to the placement,
- 4) the sketching tool,
- 5) the painting of the projected images,
- 6) the images-as-products to models-as-products.

In order to investigate volumes, it became apparent that I needed to obtain a visualization of the spatial relationships by means of depth perception, that is, the perception of the distance between objects in the third dimension. Using my “painter’s eye” (to borrow Alberti’s terminology), I applied a set of restraints to the structures in order to understand the images-as-products. I investigated the process of architectural visualization by the use of a modified camera obscura, observing the photographic images and clarifying a reality about depth perception, while simultaneously observing and composing the forms to clarify the unforeseen as well as anticipated and expected volumes. The following chapters describe the methodology utilized in the project. A series of twenty-five plates is included as visual representations of my hypothesis.

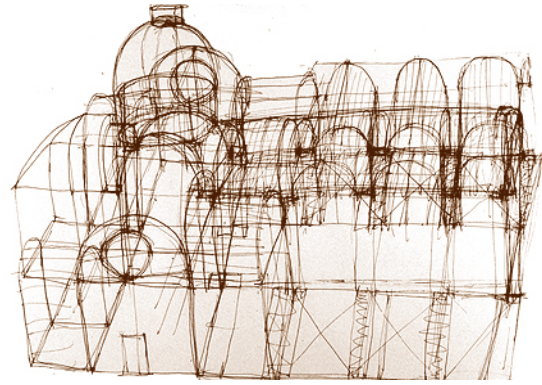


Fig. 5.

Figure 5.
*Wire Frame Hand Sketch of the
Volumes of Leon Battista Alberti's
San Andrea Church in Mantova,
Italy, 3/96.*

Endnotes. Introduction.

1. R. Matthaei, ed., Goethe, J. W. von, *Goethe's Color Theory; Arranged and Edited by Rupprecht Matthaei: Epilogue, Gentle Xenien VI.* (New York: Van Nostrand Rienhold Co., 1971), p. 204 poem excerpt.
2. F. Cachin et al., *Cézanne* (Philadelphia, PA: Philadelphia Museum of Art, 1996), p. 375 fig. 154 notes, p. 370.
3. P. Johnson, *Art: A New History* (New York: HarperCollins Publishers, Inc., 2003), p. 604.
4. My term *visual touching* can be defined by J. J. Gibson thus: “The perspective of surface texture is not shown, only what are called outlines. In both notes that it is the optic array that is the stimulus, not the image.” The perspective of texture, as distinguished from the perspective of rectilinear outlines, seems to be a fundamental basis for the impression of a three dimensional environment, or what has been called space. See K. H. Veltman, *The Sources and Literature of Perspective: Vol. 3, III Vision and Representation, 5. Gibson's Distinctions* (Canada: System for Universal Media Searching SUMS © 1992–1997), pp. 11–12 (printed in a 12pt. font size). Also available online at <http://www.mmi.unimaas.nl/people/Veltman/books/2004%20Literature%20on%20Perspective.pdf>
5. Johnson, op. cit., p. 604.
6. *ibid.*
7. F. Cachin et al., op. cit., p. 382 fig. 158, notes, p. 381.
8. *ibid.*, J. J. Rishel et al., p. 517 fig. 227, notes, p. 516.
9. After the completion of my research, I discovered three artists whose works parallel the body of my work—Robert Irwin, James Turrell, and George Stadnik. To view exhibits of their work: see available online at <http://www.diabeacon.org/exhibs/irwin/excursus/>, <http://www.pbs.org/art21/artists/turrell/> and <http://www.photonlightguitars.com/pages/1/index.html>.
10. Anonymous Biographer (1482), *Brunelleschi* reproduced in Eugenio Battisti, *Filippo Brunelleschi* (New York, 1981), pp. 102–13. Reprinted in E. Renner, *Bibliography of Pinhole Optics in Science and Art from the 5th Century BC. to 1850 AD* (San Lorenzo, N.M.: Pinhole Resource., 1985), p. 12 of photocopy.

In this chapter I seek to elucidate three-dimensional perspective sketching by exploring two main issues: 1) the perceived visual dimension through empiricism—the subjective, the visual space/field, sensual and mental perceptions, and the expression of light going into the cone of vision, with the light acting as the instrument of perception; and 2) the physical aspect of perceptual sketching through rationalism—the objective, the visual world, optical space, geometrical space, and pure reason. In this investigation, I drew upon Vitruvius’s advisement:

Reflexion is careful and laborious thought, and watchful attention directed to the agreeable effect of one’s plan. Invention, on the other hand, is the solving of intricate problems and the discovery of new principles by means of brilliancy and versatility.²

In order to explore a visual reasoning of volumes through depth perception, which entails observing exactly what occurs as light and color illuminate the dimensions of an image, I found it necessary to understand the subject matter³ of depth perception, namely, “color chiaroscuro”⁴ (light, color, shade, and shadow), background, scale, visual characteristics (shape, brightness/value, proportion, texture, contrast—adding black or shadow), density, gradation, and chromatic color (Figures 6–7). This understanding was followed by both the perceived visual dimension and the physical aspect of perceptual sketching. Da Vinci described the act of painting thus: “The first object of a painter is to make a simple flat surface appear like a relief and some of its parts detached from the ground... This perfection of the art depends on the correct distribution of lights and shades called chiaroscuro.”⁵

1) Perceived Visual Dimension. The experiment required an empirical model to explore a means for visualizing space that was not limited by one-dimensional line. I merged the visual and geometric spaces and then explored the historical perspective and the appropriate theories to clarify the results of the experiment. For this reason, I have used the terms “artist” and “observer” extensively to describe my role.

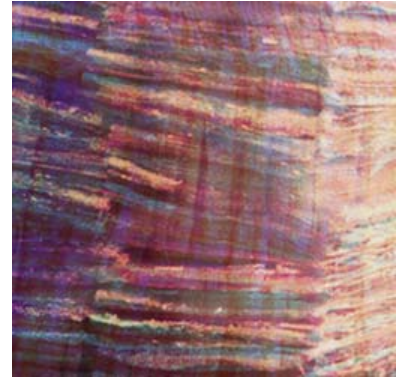


Fig. 6.

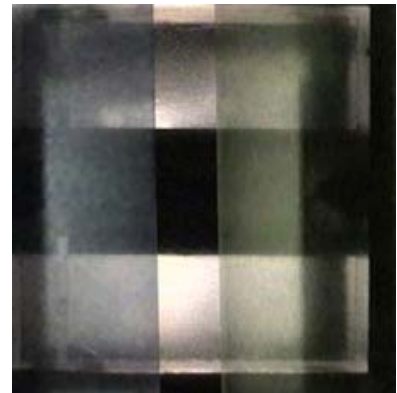


Fig. 7.

For the best and safest method of philosophizing seems to be, first diligently to investigate the properties of things and establish them by experiment, and then to seek hypotheses to explain them.¹

Sir Isaac Newton

My point of view as an artist was influenced first and foremost by Cézanne, who wrote:

In painting there are two things, the eye and the brain. They shall mutually aid one another; one must work to develop them in tandem with one another, the eye through looking at nature, the brain through the logic of organized sensation, which provides the means of expression.⁶

In addition, as an observer, I relied on the theories of classical architectural philosophers and experimenters, such as Plato (428–347 B.C.) and Aristotle (384–322 B.C.), who propounded two main theories. Plato claimed that the energy of light comes from the eye out (“eye extramission”), while Aristotle maintained that images go into the eye (“eye intromission”). Aristotle held that there was nothing in the intellect that was not first taken in through visual stimulation.⁷ Later, Alberti further defined the optical environment as a visual pyramid comprised of “centric rays,” “median rays,” and “extrinsic rays”—the definitive rays of the visual sense.⁸ He concluded that centric rays are the strongest in capturing information. As he described it, “Let us imagine the rays, like extended very fine threads gathering tightly in a bunch at one end going back together inside the eye where lies the sense of sight.”⁹ Therefore, I selected the centric rays of light as the “palette” for observing and painting depth perception. The camera’s eye—its aperture—was to act as my own eye superimposed into the camera (eye intromission) in order to compose the images. The light was to be, figuratively speaking, the artist’s arm and hand holding the brush, with the light rays acted as the paint. I started with the camera obscura, which was to be my sketching device—a darkened boxlike chamber that uses light to project an image through a lens onto a distant surface—and modified its application. (See Figure 8 for an illustration of a camera obscura, and Figure 12 for an illustration of a pinhole camera.) The images produced by sketching with the modified camera obscura were still-frame, three-dimensional hyperbolic geometries, or holographic stereograms¹⁰—not traditional, two-dimensional photograms.¹¹ The holographic stereograms included *atmo-*

Preceding page:

Top: Figure 6. *Cellophane Weave, Constructed Object*, 9/95.

Bottom: Figure 7. *Close-Up View of an Object’s Base*. 4/95.

These objects represent what I call “visual touching” of forms—visual and cognitive sensations describing an object’s surface—texture, shape, size, or visual attributes denoted through a visual exploration of the object’s characteristics.

sphere,¹² which is the essence of depth perception, identified as “background” by Da Vinci, who explored analogies between the eye and the camera obscura.¹³ Early in my experiments, I had not yet realized that atmosphere would affect the pictures so distinctively, allowing me to distinguish depth. Johann Wolfgang von Goethe (1749–1832) noted that painting is “...an art which has the power of producing on a flat surface a much more perfect visible world than the actual one can be.”¹⁴ Goethe’s compelling statement prompted me to focus on both object and atmosphere within a photographic composition through the eye of the camera.

While observing the projected transmission of light through the modified camera, I discovered that the light not only carried the image of the subject matter onto the picture plane, but also appeared to resonate off the plane, producing a hyperbolic image. I recognized the need to clean my mental slate in order to follow my instincts; rationalization would come later. This observation concurs with philosopher John Locke’s (1632–1704) view of life as a *tabula rasa*: sensations are the first step, followed by mental associations that help to form the abstract image.¹⁵ I wanted to record the sensation of space, not just three-dimensional objects. True space was ultimately created with volumes, spatial relationships, and background. (Plates V and XXI.) I soon realized that I was combining two types of perspective—the perceived visual dimension and the perceived physical space.

Alberti describes the process of imagining forms in the mind as *lineaments*:

It is quite possible to project whole forms in the mind without any recourse to the material, by designating and determining a fixed orientation and conjunction for the various lines and angles. Since that is the case, let lineaments be the precise and correct outline, conceived in the mind, made up of lines and angles, and perfected in the learned intellect and imagination.¹⁶

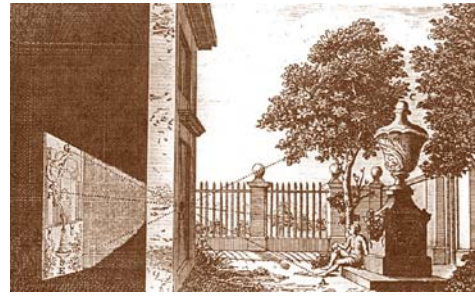


Fig. 8.

Figure 8.

John Hinton, *Room Camera Obscura*, c. 1752.

The illustration is an example of a Camera Obscura. It depicts an operating camera with an inverted image projected on the opposite interior wall.



Fig. 9.

Figure 9.

An architectural schematic sketch of shapes through the expressive use of color and texture. 10/95.

This study uses both color and texture to achieve a visual depth that transforms the shapes into a visual sensation of volumes.

In the process of formulating the structural elements of height, width, and breadth for the composition as a whole, I recognized that lineaments would contain circumscription, i.e., the capturing of external outlines and the repetition of light patterns, forming volumes from point, line, and plane.¹⁷ To Alberti's "means" in mathematics, geometry, and music, I added a fourth means: color. In other words, color and its dimensions of hue, value, and chroma served as an additional means for exploring the volumes.¹⁸ By visually balancing transparent structures within the compositions, I sought mental organization for the value and chromatic categories.

2) Physical Aspect of Perceptual Sketching. As Cézanne and noted psychologists G. Ten Doesschate and F. P. Fischer (1937) observed, perspectival sketching lacks the sensation of atmosphere.¹⁹ Doesschate and Fischer claimed that physical space and depicted space are very different visual experiences. The former utilized the sensual and the emotional.²⁰ Like Cézanne, I sought to perceive through "the painter's space" a true sensation of visual space. When peering through a tube, the viewer sees only centric rays striking the plane. There are small amounts of median rays and no extrinsic rays, eliminating extraneous subject matter and allowing one to better perceive depth. It seemed like a natural transition to work with the vantage point of one-point perspective, as it has an innate relationship with centric rays.

In the 1960s, John J. Gibson (1904–1979) mathematically analyzed the shading of a given object in the atmosphere in terms of the optical flow pattern reflected from a surface to the eye.²¹ He then redefined one-point perspective as follows:

Linear perspective of the classical sort would be only a small part of it, for that is merely the perspective of the edges of rectangular objects. There is also the perspective of the texture of inclined surfaces, the gradients of texture-density, the steps of density at the edges of objects, the ratios of densities in different directions and still other variables of higher order.²²

His analysis would lend credence to the results of my experimentation: capturing atmosphere by utilizing texture-density and sketching in true space (Figure 10).

To establish a framework for analyzing and producing a genre²³ of abstract subject matter, I followed Vitruvius's approach:

Order gives due measure to the members of a work considered separately, and symmetrical agreement to the proportions of the whole. It is an adjustment according to quality. By this I mean the selection of modules from members, constructing the whole work to correspond. *Arrangement* includes the putting of things in a proper place and the elegance of effect which is due to adjustments appropriate to the character of the work. *Eurythmy* is beauty and fitness in the adjustments of the members [structure]. *Symmetry* is a proper agreement between members of the work itself, and relation between the different parts and the whole general scheme, in accordance with a certain part selected as standard.²⁴

The formation of pre-architectural forms in this project was based on order, arrangement, eurythmy, and symmetry. I turned from being the artist to the architect, taking Vitruvius's statement as my rationale for the construction of a genre. I first confronted the physical restraints inherent in proportional viewing through the linear optics of one-point perspective (Figure 11). As objects moved further away from the camera's internal light source, they appeared to become smaller, and the central vantage point produced a one-point perspective. I used the idea of sketching with the media of light and color to establish a system that included foreground, midground, and background. The tool used was a mechanical sketching device—a modified camera obscura—which projected the light and acted as an orthographic sketching tool for rearranging the object plane and the picture plane. The camera was used as a freehand sketching device to create transparent pre-architectural forms, or images-as-products, in a constructed environment. I continued to follow Vitruvius's rationale: "Perspective is the method of



Fig. 10.

Figure 10.
*Photographic Monoprint Collage
of Buildings and Landscapes
Surface Textures, France, 1/96.*



Fig. 11.

sketching a front with sides with drawing into the background, the lines all meeting in the centre of a circle.”²⁵

More clearly stated, the object plane is that which is perceived in the mind, while the picture plane is that which is physically sketched. When the object plane and the picture plane were combined, the question of the perception of shapes becoming forms and the means of sketching of objects needed further explanation.

Figure 11.

One Point Perspective of an Exterior Corridor, Stuttgart, Germany, 3/96.

Endnotes. Chapter One.

1. Sir I. Newton, *Opticks, or A Treatise of the Reflections, Refractions, Inflections and Colours of Light, Preface by I. Bernard Cohen* (Dover Publications, 1952), p. xxiv.
2. M. Vitruvius Pollio, *The Ten Books on Architecture* (New York: Dover Publishing, Inc., 1960), p. 14.
3. “Subject – as individual or beholder, Object– all that is without him or matter.” J. W. von Goethe, *Goethe’s Theory of Colours: Translated from German: with notes by Charles Lock Eastlake, R.A., F.R.S. 3e: Part I. Physiological Color* (London: Frank Cass & Co. LTD., 1967), p. 1.
4. I define *color chiaroscuro* as chromatic color with value (brightness) based on highlights to shadow, reflective light, and cast shadow. The value and chroma levels of the color equate to my levels of color or Munsell’s visual scale of value and chroma in one particular hue.
5. E. McCurdy, *The Mind of Leonardo da Vinci* (New York, Dodd, Mead and Co., 1948), p. 285.
6. F. Cachin et al., op. cit., p. 37, item no. 5.
7. Veltman, op. cit., *Literature of Perspective: Introduction*, p. 1. (printed in a 12pt. font size).
8. L.B. Alberti, *On Painting: Translated by Cecil Grayson with an Introduction and Notes by Martin Kemp.*, (New York: Penguin Books Classics, 1991), pp. 40-41, fig. I.
9. *ibid.*
10. The stereoscopic vision was first mentioned in 1594 by Leonardo da Vinci in “Della Portas” in his notebooks. The original holography was constructed by a single light source with a series of several pinhole filters by Dennis Gábor in 1947 (which is a similar translation to my multiple three or more slides). In 1948 psychologist Luneberg distinguished between visual space and physical space in mathematical terms. He claimed that while physical space was Euclidean, “the visual space of binocular vision is a hyperbolic Riemannian space.” It is a psychometric distance “which varies in its numerical parameters from observer to observer. But its general form is invariant; it is the metric of the three-dimensional hyperbolic geometry.” In the combination with my parallax perspective, my parallelograms are within an acute angle of 30 to 40 degrees, which creates a hyperbolic third-dimensional geometry that is in line with the theories of psychologist Kentzler (1954–1955), who explored parallels between optical and acoustical ratios, claimed that the limits of undistorted perspective were within an angle of 30 to 40 degrees, and that the eye had a hyperbolic image, whereas perspective had a plane image. For the history of holography see E. Hecht, *Optics* (Reading, Mass.: Addison-Wesley Publishing Co. 1974), pp. 617–620. For hyperbolic space and hyperbolic geometry see Veltman, op. cit., *Literature of Perspective: 4. Geometrical Spaces and. Status of Perspective*, p. 10, Luneberg, and p. 16, Kentzler. (printed in a 12pt. font size).
11. The Massachusetts Institute of Technology (MIT) has done extensive research in the area of holographic images. I have used their history of the hologram and the glossary of terms to define “stereoscopic” and “holographic.” The holographic stereograms in my project are a still-frame capturing versus MIT’s animation of holographic images. Essentially, MIT did numerically in the computer what I accomplished manually with a modified camera obscura. Please refer to Luncente, Mark and Galyean, T. A., *Rendering Interactive Holographic Images* MIT Media Laboratory Published in: Proc. of SIGGRAPH 95 (Los Angeles, CA, Aug. 6-11, 1995). Also in *Computer Graphics* Proceedings, Annual Conference Series, 1995, ACM SIGGRAPH, pp. 387–394. Also available online at <http://xenia.media.mit.edu/~lucente/pubs/>

siggraph95.html

12. *Atmosphere* is referred to throughout this paper as a specific distance in space. See J. J. Gibson's description of aerial perspective as being derived from the increased haziness and changes in color due to the atmosphere. E. Hall, *The Hidden Dimension* (Garden City, New York: Doubleday and Company, 1966), pp. 180–181, item no. 6.

13. Veltman, op. cit., *Literature of Perspective: 3. Retinal Image*, p. 3. (printed in a 12pt. font size).

14. Goethe, op. cit., (London, 1967), *Introduction*, p. xxxix.

15. Veltman, op. cit., *Literature of Perspective: 2. Independence of Perspective From Vision*, p. 3 (printed in a 12pt. font size).

16. L. B. Alberti, *On the Art of Building*. Trans. Joseph Rykwert, N. Leach, and R. Tavernor. (Cambridge, Massachusetts: The MIT Press. Fifth Printing, 1994), p. 7.

17. For an understanding of circumscription see Alberti, op. cit., *Painting*, pp. 64–65.

18. For an analysis of “means” see Alberti, op. cit., *Building*, pp. 308–309.

19. Veltman, op. cit., *Literature of Perspective: 4. Geometrical Space and Visual Space*, p. 6 (printed in a 12pt. font size).

20. *ibid.*

21. *ibid.*: 5. *Gibson's Distinctions*, p. 12 (printed in a 12pt. font size).

22. *ibid.*, See Gibson (1960), p. 12 (printed in a 12pt. font size).

23. The term *genre* is being used to denote my specific means of sketching with texture, light and color, defined as: A category of art distinguished by a definite style, form, or content. W. Morris, *The American Heritage Dictionary of the English Language, 2.a* (Boston: Houghton Mifflin Co., 1978), p. 550.

24. Vitruvius, op. cit., pp. 13–14.

25. *ibid.*, p. 14.

In this chapter I evaluate the role of the artist as *subject*, and introduce the *object* and *subject matter* as the expression. The artist is the subject, viewing through intellect, the essentials of “nature” by distinguishing the object’s attributes. The principal idea of this creative working process became a discourse in my artist’s mind. As Da Vinci recognized,

Nature is perceived through the senses mainly through the sense of sight. The art of painting is embedded in the art of seeing. Fields of views are conveyed [through] visual rays into the eye. The painter analyzes this experience in order to reproduce the image in the eye on his picture plane.²

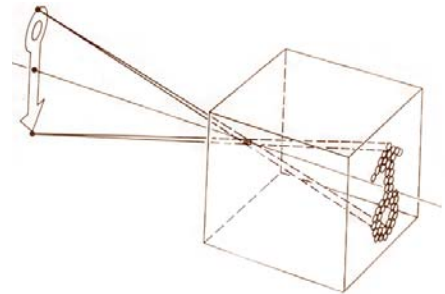


Fig. 12.

The image portrayed, through the camera as the chosen medium, was the three-dimensional object perceived by my senses, i.e., observed and visually felt³ as a material object. My subject matter in this work was the sketching of volumes, representations of the object, the underlying expression of the material. By sketching the objects I used my judgment⁴ as “the organ of perception”⁵ (to use Da Vinci’s term). I investigated and shaped the subject matter through the physical expression of sketching volumes to represent objects.

As Goethe stated in relation to subject matter,

We observed that all nature manifests itself by means of colors to the sense of sight. We now assert, extraordinary as it may in some degree appear, that the eye sees no form, inasmuch as light, shade, and color together constitute that which to our vision distinguishes objects from objects, and parts of an object from each other.⁶

Using the rationalist approach of viewing an object in space, I systematically dissected both *Rectangular Shapes* (Figure 15) and *Planar Figures No. 1* and *No. 2* (Figures 13–14) in the quest for volumes, contained in photographs of rectangular study models and roof eaves. I then utilized the elements of perspective (point, line, plane, and volume) to reconstruct visual images with one-point perspective. In visually constructing the one-point perspective it is understood that a person uses bifocal line of sight. The science of optics defines the bifocal line of sight as the perceived visual dimension. As Gibson *et al.*

... the basis of this direct perception is not the form sensations, or even the remembered sequence of these forms, but the formless and timeless in variants that specify the distinctive features of the object. These are the information for perception.¹

James J. Gibson



Fig. 13.



Fig. 14.

Preceding page, Figure 12.

The Pinhole Camera.

The illustration depicts an inverted image being projected as resolution pixels on the opposite interior wall.

To simulate the visual field of the camera's eye, it is best to view the plates through a tube. This vantage-point increases the focus of the subject matter recorded in the depth of field, the images becoming more defined when the viewer simulates the visual field of the camera's eye.

pointed out in their experiments, “Four cues were needed to see the distance of a given object in space [visual world]: binocular parallax or disparity; linear perspective; aerial perspective, superposition; shading; and motion parallax” [perspective].⁷ In the experiments, the camera had one vantage point, a conal line of sight, centered along the linear orthogonal distance (Figure 12). The final product of such a reconstruction was an object in space viewed bifocally and, thus, perceived in the third dimension.⁸ In contrast, an image that is superimposed onto a two-dimensional surface—for example, an image on photographic paper—is seen as a perceived visual space, a representation of the volumes, spatial relationships, and background.⁹ The distance between the camera's aperture and the picture plane provides “a great depth of focus” within the depth of field. This “virtue” strengthens the viewer's perceived visual dimension.¹⁰ These experiments resulted in images-as-products that are two-dimensional graphic depictions of three-dimensional hyperbolic geometric objects. A comprehensive understanding of objects in space includes the basic distinctions of points, lines, and planes, which form volumes¹¹—the starting point for analysis of these newly constructed pre-architectural forms.

The perceived visual dimensions of form are, in fact, the visual pathways of seeing. These pathways reflect an understanding of contours and the structure of an object. In distinguishing object from form, one comprehends the object's illuminating essence by recognizing material distinctions, such as chiaroscuro, brightness, texture, etc. The next step is to use sight in combination with intellect to visually touch the object. I studied the perceived visual dimension as a multileveled transformation of the shape to volume as a three-dimensional object to form. The shape is a two-dimensional outline of a figure. It becomes a volume when its parallel planes tilt to a certain degree or angle. I analyzed the perceived volume as a three-dimensional object within atmosphere. The characteristics of form came from the extrusions of the modified camera obscura's depth of field. The form incorporated the object with its illuminating essence, resulting in a curved surface. (Diagram 2.1.)

In this experiment I also used saturated hues¹² (green, orange, violet, and magenta) to distinguish volumes from objects. These chromatic colors, when overlapped, signaled a change in the object, i.e., a newly perceived shape or volume. This use of color parallels Cézanne's mixed colors and values representing shape abstractions that formed massings,¹³ as seen in *Rocks at Fontainebleau*.¹⁴ Similarly, the solidification of hues represented the massings of architectural volumes in my experimental images.

In anticipation of recording the pre-architectural forms, I also established a process to analyze the images. This analysis was a reconstruction of the subject matter using visual balance, harmony, and depth. The atmospheric perspective was the space among the transparent sections, viewed as volumetric extrusions. The analysis was of a direct positive image containing rectangular and linear forms as well as depth, a visually tactile atmosphere. The analytical process included the manipulation of forms translated mechanically into geometric shapes—pre-architectural forms.

I had begun with the extraction of the visual characteristics of a form. These distinguishable components were the elements I would use to sketch new subject matter. The intellectual process was the combination of the analysis of the perceived geometric and linear forms of both the *Rectangular Figures* and *Planar Figures No. 1* and *No. 2* and the perspectival sketching processes for visually tactile characteristics printed on slide film.

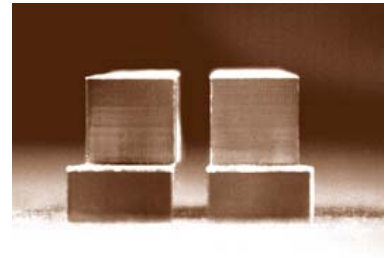


Fig. 15.

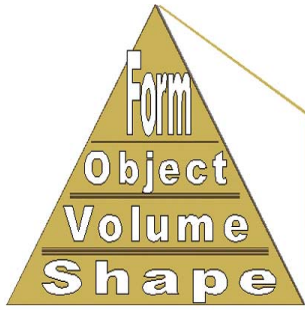
Opposite page, Figures 13 and 14.

Top: *Planar Figures No. 1.*,
Original Photograph of Eaves,
Siena, Italy, 2/96.

Bottom: *Planar Figures No. 2.*,
Original Photograph of Eaves,
Siena, Italy, 2/96.

This Page: Figure 15:

Original Photographs of
Rectangular Models, Machine-
Milled Aluminum Objects, 10/95.



Dia. 2.1.

Endnote. Chapter Two.

1. Veltman, op. cit., *Literature of Perspective: 5. Gibson's Distinctions*, pp. 13–14 (printed in a 12pt. font size).
2. I. A. Richler, ed., L. Da Vinci, *Leonardo Da Vinci Notebook*. Chapter 4, *The Art, The Painter's Course of Studies, The Treaties of Studies on Painting* (New York: Oxford University Press, 1998), pp. 107–108.
3. R. Arnheim, *Art and Visual Perception A Psychology of the Creative Eye The New Version. Shape II* (Berkeley and Los Angeles: University of California Press, 1969), p. 43.
4. I. A. Richler, ed., L. Da Vinci, op. cit., p. 108.
5. *ibid.*, p. 107.
6. Goethe, op. cit., (London, 1967), *Introduction*, p. xxxviii.
7. Veltman, op. cit., *Literature of Perspective: 5. Gibson's Distinctions*, p. 12 (printed in a 12pt. font size).
8. A general description of *Human Vision and Color Perception*—“Human stereo color vision is a very complex process that is not completely understood, despite hundreds of years of intense study and modeling. Vision involves the nearly simultaneous interaction of the two eyes and the brain through a network of neurons, receptors, and other specialized cells. The first steps in this sensory process are the stimulation of light receptors in the eyes, conversion of the light stimuli or images into signals, and transmission of electrical signals containing the vision information from each eye to the brain through the optic nerves. This information is processed in several stages, ultimately reaching the visual cortices of the cerebrum.” Davison, M.W. and Abramowitz, M., (Olympus America Inc., and The Florida State University, 1998–2004). Also available online at <http://micro.magnet.fsu.edu/primer/lightandcolor/index.html>
9. E.H. Gombrich, *Art and Illusion A Study in the Psychology of Pictorial Reproduction* (London: Phaidon Press, 1977), p. 57.
10. “The lensless pinhole camera is by far the least complicated device for the purpose [of image recording], yet it has several endearing and, indeed, remarkable virtues. It can form a well defined, practically undistorted image of objects across an extremely wide angular field (due to great depth of focus) and over a large range of distances (great depth of field).” As stated by Hecht, op. cit., pp. 219–220, see fig. 5.113, p. 219.
11. F.D.K. Ching, *Interior Design Illustrated* (New York: Van Nostrand Reinhold, 1987), p. 92.
12. Mattheai, ed., Goethe, op. cit., *Part VI: Sensual and Moral Effect of Color*, pp. 190–194.
13. Cachin et al., op. cit., p. 37, item no. 6.
14. *ibid.* J. J. Rishel et al., notes pp. 381, 383, fig. 158, p. 382.

Diagram 2.1. *Organizational Pyramid, Graphic Depiction.*

The graphic represents my pyramidal order for the stages of visual awareness of the object's form with analytical observation through associative, mind's-eye and eye-hand drawing.

The idea of “sketching with light” is analagous to light striking a surface when an artist’s brush strikes a canvas. I took the idea to mean that the utilization of the qualities of light as a medium was inherent in the expression. Light carries intrinsic qualities, such as warmth, brightness, and motility, and a boundless ability to carry information that expresses the physical movements of the artist’s hand. These tangible qualities can enhance the transition from a traditional sketching method to a medium of “sculpted palette.”² By the very nature of light, the artist cannot modify the image and deceive the viewer; thus, I believed that the expression of finding volumes would not be an illusion. The image, in fact, is similar to the transparent skeleton of a solid form in a still-frame that records a holographic stereogram,³ which is the hypothesis behind this work.

In the spring of 1997 I developed a pyramidal graphic organizer, in order to systematically extract the nuances of the subject matter from the original photographs (Figures 13–15 and Diagram 2.1). In this way, I was able to follow Alberti’s system of drawing, which includes the circumscription, composition, and reception of light, i.e., shape-to-object, so as to denote form, all through the intensive visual study of light illuminating a subject.⁴ This process allowed me to metaphorically study the visual characteristics of a beam of light as applied brushstrokes. This included the hierarchical placement⁵ of attributes in the visual field, thus translating them into a visual world. I traced with light the characteristics that became the foundation of my subject. With the same intensity of examination, I was able to extract nuances that became new forms, reaching the top tier of the organizational pyramid, the essence of an environmental field.⁶ I created textural surface studies of figures and shapes, later transformed into two-dimensional stills of shape-abstractions on transparent sections. Each extraction served to isolate one characteristic of a form.

The purpose of these studies was to see whether a photographic image could convey information, such as line location, tonal density, and clarity of shape, after a series of transforma-



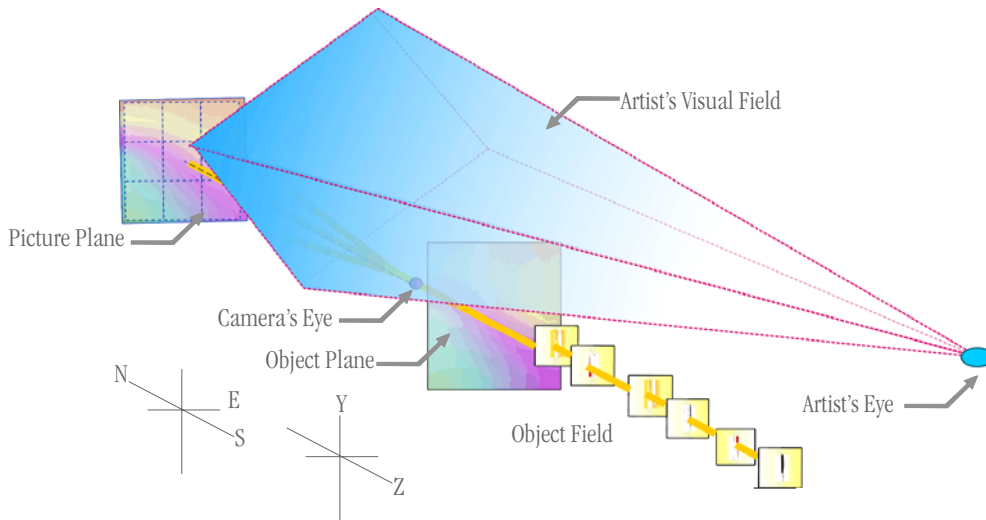
Fig. 16.



Fig. 17.

Surface of objects that become visible to us have, besides their own characteristics that we recognize by touch, an additional one that is usually not attributable to touch. We call this characteristic color.¹

Johann Wolfgang von Goethe



Dia. 3.1.

Preceding page:

Top: Figures 16. Projected White Light Mixed Through Colored Glass as a Representation of Aristotle's Linear Sequence of Colors or a Transparent Color Palette.

Bottom: Figures 17. Representation of Leonardo da Vinci's Color Palette, c. 1510.

This Page: Diagram 3.1.

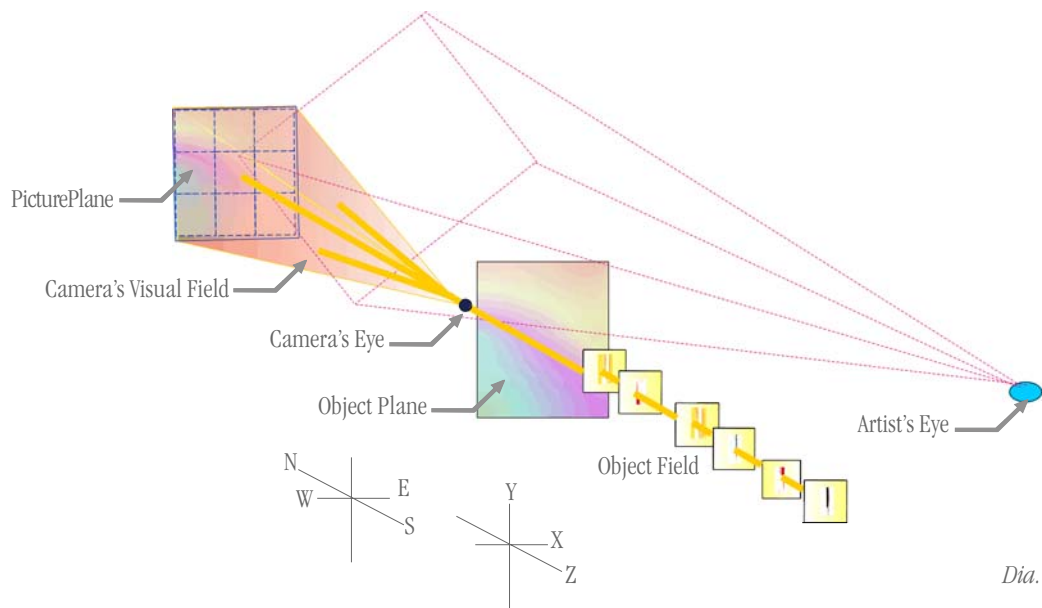
Visual Field No. 1; The Artist's Visual Field (dashed lines) and Visual Sketching Angle (blue color).

This diagram depicts the artist's visual field or angle. The approximate location was above and to the right of the picture plane, versus the camera's eye (black), which is in line with the platform of the camera (the vantage-point of linear perspective).

tional processes. A series of transparencies evolved into twenty-five observational studies. Necessary inquiries included: how (or how not) an image would be transformed within a controlled environment when one variable was altered, and whether these studies could be utilized as pre-architectural forms. The harmonious eurythmy of the structural connections and the symmetry of the chromatic balance created a compositional hierarchy, a foundation of design. At that point I was exploring the shapetier of the pyramid, which is *shape* in the *visual field*. The next step would be to transform *shape* into *volume* in the *visual world*.

In order to extract and record the visual characteristics of shapes, a rationale was needed to produce images-as-products, which would be later identified as holographic stereograms, still-framed holographic images. I unknowingly recorded on photographic medium, not only the impression of, but also the physical depth of the camera platform. This resulted in the observation of visual movement,⁷ or disparity of images. It was a resolution parallax⁸ that the naked eye could not see while operating the camera, but could, in fact, be reproduced photographically. The visual characteristics on the slides were a gathering of gradient-textures needed for a resolution parallax.

Gradient-textures and color palette combined to form what I refer to as image residues. This was a means for working with multiple disciplines, i.e., painting, graphic arts, sculpture, and



Dia. 3.2.

photography. It was also a way to discover a new expressive medium. (See historic palettes, Figures 16–17.) The transparent sections were metaphorically the paint on the brush, a means of applying visual characteristics⁹ to objects in the visual field, including light, color, scale, shade, shadow, and background. Visual characteristics¹⁰ are the describable qualities of an object in the visual world,¹¹ i.e., shape, brightness, proportion, texture, contrast, density, gradation, and chromatic color, all those things that make one projected object distinguishable from another. I used Rudolf Arnheim’s (b. 1904) concept of “invisible fingers” to touch, scan, trace, and explore an object’s texture through light,¹² with the light transforming the shape of the surface plane into *visual texture*. This approach provided density and contrast, which allowed for the visual interpretation of the object.

I then concentrated on making the segmented slides and establishing their positions on the camera’s platform.

The artist’s and camera’s visual fields were brought together through the sketching tool, in order to compose the images-as-products and to comprehend perception as it related to perspective (Diagrams 3.1 and 3.2). The mechanics of the visual fields, as in Field No. One, dealt with the perception of the object in the object field as it resided on the object plane. My vantage point was through the slides, that is, through the object field



Animation Button

For a sensation of image deduction, refer to the image movement animation on the CD-ROM in the back sleeve or left-click on the animation link button.

Diagram 3.2.

Visual Field No. 2; The Camera’s Eye (black) and Visual Drawing Angle (light orange color).

This diagram is of the camera’s visual field or angle. The camera’s eye (black) was in line with both the camera’s drawing platform and the object plane to the picture plane (the vantage-point of linear perspective). Artist’s eye is represented by the blue color and the visual angle is marked by dashed (light red) lines.

onto the object plane, or through the motility of light intromission. Field No. Two started at the camera's aperture; my visual field became secondary for constructing the geometric figures. The aperture's light-extramission action projected the characteristics of the object through the chamber to the far end, onto the picture plane. The image was comprised of identifiable points, lines, planes, and volumes—namely, subject matter, as well as an unanticipated occurrence, atmospheric background.

I realized that I was following Da Vinci's principle of perception by separating-out and categorizing painterly techniques or what he called "visual deceptions." Adding chiaroscuro and background to the object contributed to its dimensionality, a new development for the sketching of geometric shapes in space.¹³ By digitizing the original photographic images (*Planar Figures No. 1* and *No. 2* and the *Rectangular Shapes*), I was able to conduct a series of digitally deductive searches in order to isolate the essential elements of the object under examination. A digitized photograph is comprised of pixels that can be multiplied, duplicated, and manipulated at will. The variables include hue (distinctive chromatic color), value, gradient, and texture-density.¹⁴ I was, in essence, digitally dissecting the photographic image. The parameters within which I was working formed a comparison between the digital and the traditional black- and-white photography-printing processes. In addition, digitized images were reproduced three-dimensionally; both the vertical and horizontal planes of the object peeled back like the layers of an onion. At the pixel level, however, photographic images were graphically extracted two-dimensionally. I hypothesized that the geometric attributes of the object's form (points, lines, planes, or volumes) were not lost by the dissection process. As a painter I was interested in surface depiction and followed Da Vinci's rationale:

The science of painting begins with point, then comes the line, the plane comes third, and the fourth the body in its vesture of planes. This is as far as the representation of object goes. For painting does not, as a matter of fact, extend beyond the surface; and it is by its surface that the body of any visible thing is represented.¹⁵



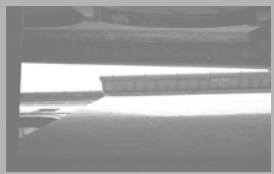
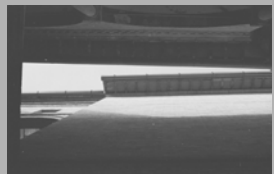


Polaroid Spirit Scanner Software Settings	Capture Scans	Constant/notes
Sharpen, Detail, and Smooth Noise GM-Gamma (Value) decreased by (.4) BR-brightness decreased in increments.	35mm Color Film to Digital Files	<i>Contrast</i> Plane Figures No. 2 Change the image to grayscale (value); study the changing levels of value and brightness on an image.
Test 1 GM 4.0 BR 100		The indication of light lines of textural characteristics, are mostly seen in the positive form.
Test 2 GM 3.6 BR 70		An initial definition of lines indicates a separation of textural characteristics.
Test 3 GM 3.2 BR 30		This level of grayscale represents the outline of shapes and the initial footprint of the final form.
Test 4 GM 2.8 BR -10		The lines of the characteristics are fading and the attribute of shape is more prominent.
Test 5 GM 2.4 BR -40		This is a large transition from characteristics to shape. The footprint of the final shape is evident.
Test 6 GM 2.0 BR -50		The final footprint is evident; the or shape has become very clear.

Table 3.1.
Value Studies.

Value studies in order to create visual characteristics of *Planar Figures No. 2*. Gamma (Value) decreased by increments of .4. Brightness decreased by variable increments.

Table 3.1.

The elements of two-dimensional sketching (chiaroscuro, background, and scale) were needed for a visual palette. First, I sought to distinguish the visual characteristics of the contextual surface through a deductive process, using a *Polaroid Spirit* thirty-five-mm slide scanner to digitize the film. By adjusting the parameters in the scanning software (chromatic-intense/weak, photic-light/dark, and thermal-warm/cold), I was able to separate-out the following variables within the photographic images: (Table 3.5.)

- 1) *Shape*: The light in the scanner was intensified so that the shape had a more definitive contour.
- 2) *Brightness or value*: Using one hue increased contrast (black) or tinting (white) levels.
- 3) *Proportion*: A selection of shapes was scaled down by fifty percent forcing the one-point perspective for composition.
- 4) *Texture*: Grainy dimensional qualities were discerned.
- 5) *Contrast*: Textures were subtracted from the original form to achieve background.
- 6) *Density*: Light was subtracted to create opacity.
- 7) *Gradation*: Residues were reduced in order to examine tones within the objects.
- 8) *Chromatic*: The hue saturation-level was used to see how deducting chroma could yield a defined shape.

Second, in order to categorize subject matter according to visual characteristics that would create my visual palette, I developed a series of hue, value, and chroma studies (Tables 3.1–3.3). By digitally slicing along horizontal or vertical planes, I printed sections of the objects onto *Kodak Ektachrome* slides, allowing for a multifaceted examination of underlying structural elements. For example, by deleting color hues from *Planar Figure No. 2*, the image was transformed into a digital grayscale¹⁶ (Table 3.1). This gray value-range demonstrated the difficulty of observing minute characteristics of an object. I had realized early-on that chromatic hues would be needed to denote such minute qualities. The process clearly showed that increasing or decreasing color contrast revealed greater definition of an object. Further, by animating monochromatic hue and studying the

effect of decreased contrast and increased saturation, I discovered the color chiaroscuro of the object (Table 3.2). For the hue studies (Table 3.3), the goal was to identify prominent saturated hues. The subject matter was no longer shapes, but rather contrasting chromatic hues. This resulted in a greater understanding of the medium of projected light, specifically how to mix projected colors.

In studying value and color chiaroscuro (Tables 3.1–3.3), visual resonance became apparent as the objects became forms. (Figure 18.) These multiple studies represented the pitch of the color, the azimuth angle of chromatic saturation, an essential quality for depth perception in design.¹⁷ In Table 3.3, I selected twelve hues in order to explore azimuth angles.

A sequence of sections (Table 3.4) demonstrates the culmination of the key factors discussed above, including the visual characteristics of brightness, shape, density, and texture.

The digital residues of density and gradation were maintained as stippled, half-tone pixels on the slide reproductions. I created visual balance and harmony through scale, size, texture, and color, thus reflecting a sense of depth perception for the composition. I now had all of the necessary architectural lineaments,¹⁸ or the distinctive characteristics within the circumscription, to begin the pre-architectural form studies. As suggested by Alberti, circumscription is one of the three painterly requirements of form, along with composition and light reception.¹⁹ In Chapter five, I will discuss the process of composing the object in an environment, and, in Chapter six, how I interpreted the reception of light.

By positioning the slides along the camera platform (the artist's visual field), I had to reverse the arrangement of subject matter because of inversion. Only one slide out of eight would be in sharp focus. This maneuvering of the slides on the platform provided the means for changing the motility of the light, a kind of brushstroke on a picture plane, or "lightstrokes." For



Fig. 18.



Animation Button

For an example of the transformation of hue saturation, chroma, and value, refer to the animation on the CD-ROM in the back sleeve or left-click on the animation's link button.

Figures 18.
Color Chiaroscuro; A Dimensional Drawing Technique.

This graphic is an illustration of a single directional light source casting shadow (lightest blue) and casting shade (darkest blue). This is a dramatized depiction of "color chiaroscuro."

Color Animation Studies	Hue/Saturation and Contrast Settings	Hue/Saturation Contrast Studies	Color Animation Studies
	Frame 1 Hue 0 CT -100	Frame 1 Hue -180 CT -100	
	Frame 2 Hue 10 CT -90	Frame 2 Hue -150 CT -80	
	Frame 3 Hue 20 CT -80	Frame 3 Hue -120 CT -60	
	Frame 4 Hue 30 CT -70	Frame 4 Hue -90 CT -40	
	Frame 5 Hue 40 CT -60	Frame 5 Hue -50 CT -20	
	Frame 6 Hue 30 CT -50	Frame 6 Hue -20 CT 0	
	Frame 7 Hue 20 CT -40	Frame 7 Hue 20 CT 20	
	Frame 8 Hue 10 CT -30	Frame 8 Hue 50 CT 40	
	Frame 9 Hue 20 CT -20	Frame 9 Hue 90 CT 60	
	Frame 10 Hue 30 CT -10	Frame 10 Hue 120 CT 80	
	Frame 11 Hue 40 CT 0	Frame 11 Hue 150 CT 100	
	Frame 12 Hue 50 CT 10	Frame 12 Hue 180 CT 120	
	Frame 13 Hue 60 CT 20		
	Frame 14 Hue 70 CT 30		
	Frame 15 Hue 80 CT 40		
	Frame 16 Hue 90 CT 30		

Left: Table 3.2.

Observation of the Movement of Visual Characteristics When Contrast and Saturation Levels Changed.

Image residues of *Rectangular Shapes* captured still-frame animation in monochromatic hue of cyan. Saturation levels were increased by increments of ten (10) percent. Contrast levels decrease by increments of ten (10) percent.

Right: Table 3.3.

Observation of Visual Characteristics: Distinction When Contrast and Hue Levels Changed.

Hue levels increase by increments of thirty (30) percent, Contrast levels increased by increments of twenty (20) percent.

Table 3.2.

Table 3.3.


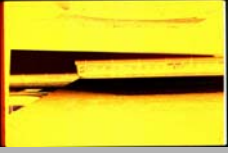

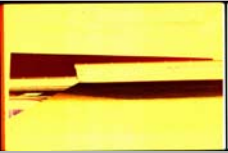




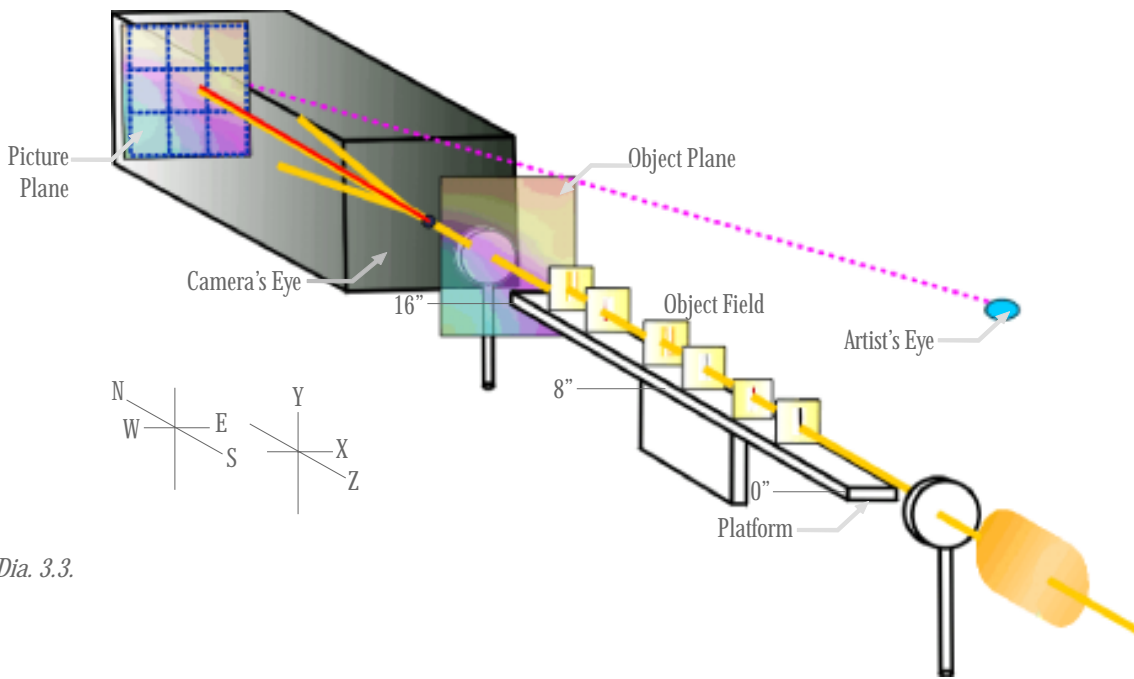
35mm Color Film	Constant/Notes	Capture Scans
Slides Used in Modified Pinhole Camera	<i>Planar Figures No. 2</i> EX - Exposure Constant BR - Brightness	Hue/Saturation and Contrast; Applied Scaling. The scanned rate of brightness was adjusted.
	<i>Right:</i> EX_BR 44 <i>Left:</i> The removal of the red and green down to 10%.	
	<i>Right:</i> EX_BR 9 <i>Left:</i> Maintain the very darkest red only.	
	<i>Right:</i> EX_BR 148 <i>Left:</i> Maintain the brightest red down to 10%.	
	<i>Right:</i> EX_BR 200 <i>Left:</i> Maintain the green down to 10%.	

Table 3.4.
Planar Figures No. 2; Elimination Phase for the Final Visual Characteristics.

The table's right-hand side represents the original captured scans. The table's left-hand side represents the process of removing the selected hues in order to separate the distinctions of the contextual subject matter. This was the final stage of creating an artist's palette. Exposure and brightness increased by increments of fifty-two (52) percent.



Dia. 3.3.

example, in Diagram 3.3, three slides were placed on the platform, forming an arrangement of all the objects to be composed on the object plane—the envisioned vertical plane on which all subject matter resided. Significantly, the object plane relative to the visual angle was in a non-traditional location. By placing the object plane *in front of* the picture plane, I was able to manipulate both the object field and the projected light to “paint” using light as my medium. The object field, in turn, determined the camera’s depth of field and the order of focus,²⁰ or the slides’ placement on the platform.

There was greater depth-of-focus within the camera obscura’s²¹ visual angle as compared to the artist’s visual angle. The approximate positioning of the three slides around the twelve, ten, and eight-inch markers on the platform produced depth perception in the composition (Plate XI). In other words, the first slide (located at the twelve-inch marker) produced the extrinsic rays as background, having received the greatest level of magnification (ten). The second slide (magnification of seven to ten, located at the ten-inch marker) contained median and centric rays in the midground, appearing in soft-focus. The third

Diagram 3.3.

Object Plane is Placed in Front of the Picture Plane.

This diagram depicts the location of the object field in relation to the object plane, centered along the orthogonal line of sight relative to the picture plane.

slide (magnification of five to three, located at the eight-inch marker) was in the foreground and contained primarily centric rays and, therefore, was in sharp focus.

Within the depth-of-focus the colors were transformed as well. For example, Plate X—Images A-C provided an example of Goethe’s subtractive color mixing within the depth-of-focus. See in particular Image B, Slide One (purple-blue Munsell 5/2/4),²² which is a single slide at approximately the eight-inch marker with dark indigo, representing the “cyan species” as the hue. In Image C, Slide Two (green-yellow Munsell 5/7/8),²³ was located at the ten-inch marker, with light green representing the “yellow species” as the hue. Image A, with the addition of Slide Three (red-purple Munsell 5/5/6),²⁴ with light magenta being the last color added, represents the “magenta species” at the twelve-inch marker. Slide Three produced visible mixed-colors that transformed the residues from the weakest to the most intense saturation of hues. The anticipated end result was to obtain Goethe’s subtractive mixed colors (Figure 19)—in this case dark orange or yellow-red, red, violet or purple, and dark blue-green, which occurred in Plate X—Image C. Having one sectional slide in front of the other produced color chiaroscuro, with the actual pixel density representing shadow. The anticipated hues were visually separated into different color species. The placement of the mixed hues was a process of finding the visually brightest colors as they moved forward while being altered dimensionally by the density of gradient-texture that caused the hues to recede. This anticipated alteration of the hue, value, and chroma levels would, therefore, distinguish the dimensional expression, i.e., the height, the width, and the depth, or model, of the object. (Plate II.)

The color resonance in this part of the experiment was comparable to my interpretation of Cézanne’s later paintings, such as *Large Pine and Red Earth* (Figure 2). In these works, he controlled the visual movement in two ways: First, using a strong center-focus, he pulled the viewer’s eye inward, using primarily warm colors. Second, he simultaneously blurred the outer edges

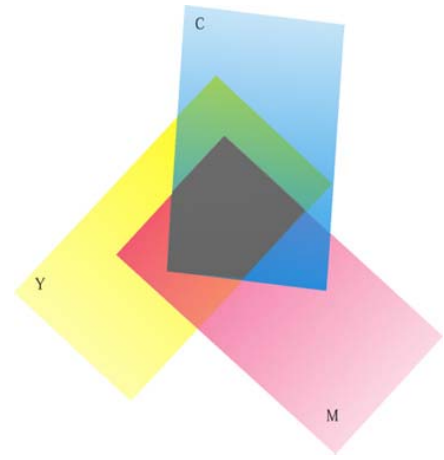


Fig. 19.

Figures 19.
Goethe's Subtractive Method;
CMYK Color Palette.

The “K” refers to black or the totality of the mixed translucent colors of cyan, magenta, and yellow.


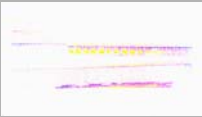

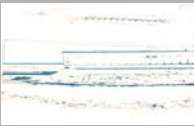







Capture Scans	Constant/Notes	Capture Scans
Planar Figures No. 2: Slides used in Modified Pinhole Camera	Proportion and Chromatic Hues Apply to All	<i>Rectangular Figures:</i> Slides used in the Modified Pinhole Camera
	Shape	(Blank)
	Brightness	
	Texture	
	Contrast or Tinting (<i>Right:</i> 50% Smal)l	
	Density	
	Gradation	

Table 3.5.
Visual Characteristics or “Palette”
Used in the Modified Camera
Obscura.

A sample of the subject matter that
was located on the platform of the
camera.

Table 3.5

of the subject matter with cool colors. This dual effect gave depth, motility, and color dimension to the painting.

The residues from my original images contained three-dimensional visual characteristics similar to Cézanne's. Constructing volumes would depend on the effective manipulation of these same characteristics on a picture plane.²⁵ These volumes' characteristics would be recorded at a single moment in time, a limited view of the object in space. In order to achieve three-dimensionality, a mechanism for adjusting the depth of field would need to be constructed. The next chapter describes the mechanics and operation of a modified camera obscura for the purposes of these architectural studies.

Endnotes. Chapter Three.

1. Matthaei, ed., Goethe, op. cit., p. 20, paragraph 25.
2. What I mean by “sculpted palette” is that the visual characteristics are applied to the light as well as to the colors as “lightstrokes.”
3. I define a holographic image as the visual impression of what the viewer sees in a three-dimensional state composed of light recorded on photographic medium.
4. Alberti, loc. cit., paragraph 30, (see chap. 1, n. 17).
5. By hierarchy I mean the placement of objects and the spontaneous organization of the visual field to show the interdependencies of the overall composition. Please refer to Arnheim, op. cit., *Art and Visual*, p. 380.
6. See “impressions of surface and edge” Veltman, op. cit., *Literature of Perspective: 5. Gibson’s Distinctions*, p. 11 (printed in a 12pt. font size).
7. What I mean by visual movement is in line with a similar action that R. Arnheim calls an “invisible finger.” The visual mechanics or movement of the eyes’ sensory recognition of objects can be defined by 1) ocular accommodation a (monocular) depth cue in which the eye senses depth by focusing at different distances and 2) motion parallax a (monocular) depth cue sensed from the apparent change in the lateral displacements among objects in a scene as the viewer moves. Arnheim, loc. cit., (see chap. 2, n. 3). For definitions see Luncente et al., loc. cit., (see chap. 1, n. 11).
8. “A parallax is an apparent change in the direction of an object, caused by a change in observational position that provides a new line of sight.” Morris, op. cit., p. 950. “A resolution parallax is [viewing the apparent changes of an object placed in a composed visual field] a number of different perspective views available to the viewer [and for composition sake selected by the artist for the viewer to move about his subject.]” See Luncente et al., loc. cit., (see chap. 1, n. 11).
9. I use “characteristics” rather than “attributes” to distinguish between expressive features (characteristics) and physical features (attributes).
10. For a discussion on “Visual Field” see Hall, op. cit., p. 62. For a description of L. Da Vinci’s background that effects size, brightness, shadow, colour, and relief of an object see Veltman, Kim H., *Studies on Leonardo da Vinci. Vol. II, Continuity and Discovery in Optics and Astronomy: Part Three. The Eye and Vision: Appearance and Illusion: The Effects of Sound and Contrast* (London: England: Warburg Institute, University of London, 1975), Reprinting: (Ontario, Canada: SUMS System for Universal Media Searching Corp., 1999). Also available online at <http://www.sumscomp.com/books/comtin/title.html>.
11. Hall, op. cit., for a discussion of “Visual World,” p. 62.
12. Arnheim, loc. cit., (see chap. 2, n. 3).
13. Veltman, op. cit., *Studies of Leonard da Vinci Vol. II: 3. Effects of Sound and Contrast*, including 3.1–3.5.
14. For definitions and a discussion on chromatic colors see, pp. 33–34; for value and value gradation, see, pp. 35–38, 54; for chroma and chroma gradations; see, pp. 39–42, 54, and Hue, pp. 43, 55 see W. Wong, *Principles of Color Design Second Addition*. (New York, N.Y.: John Wiley and Sons, Inc., 1997).
15. I. A. Richler, ed., L. Da Vinci, op. cit., Chapter 4, *The Arts, I. The Painters Course of Study*, p. 125.
16. Value or brightness generally refers to a material medium that adds black or white. Grayscale, on the other hand, has the same equivalent meaning but is related to digital pixels being interpolated with more or less pixel density compared to a value scale.
17. The azimuth angling of chromatic hues are the purest measurable saturated chromatic hues located on the x-axis on a vertical rise or y-axis (value) to a breadth, depth or pitch (azimuth) on the z-axis location (chroma). The azimuth navigates the pitch defining a depth or degree of the angle and the distance relative to the sight line or

the horizon-line between a point of reference (value level), usually the observer's bearing, and the object.

18. For a discussion of lineaments, see Alberti, op. cit., *Building*, pp. 7, 422–423.

19. For an explanation of circumscription, see Alberti, op. cit., *Painting*, “Planar,” pp. 65–67.

20. A general definition of *depth of field*: When a lens or aperture focuses on a subject at a distance, all subjects at that distance are sharply focused. Subjects that are not at the same distance are out of focus and theoretically are not sharp. However, since human eyes cannot distinguish very small degrees of unsharpness, some subjects that are in front of and behind the sharply focused subjects can still appear sharp. The zone of acceptable sharpness is referred to as the depth of field.

21. General definition of camera obscura: Chamber, boxlike apparatus into which an analysis of an outside image from light is projected through a convex lens creating a detailed image, within one-point perspective; it is used to make precise drawings or photographs.

22. A. H. Munsell, *Munsell Student Chart: 10 Munsell Hue Value/Chroma Charts* (Baltimore, Maryland: Munsell Color Macbeth, a Division of Kollmorgen Corp., 1981), Munsell Student Chart Hue 5.0 as a Constant: Hue/Value/Chroma.

23. *ibid.*

24. *ibid.*

25. To describe a visual concept of an object in terms of three dimensional visualization to drawing onto a two dimensional picture plane see M. A. Hagen, *The Perception of Pictures Vol. II: Dürer's Devices: Beyond the Projected Model of Pictures* (New York, New York: Academic Press, 1980), p. 12.

Within the discipline of architecture, the choice of tools defines an integral part of the architect's ability to obtain desired results in both perceived and built surroundings. I attempted to follow the principles of Brunelleschi, who also conducted optical experiments with a new invention.² Projecting the visual world onto his picture plane, the flat panel drawing tool served to expose distortions in the drawing for the purpose of correction (Figure 20). The tool emphasized the viewer's vantage-point relative to the trajectory lines of constructing a one-point perspective study. This allowed the painter to see planes accurately within height, width, and depth, in order to depict an object in the third dimension.³ Alberti, who further developed the technique for depicting the third dimension in painting, recorded Brunelleschi's principles of perspective.⁴ My work was assisted by Brunelleschi and Alberti's approach to painting. I sought a means to use painterly techniques within white light—the spectral light of simple and compound colors—to produce pre-architectural volumetric forms.⁵

To fulfill the requirements of this perceived visual dimension a, sketching tool had to be developed that could be used to:

- 1) Apply the inherent qualities of one-point perspective from both the artist's visual angle and the camera's vantage-point in Euclidean physical space;⁶ the centric point needed to be the same on both the object plane and the picture plane. This allowed maximum possible depth of field for the figure-ground visual ratio (linear and diminution perspectives—scale of visual perception of objects as they recede away from the eye.)⁷
- 2) Place the subject matter of pre-extracted visual characteristics⁸ and the strength of the brightness of light through the new compositional arrangement. The linear orthogonal distance had to be a physical distance, magnified by the pinhole camera, in order to sketch the perspectives of color and diminution⁹ (Diagram 3.3 and Figure 39).
- 3) Vary the depth-of-focus for the compositional figure-ground as it relates to foreground, midground, and back-

For hypotheses ought to be fitted merely to explain the properties of things and not attempt to predetermine them except in so far as they can be an aid to experiments.¹

Sir Isaac Newton

ground (perspective of blur).¹⁰

- 4) Make the object-surface transparent in order to locate points, lines, and planes—finding the skeletal structure, exposing the internal volumes.¹¹
- 5) Create both active and observational visual fields, described by Gibson's definition of visual space: shade, shadow, and background create the visual world,¹² the perspectives of disappearance, atmosphere, and texture—the diminished distinctiveness of the forms and outlines displayed by the objects at various distances.¹³

The camera obscura was modified to integrate two visual angles¹⁴—the artist's view and the camera's view. The artist's visual field consisted of light being projected through the object field onto the object plane¹⁵ (Diagram 3.1). The camera's visual field extended from the aperture, through the chamber, to the picture/focus plane (Diagram 3.2). The distance between the object plane and the aperture was the critical focal length (ten inches to fourteen inches) that determined projection clarity. The focal depth was the distance between the light source and the aperture, and the depth of field was the distance between the aperture and the focus plane.

Initially, I was sketching “blind;” the objects being sketched were projected into the darkened chamber. Cutting an access panel through the top of the chamber allowed for a view (inside the chamber) of the projection onto the picture plane. The face of the pinhole camera box acted as a “veil”¹⁶ (Figure 21.2). Significantly, the access panel also made it possible to view the visual connections among the objects from one slide to another. The images-as-products thus produced were the actual projections of the anticipated and expected visualization of volumes, connections, and relationships.

An extended exposure time for depth of field was necessary for volumetric extrusions to reveal depth perception. Subtleties of the visual characteristics of the outer skin or surface became clearer as the objects progressed from transparent-to-translucent-to-opaque images. After additional exposure time, an environ-

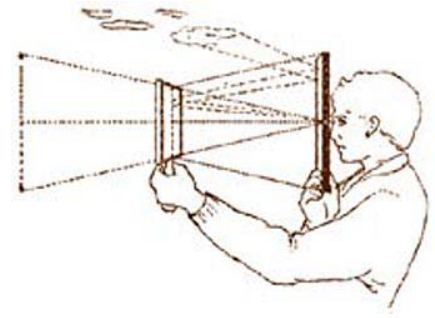


Fig. 20.

Figures 20.
*Brunelleschi's Pinhole Flat Panel
One-Point Perspective Tool.*
c. 1425.

The pinhole flat panel tool allowed Brunelleschi to visually correct his architectural studies of one-point perspective, which incorporated the effects of atmospheric diminution among other perspectival cues.



1. Light Source.



2. Artist's Vantage Point to the "Vail."



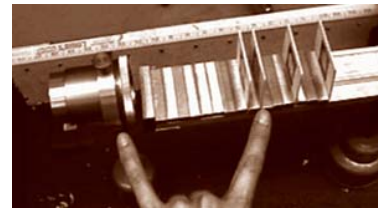
3. View of Aperture.



4. Transparent Slide Sections.



5. Rear View Opened.



6. Condenser Lens and Sections.



7. View of the Focus Plane or Picture Plane.

Figure 21.1–7.

*Captures of the Modified Camera
Obscura in Use, 2/19/98.*

Random views of the components
of the camera.

Fig. 21.

ment enhanced by the third dimension emerged to be captured and analyzed. The modified camera served to reconstruct existing two-dimensional shapes into three-dimensional volumes with clearly defined visual characteristics. This process was an important step toward the development of pre-architectural forms.

As described earlier, the visual characteristics came first, followed by the design and operation of the platform, and then the modeling of light transference in the camera. This chapter explores the techniques that were used to create the visual fields and the object plane that were expressed and translated through directed light.

The requirements for a modified camera obscura with sketching capabilities were as follows:

- 1) The content of the slide located in the center of the platform was always the primary focus slide;
- 2) The maximum amount of focus was necessary for transmitting light through the distance of the object field;
- 3) The location of the transparent slide sectional series was always on the orthogonal distance line of the platform;
- 4) Flexibility in the placement of the slide sections along the sixteen-inch platform provided varied combinations (Figure 21);
- 5) Telephoto capabilities for increased magnification (up to twelve times) were needed; enlargement of the camera body would provide a clear picture of a near object against a blurred background;
- 6) Additive and subtractive color-mixing capabilities allowed for sketching with light and color;
- 7) A light source as close to natural sunlight as possible was used for recording true visible color, i.e., a 150-watt halogen light (3200 Kelvin, 40 lux sec.), in order to calibrate the color temperature of the direct-positive print medium;¹⁷
- 8) A direct-positive print medium was necessary to minimize color correction errors;¹⁸
- 9) An eight-by-eleven inch, direct-positive medium prevented interpolation in the reproduction of the images-

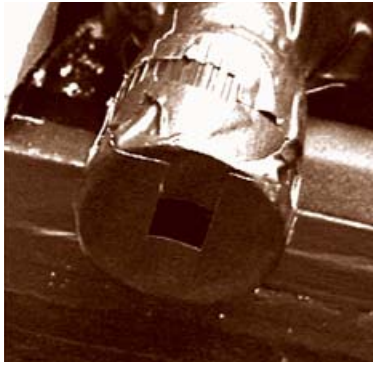


Fig. 22.



Fig. 23.

The Filters Used for the Light Source in the Modified Pinhole Camera, 2/18/98.

Top: Figures 22. First filter was used to narrow the beam of light.

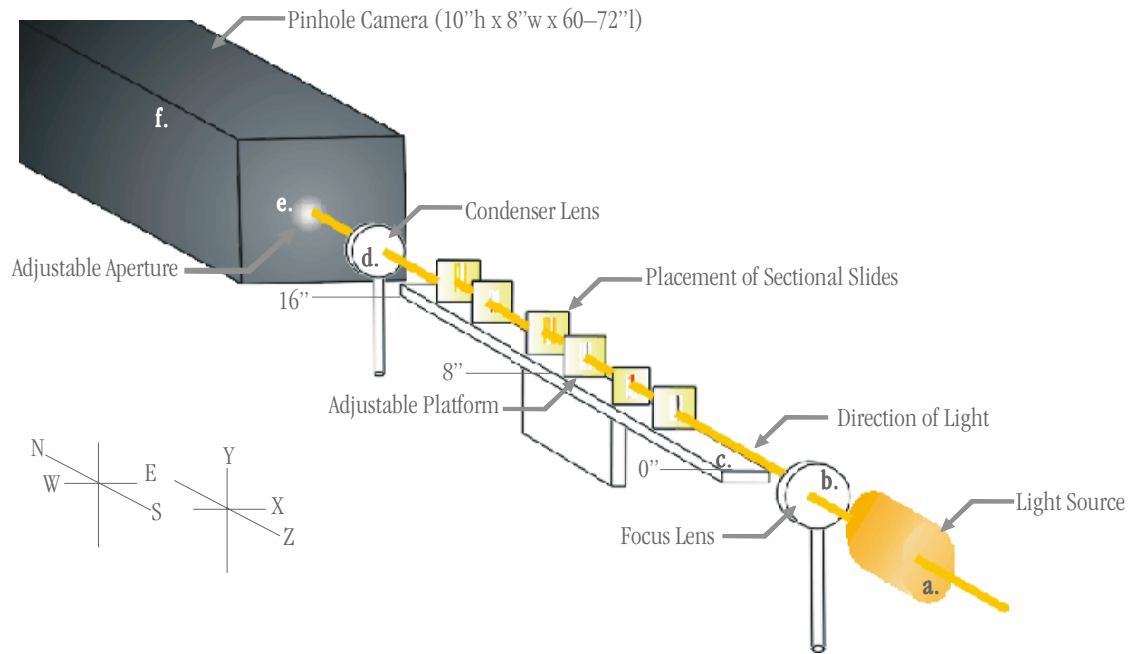
Bottom: Figures 23. Second filter used a double-sided frosted plastic to block out the lamp in the light source.

- as-products;
- 10) A collimation lens was needed to produce a non-diverging beam of light;
 - 11) Two filters (Figures 22–23) were necessary to eliminate extraneous light and distortion by the light fixture. One set narrowed the beam to centric rays, and the other filtered out the lamp;
 - 12) Loading the slides upside down eliminated inversion;
 - 13) The capability to record the “light-tracings”¹⁹ and atmosphere among the objects on the transparent sections was a central impetus for this study.

The basic design of a pinhole camera and the operation of the camera obscura were applicable to the operation of the modified camera.²⁰ In addition, the camera had six elements that contributed to obtaining the three-dimensional images-as-products (Diagram 4.1 and Figure 21). They were (a) the halogen light source; (b) the collimation lens, (to produce a cylindrical light beam); (c) the slide platform for the space between the slides; (d) the condenser lens (with the focal length of the light source to the aperture being approximately forty-two inches); (e) the aperture (iris diaphragm);²¹ and (f) the pinhole camera, including the body length (focal length) of the telephoto camera body, the viewing access panel, and the focal plane (picture plane).

The adjustable platform design allowed for translation, differentiation, and distancing of the slides’ positions (Figure 24). The distance between the imaginary object plane at the end of the platform and the camera’s aperture was the focal length (approximately ten inches to fourteen inches) and was significant to the ultimate clarity of the projection. Once the light went through the final section along the platform, the composition resided on the object plane. The focal depth was the distance between the light source and the aperture, and the depth of field was the distance between the aperture and the focus/picture plane. Both the depth of field and the depth-of-focus incorporated the range of object distances.

The condenser lens directed the light into the aperture, increasing the intensity of the beam while decreasing required ex-



Dia. 4.1.

posure time (Figure 25). The aperture was adjustable from one sixty-fourth of an inch to one thirty-second of an inch, which allowed for contrast control; i.e., the smaller the aperture the sharper the image and, correspondingly, the greater the depth of field. Aperture size and the chamber length were proportional to the aperture/film plane distance, maximizing field depth. The light, having entered the pinhole camera, traveled approximately five feet to the picture plane. The picture plane, in turn, recorded focused mixed colors. The duration of exposure time ranged from eight to twenty-four hours: the longer the exposure time, the greater the detail. Importantly, lengthening the exposure time improved the depiction of depth of field.²²

Initially, a series of study photographs was taken to calibrate the camera. Through trial and error, the correct exposure times for this photographic medium were determined, as was the regulation of light intensity for hue clarity. I learned how to implement translation techniques, such as offset, mirroring, and repetition of shapes, to investigate depth perception. For example, one of the test images (Diagrams 5.1–5.3) demonstrates the massing of hues. Significantly longer exposure time facili-



Movie Button

To see a short documentary movie of the modified camera obscura and the operation of the tool, refer to the CD-ROM in the back sleeve or left-click on the animation link button.

Diagram 4.1. (Assembly Parts a.–f.)

Modified Pinhole Camera

Layout, 11/15/98.

Overall Size 9'-0."

The diagram approximates the location of the camera assemblage.

The camera had a 12x magnification capability and a light source with a conal directional light beam.



Fig. 24.



Fig. 25.

tated observations of differences in hue, value, and chromatic levels.

As the mechanics of light transference became clearer, the transmission of projected objects comprised the next phase of the experiment—how to utilize the objects in the painting process. From this point forward, I had to merge the roles of artist and architect, using the modified camera obscura as a device for creating volumetric forms.

Top: Figure 24. Viewing the Modified Camera Obscure in the Direction of the Light Source, 2/98.

Bottom: Figure 25. Modified Pinhole Camera in Operation, 2/98.

Camera Size 14 h x 24 w x 144 d inches.

Endnotes. Chapter Four

1. Newton, op. cit., *Opticks*, pp. xxiv–xxv.
2. E. Renner, loc. cit., (see in this text, introduction., n. 10). Also see Brunelleschi's Pinhole Perspective Device, E. Renner, *Pinhole Photography Rediscovering a Historic Technique* (Boston, London: Focal Press, 1995), pp. 23–25.
3. Renner, op. cit., *Pinhole Photography*, pp. 23–25.
4. Alberti, op. cit., *Painting*, pp. 37–59.
5. This is in accordance with Sir Isaac Newton's reference to the colors produced by the spectrum of light viewed through a prism as being either simple or compound, i.e., primary and secondary. Then mutual aligning rays of different species, i.e., color origins, produce "midling" or intermediate color. Sir I. Newton, *New Theory about Light and Color* (München: Werner Fitsch, 1967), p. 3082.
6. In *Euclidean physical space* there are three independent directions that objects within the space can move: up/down, left/right, and forward/backward.
7. J. P. Richter, ed., L. Da Vinci, *The Notebooks of Leonardo Da Vinci Compiled and Edited from the Original Manuscripts by Jean Paul Richter in Two Volumes*. First vol. (New York, N.Y.: Dover Publishing, Inc., 1970), pp. 29–36, items no.50 to 56. For J. J. Gibson's description of linear and size perspective see Hall, ed., Gibson, op. cit., p. 180, items no. 2–3.
8. See e.g., (within this text see chap. 1, p. 1, and chap. 3).
9. Aerial perspective relies on the gradients of brightness, saturation, sharpness, texture, and to some extent of hue. Arnheim, op. cit., *Art and Visual*, p. 279. See Hall, op. cit., p. 182, item no. 13. And see branches of perspective J. P. Richter, ed., L. Da Vinci, op. cit., pp. 16–17 items no. 14–16.
10. For J. J. Gibson's description of blur perspective see Hall, ed., Gibson, op. cit., p. 181, item no. 7.
11. For an understanding of a conceptual visual abstraction, see M. Hagen: "... visual concept is thus accomplished by seeing certain aspects of the particulars as deformations of an underlying structure that is visible within them, not through the integrating of elements across the sequence." Hagen, loc. cit., (chap. 3, n. 25). *Volume II Durer's Devices*. Read a discussion within this text including K. H. Veltman's quote on Leonardo da Vinci's use of models: (see chap. 6, n. 3).
12. The retinal image is the visual field and what man perceives or the visual world. "... Vision is not passive but active, in fact, a transaction between man and his environment in which both participate." Hall, op. cit., pp. 62 and 75.
13. For J. J. Gibson's description of textural and aerial perspectives: see E. Hall: "[it] is derived from the increase haziness and changes in color due to the atmosphere." Hall, ed., Gibson, op. cit., pp. 180–181 items no. 1 and 6, and p. 182, item no.12. See J. P. Richter, ed., L. Da Vinci, op. cit., pp. 17, 37–41, item no. 16, and pp. 58–66.
14. Renner, op. cit., *Pinhole Photography*, pp. 23–34. (Within this text see chap. 2.)
15. Da Vinci uses the following analogy to describe the actions of bringing a concept to life: "A good painter has two chief objects to paint, man and the intention of his soul. The former is easy, the latter hard because he has to represent it by the attitudes and movements of the limbs." McCurdy, loc. cit., (see chap. 1, n. 5). Also quoted (within this text chap. 5, n. 14).
16. The "intersection" is also known as the "veil" in Alberti's terminology. The threads would be tied to a frame in a parallel square section. The frame would then be placed between the painter and the object or landscape. An imaginary line would be perceived between the painter's one eye as Alberti's "centric point" and the object beyond the frame. The "veil" helps the "painter" correctly place the object in his painting. My veil was just the centering of the light beam to the camera's eye. See Alberti, op. cit., *Building*, p. 22.
17. A direct positive print medium or cibachrome is dye bleach. A positive to positive (reversal) process using three emulsion layers of silver salts was sensitized to one of three

colors: red, blue, or green. The image was formed by selectively bleaching dyes already existing within the paper. "Cibachrome" is the patented name given by Ilford. The medium I used in the modified camera obscura was Ilfochrome classic RC Paper with a pearl surface CPM.44M. I chose this medium because positive to positive means it is both the negative and positive version of the image and at the same time no "color coupler print" needed. Other requirements that this medium qualification needed were excellent color renditions and color separations, sharpness, definition, fade resistance, and archival stability. See Ilford Photo, *Ilford Ilfochrome Classic Technical Information: Ilford Color Products*. Catalog #10780. (Paramus, N.J.: Ilford Photo, 1994), pp. 2–5.

18. J. W. Oakes, *Minimal Aperture Photography Using Pinhole Cameras* (Lanham, MD: London, England: University Press of America, Inc., 1986), chap. 5, pp. 63–64.

19. What I mean by *light-tracings* is the characteristic of visual residues being transmitted by light-rays as they pass through each of the sectional transparencies, such as, a line extending from a point moving in a direction as a "ray;" each section alters the strength, quality, and condition of the light-rays. The physical altering and capturing of the light-rays was a perceived graphical recording of the perceptual trajectory light-tracings among the sections within a one-point transparent perspective study.

20. Oakes, op. cit., (see chaps. 1–4, 7, 10–11, and 16).

21. For a description of the aperture see Edmond Scientific Co. *Industrial Optics Division, 1997 Optics and Optical Instruments Catalog*. n977a. 1997. Also available online at <http://www.edmundoptics.com/onlinecatalog/DisplayProduct.cfm?productid=1373>.

22. Hecht, loc. cit., (chap. 2, n.10).

The artist expresses an idea with pen and paper, actualizing creative thought and instinct. This actualization is achieved by the physical sketching of shape abstractions so that the desired image is obtained (Figure 26). As an artist, I switched back and forth between the roles of observer and operator, readjusting the camera and its parts, noting the changes in the effects of the light, in search of the image. Through this procedure I developed a new interpretation of the architect's sketching operation.

This chapter will focus on the process of sketching, or painting, images-as-products.

By extending the function of the camera obscura to become a “light-sketching”² device, it became a mechanism for composing in a controlled environment. This modified sketching tool could be used to create abstract geometric planes and volumes as potential pre-architectural forms. The process of changing transparency-to-translucency of forms allowed for viewing and recording both internal and external volumetric interconnections and compartments.³ Goethe described the advantages of using transparent colors in their lightness and darkness:⁴ a viewer’s eye visually feels the subject matter through surface-quality, texture, and density. Arnheim further described this experience: “With an invisible finger we move through the space around us, go out where things are found, touch them, catch them, scan their surfaces, trace their borders, explore their textures.”⁵ This sensation is due in part to increased or decreased light on which an object casts shade or shadow, producing the concavities and convexities that cause chiaroscuro. In attempting to understand how to sketch shadow, Cézanne defined it thus: “Shadow is color like light, but it is less brilliant; light and shadow are nothing other than a relation between two tones.”⁶ Using these timeless principles, I sought to understand the blending of light transmission through space (Figures 27–28). I hypothesized that, if there were a way to direct the light as if it were my lightstrokes, the blending of the light could be understood through color chiaroscuro. Painting with light became the transparent planes that resulted

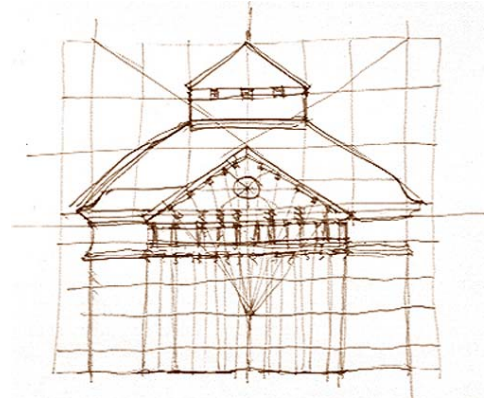


Fig. 26.

*A perfect bridge between nature and our human powers of observation and judgment is provided by those arts that are 'born of Chance and Observation, fostered by Use and Experiment, and matured by Knowledge and Reason.'*¹

Leon Battista Alberti



Fig. 27.

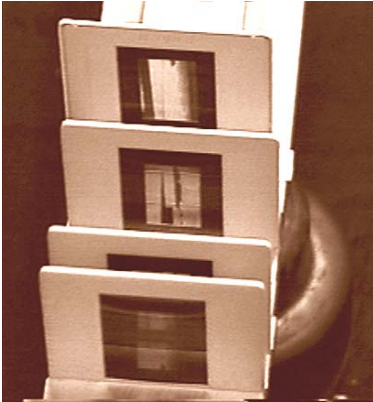


Fig. 28.

Preceding page: Figure 26.

An Architectural Sketch of The Director's Building by Claude Nicholas Ledoux at Royal Saltworks of Arc-et-Senans, 1775 (Saline Reali ad Arc-t-Senans), 3/29/96.

This two dimensional sketch was drawn with the aid of a traditional proportional grid or veil to locate the shape's characteristics in order to proportionally draw the composition correctly.

in a cross-sectioning of translucent volumes,⁷ expressed by compound colors.

Primary variables of the media and techniques included the following considerations:

- 1) One-directional light source on the transparent sections was directed toward a single centric point aligned with the horizon-line located on the picture plane;⁸
- 2) Each photograph was a monoprint⁹ and each color composition differed;
- 3) The subject matter was located as transparent two-dimensional shape abstractions;
- 4) The slides on the camera-platform represented the easel and canvas within my visual field (Diagram 3.1);
- 5) The picture plane was proportional to the object plane, approximately six feet from the end of the camera platform;
- 6) The Subtractive color palette was based on Goethe's color theories delineated by Albert H. Munsell's (1858–1918) "Hue-Strong-Chroma Circle" (Figures 29–30).¹⁰

Secondary variables were as follows:

- 1) the artist's creative instinct and judgment¹¹ for composition, including proportional distance between objects on the picture plane¹² (Plates V, XIX, and XX);
- 2) magnification of the halftone-dot patterns for textural qualities as "lightstrokes";¹³
- 3) translational movement of superpositioning and offsetting of the transparent sections¹⁴ (Plate XI; Diagram 5.2; Table 5.1; also Plates XXI and XIX);
- 4) translational movement mirroring of transparent sections (Plate X);
- 5) directional rotation of transparent sections from a selected point (Plate XIII).

A subjective placement hierarchy for the geometrical elements of perceptual painting (points, lines, and planes) provided a framework for transforming light into an infinite variation of shapes, sizes, colors, and textures. Perception determined the physical action that was recorded. The platform holding the subject matter collectively formed the perceptual colors of the

projected objects (Diagram 3.1). This hierarchy, simply put, helped to organize projected volumes in space. Da Vinci described this painterly procedure for seeking an ideal of a composition:

A good painter has two chief objects to paint, man and the intention of his soul. The former is easy, the latter hard because he has to represent it by the attitudes and movements of the limbs... The endeavor by the medium of the limbs to express the intention of the soul is the underlying motive of that constant search for naturalness in expression which [is] in the many drawings and preparatory studies for artistic commissions—some volatile as thought itself—attempts to fix the transient.¹⁵

The act of light-sketching was the positioning and directional movement of the slides on the platform that were oriented to the World Coordinate System (the “xyz” coordinates with the z and y-axes rotated ninety-degrees).¹⁶ The platform rested on the x-axis, level with the horizon-line. The x-axis formed the horizontal width of the platform, extending west (–) and east (+). The positive y-axis was vertical to the platform, perpendicular to the horizon-line. The z-axis (south to north) traveled the linear orthogonal distance of the platform’s length in a negative direction, south being nearest to the light source and north being toward the aperture. This axis represented depth perception (Diagram 4.1). The platform’s midway mark was the point of true focus within the depth of field. The direction on the z-axis represented foreground, midground, and background. The transparent sections were positioned vertically on the y-axis, separated along the z-axis by as little as one thirty-second of an inch and as much as fifteen and three-quarter inches, establishing orthogonal distance, i.e., the optical axis among the objects. These three axes, comprising the painter’s space, formed the working environment for the experiment—a junction of possible light-tracings (Plate II). The physical distance among light-tracings was represented as shade and shadow, expressed by the azimuth angle (i.e., the angular distance as gradients of texture-density or diminution).¹⁷

*Opposite page. Top: Figure 27.
View of the Light Transmitting
Through the Slide Sections of the
Modified Camera Obscura. 2/98.*

*Bottom: Figure 28.
Detail of 35mm Slide Layout
Showing the Separation of the
Sections. 2/98.*

The platform was loaded for the exposure of Plate XIV.



Fig. 29.



Fig. 30.

Top: Figure 29.

Albert H. Munsell's Hue-Strong-Chroma Circle, Early 20th Century.

Munsell's ten saturated hues are represented in the circle diagram.

Bottom: Figure 30.

Johann Wolfgang von Goethe's Diagram of the Power of the Soul, Late 18th Century.

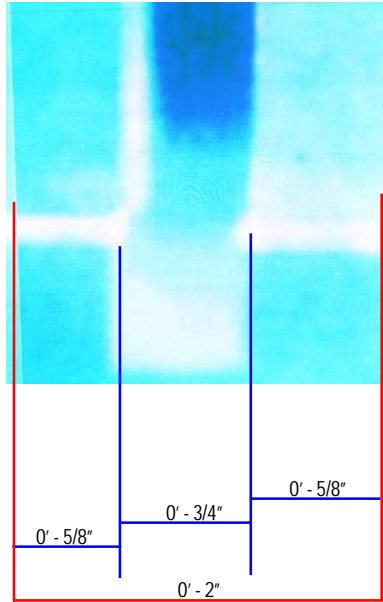
Goethe's original six-color circle.

Munsell's Hue-Strong-Chroma Circle of ten saturated transparent hues—five primary: (scarlet) red, (lemon) yellow, green, (sky) blue, violet-purple; and five secondary: yellow-red (orange), (apple) green-yellow, blue-green (turquoise [cyan]), purple-blue (indigo), and red-purple (orchid [magenta]), based on Goethe's color circle—(yellow, blue/yellow (green), blue, green/blue (cyan), yellow/blue/green (red), yellow/red (orange), blue/red (violet or purple), violet/red (magenta) or digital colors palette (CMYK).

The directional movement along the z-axis and the distance among the transparent sections represented the spatial relationships of the objects within the depth of field, the third dimension on the picture plane, i.e., lightstrokes.¹⁸ Superpositioning and offsetting of the transparent sections made possible the application of further perceptual techniques affecting the projected objects, including mirroring, rotation, repetition, proportion (near to far), scale (big to small), and saturation intensity of chromatic hues.¹⁹ These perceptual techniques provided the means for constructing the images-as-products. The light's action would merge color mixing, texture-density, and shade and shadow to produce the azimuth angle (i.e., visual density). By adjusting the slides, however minutely, a visual tension resulted among the light-tracings.²⁰ This visual tension provided the basis for the subsequent formulation of rotating parallelograms (Plate I). It was through this phenomenon that I hoped to construct volumetric forms.

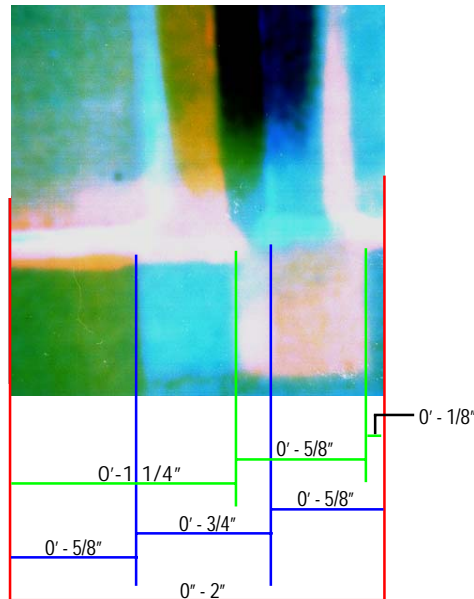
Until the photograph was taken, I could not distinguish the range of compound colors and saturated hues that resulted from time-lapse exposure²¹ (Plate X). The technique of painting with light merged physical movement with perceptual awareness—albeit with a variable of a time delay. What could be seen at that moment—and *be anticipated* in twenty-four hours when the exposure of the light had been recorded—would result in the images-as-products. Comparatively, an artist waits a day for the pigment to dry, making changes to color on a timely basis. The slide maneuverings and the delayed exposure times were factors that slowed down the creative process and influenced my understanding of the images.

The offset and superpositioning (in Diagram 5.2) specifically expressed the act of composition. The horizontal and vertical movements of the slides were a means to obtain shading; obstructing one shape with another cast a color shadow. Goethe described this process: “In all colored shadows, therefore, we must presuppose a color excited or suggested by the hue of the surface on which the shadow is thrown.”²² These techniques allowed for the relief of color resonance, without which the saturation level superseded the ability of the eye to distinguish hues.



Dia.5.1

Top: Diagram 5.1. *Single Rectangular Figures T7_ No. 1 Transparent Slide Sections*, 2/20/98. Kodak Color Pro 100T Film, Modified Camera Obscura (10 min. exposure time with .307mm aperture), 4 x 5 inches.



Dia. 5.2

Bottom: Diagram 5.2. *Two Rectangular Figures T6_ No. 1 Transparent Slide Sections, Equidistant Offset*, 2/20/98. Kodak Color Pro 100T Film, Modified Camera Obscura (10-min. and 20-sec. exposure time with .307mm aperture), 4 x 5 inches.

Locating the directional movement of offset through the mixed hues of pink, green, and orange versus the actual hues of light blue, dark red and yellow. The differentiation of the distances captured were shown here as the superpositioning of two slide sections expressed with mixed colors and are delineated with dimensional lines. The first slide section is delineated in blue and the second slide in green. The red dimension lines express the overall offset compositional distance.



Animation Button

For an animation of Table 5.1, see the *Rotating Views* animation on the CD-ROM in the back sleeve or left-click on the animation link button.

Table 5.1. *The Different Phases of Sketching Techniques*. Still- Frame Captures of *Rotating Views*, 5/98.

This study animation represented the compositional mechanical movement observed on the picture plane.

Table. 5.1

Description of Operation	Operational Animation
Single Shape	
Two Shapes, second shape applied using offset	
Second Shape, expressed in transparency	
Final Shape, the second shape placed into position	
Third Shape, applied as a solid color	
Third Shape, moved to an offset position	
Third Shape, expressed in transparency	
Final Movement, the third shape placed into position	
Final Image, expressing five shapes	
Dissection Study of color	
Dissection Study of offset	
Dissection Study of transparency	
Final Placement, of the images	

Table 5.1 shows the mechanical movements of rotation, offset, superpositioning, and color mixing. The animation and Table represent the simultaneous processes for the composition of the subject matter.

In normal three-dimensionality, color luminosity can determine the figure-ground of an object. Initially, I had assumed that the residues on the first slide would have greater luminosity because of their proximity to the light source. In fact, through a reversal of composition, the residues progressively weakened as they receded through a series of as many as eight slides before coming to rest, so to speak, on the picture plane. The residues were diffused and indistinguishable, distorted through magnification, and muted through a loss of intensity. Through this process, the residues had been transformed into background for the images-as-products. This effect was a reversal of the mental organizational process for subject matter in terms of foreground, midground, and background.²³

The visible perimeters of “white light” would typically represent white as a combination of all colors or pure colors (red, green, blue, and yellow, violet-purple or magenta, orange, and indigo), supported by Sir Isaac Newton’s (1643–1727) additive color theory (Figures 31 and 33).²⁴ “Compositional mixing” with projected light resulted in compound colors, i.e., “*indefinite variety of Intermediate gradations*” (blue: yellow/green, red: yellow/orange, orange: yellowish-green/yellow, etc.).²⁵ For Newton, “Indeed, rays, properly expressed, are not colored. There is nothing else in them but a certain power or disposition which so conditions them that they produce in us the sensation of this or that colour.”²⁶ Red was contained in the least bent rays with the greatest wavelengths; violet was contained in the most bent rays with the shortest wavelength. Together, these two colors rested, respectively, on opposite ends of the color spectrum.²⁷ Mixed colors were a multitude of both kinds of wavelengths that traveled from fast to slow.²⁸ This parameter limited my ability to record the full color range and required extended-time exposure for chromatic colors.

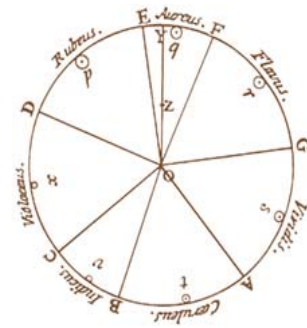


Fig. 31.

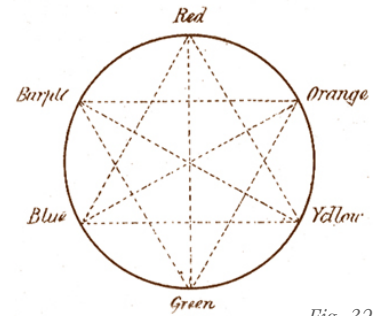


Fig. 32.

Top: Figure 31. Sir Isaac Newton, *Newton's Color Circle*, from *Optics*, 1704. Pen-and-Ink on Paper.

Newton’s color circle is a proportional example of perceived color species from the linear spectrum (See Figure 35). The center of gravity or “O” equates to white light. The perimeter circle is black or space and expresses hue value. The connection of the circle and the divisions indicate the color species (D, E, Y, F, G, A, B, C). The line division or “Z” represents a chromatic angle (horizontal azimuth or color pitch) with the darkest saturation of hue at the letters (p, r, s, t, v, x). These were the location of color fringes. For example, “p” was the darkest (value) and most saturated (chroma) of red (hue).

Bottom: Figure 32. Johann Wolfgang von Goethe, *Goethe's Color Circle*: from *Goethe's Theory of Colors*, c. 1840. Continued on following page.

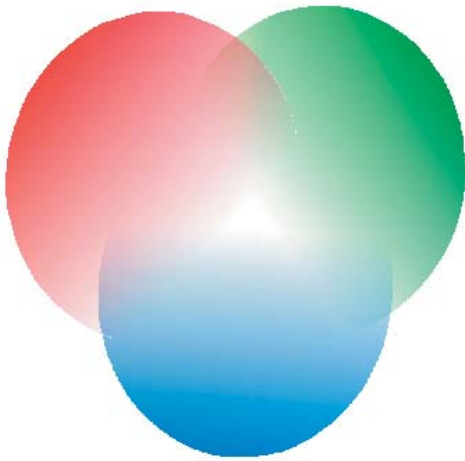


Fig. 33.

Preceding page continued.

Bottom: Figure 32. Goethe's color circle indicated the associative combination of two hues out of six (red, orange, yellow, green, blue, purple or "purpur" as violet-red). Mixed colors produced a third color through perception.

Left: Figure 33. *A Graphic Representation of Sir Isaac Newton's Additive-Physical-Light-Color-Spectrum Theory.*

This graphic depicts three primary hues of red, green, and blue (RGB) and three projected light mixtures of secondary hues of yellow, magenta, and cyan.

Right: Figure 34. *A Graphic Representation of Johann Wolfgang von Goethe's Subtractive Color Theory.* Computer Graphic.

This graphic depiction showed three primary hues of cyan, magenta, and yellow, with black the center (CMYK), and three media mixed hues of orange, green, and blue.

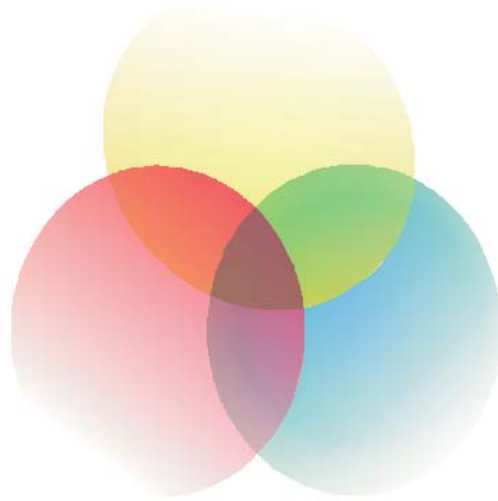


Fig. 34.

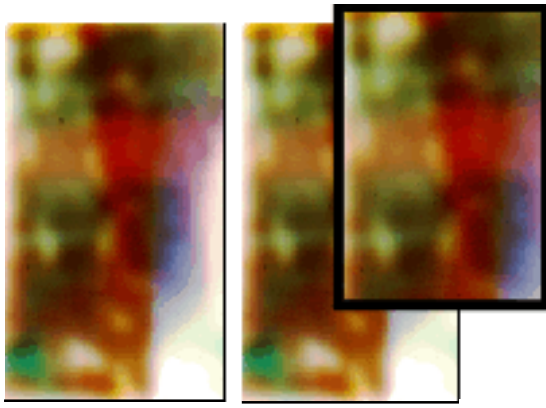
Goethe's subtractive mixing process afforded a greater range of compound colors (Figures 32 and 34).²⁹ For example, red is a combination of yellow, green, and blue. In addition, he found more interest in exploring the realm of chromatic mixed-colors such as yellow-blue and violet-red.³⁰ Goethe considered magenta to be a primary color, calling it "pure red," or "purpur," and distinguishing it from spectral red.³¹

Seeking to use compound hues for painting the azimuth (that, in turn, would become volumetric parallelograms), I applied pigments onto the slides, much in the same way as Goethe combined hues to create a secondary palette. The compound colors were, in fact, formed through the projected light within the camera as color chiaroscuro. This project had begun with Cézanne's use of a mixed color palette to produce color resonance (Plate XVIII).³²

There are no lines, there is no modeling, there are only contrasts. These contrasts are produced not by black and white but color sensations. Modeling results from precise relations between tones. When they are juxtaposed harmoniously and are all present, the picture, by itself, takes on modeling.³³

The achievement of volumes was an examination of the external-to-internal expression, locating geometric forms. Professor Francis D. K. Ching described this hue modeling in terms of architecture: "[In the] third dimensional element of architec-

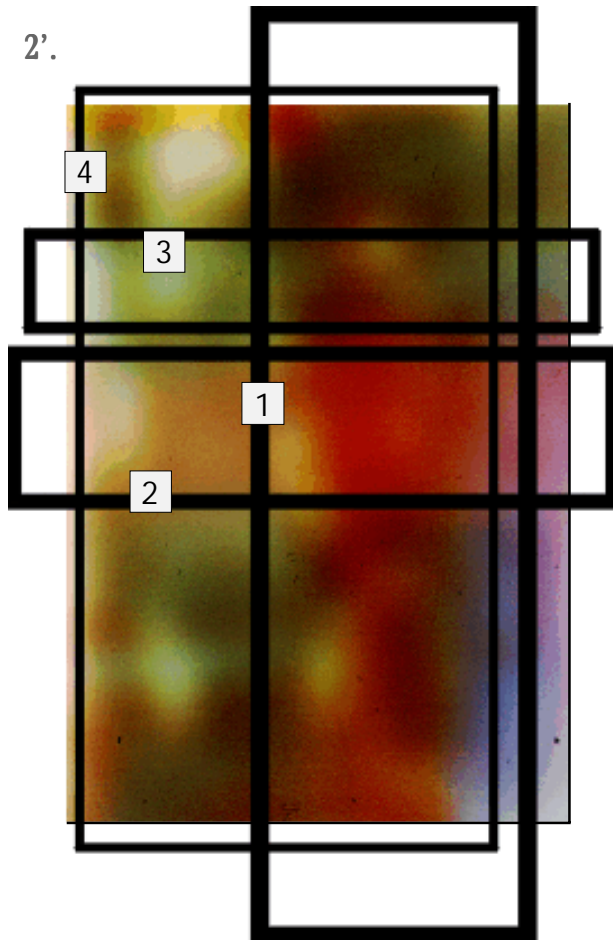
1.



2.



2'.



Dia.5.3.1-2'.

ture ...a volume can be either solid (space displaced by mass) or a void (space enclosed by planar forms).”³⁴ The spaces being created with light projection produced a sensation of contrasting color tones that allowed me to interpret my painting as transparent-to-opaque forms, or modeling. Transforming the residues of the shaped abstractions into planes generated chromatic relationships, an important step in the development of visual massing.

Initially, Diagrams 5.3.1–2’ showed the combination of the additive and subtractive processes forming visual massings produced by compound hues. Diagram 5.3.1 visually simulates formations of horizontal and vertical “woven” bands that were transformed into rounded areas or massings. Diagram 5.3.2’ indicates the linear bands as color zones 1–4, which signify the visual impact of the bands processing through the weaving motion and forming color massings. The color zones were produced by “mixing” or applying colors to the motile light; e.g., No. 1 yellow/blue/green (red), No. 2 yellow-red (orange), No. 3 blue-yellow (green), and No. 4 dark yellow (yellow). The hues being combined by the light (i.e., yellow, blue and green) produced mixed red, orange, and green. The additive motility varied the luminosity as the beam passed through the slides, resulting in a weaving effect. The subtractive mixing merged the hues, as evidenced by color fringes appearing at the edges of the shapes; these shapes vibrated with transitional movement. The contrast between the bright and dull hues caused a rounded convex form. In this study no center-focus or clear shapes were found, but rather a resonance of hues, chromatic color-fringe patterning, and massing.³⁵ In an additional example (Plate V), the white vertical band on the right side appears rounded or convex. The massings were formed as a result of lengthening the exposure time and adjusting the aperture where the hues converged.

As noted earlier, Da Vinci described the act of painting as the rationalization of the visual world and the interpretation of the perception of objects. In a further developed example (Plate XVII), increased magnification of the fringes enlarged the massing. This development gave the objects the appearance of resonating off the picture plane, projecting the painted subject into

Preceding page: Diagram 5.3. 1–2’, *A Detailed View of an Early Test Study*, 07/98. Original Photograph: *Rectangular Figures T3_No. 4, Transparent Slide Sections*, 12/1/97. Kodak Color Pro 100T Film, Modified Camera Obscura (35-sec. exposure time with .307-mm aperture).

Top Left: 1.

The original photograph selection after image cropping.

Middle Right: 2.

The rectangular lines emphasized the location of the horizontally and vertically contrasting bands of hue sensations.

Bottom: 2’.

In this diagram, No. 1–4 were graphically represented the locations of the contrasting bands. The visually spontaneous categories or visual hierarchy in response to sensation of the color dimensioning; e.g., the hues visually moved forward or backward due to chromatic changes.

Plate Numbers	Sketching Variables Dimensional Drawing Techniques Prior to Image Capture	Perceived Perceptual Expected Anticipated Unforeseen	Subject					Object					Action								
			Light	Color	Scale	Chiaroscuro	Gradients	Background	Shape	Brightness	Proportion	Texture	Contrast	Density	Chroma/Hue	Mirror	Offset	Rotate	Superposition		
			01	Rectangular Figures		•	•	•													•
			02	Rectangular Figures		•	•	•													•
			03	Planar Figures			•														•
04	Rectangular Figures				•	•	•	•										•			
05	Planar Figures		•			•					•	•						•			
06	Rectangular Figures		•	•	•													•			
07	Rectangular Figures		•			•	•	•										•			
08	Rectangular Figures		•	•		•	•	•										•			
09	Rectangular Figures		•	•	•	•	•	•										•			
10	Planar Figures			•	•													•			
11	Planar Figures		•	•	•		•											•			
12	Planar Figures		•	•														•			
13	Planar Figures			•														•			
14	Rectangular Figures		•		•	•												•			
15	Planar Figures		•	•	•	•	•											•			
16	Rectangular Figures		•		•	•	•											•			
17	Rectangular Figures		•	•		•	•	•										•			
18	Rectangular Figures		•	•		•	•	•										•			
19	Planar Figures		•			•	•											•			
20	Planar Figures				•	•	•											•			
21	Rectangular Figures		•	•		•	•	•										•			
22	Planar Figures			•	•		•											•			
23	Planar Figures		•		•	•												•			
24	Planar Figures		•			•												•			
25	Planar Figures			•	•		•											•			

Table 5.2

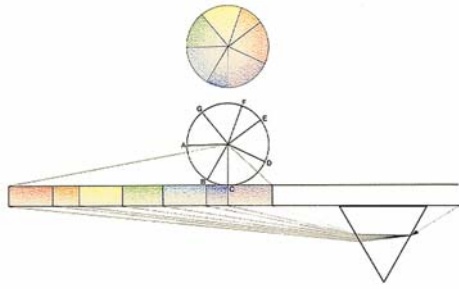


Fig. 35.

Preceding page: Table 5.2. *Sketching Variables.* Computer Graphic.

The techniques used to paint the objects and express the form's characteristics. The artist's actions were comparable to observing the action on the picture plane.

This page: Figure 35. *Sir Isaac Newton's Color Spectrum Illustration.* Original:

Experimentum Crucis, Very Early 18th Century.

This artist's rendition of Newton's "experimentum crucis" (critical experiment) represents one of several versions of his experiments that proved light was composed of all colors of the spectrum.

the visual world as a volumetric perception. Later, I would realize that still-framed, stereographic-projected images had been achieved through graphic patterning (lateral displacement among objects), a visual parallax. Multiple perspective cues would further be used to confirm the presence of transparent-to-translucent, volumetric forms.

Recognizing the need to add constructive reasoning, I established a compositional hierarchy for visual order which was in-line with Da Vinci's placement reasoning. That is, I used visual perception to distinguish the effects of context and background on objects on a picture plane. Da Vinci's guidelines enabled me to compare size, brightness, shadow, color, and relief³⁶ (Plates XI and XV). Goethe's color theory added to this experience:

...[Through] light, shade, and color, we construct the visible world [painter's space], and thus, at the same time, make[ing] painting possible, an art which has the power of producing on a flat surface a much more perfect, visible world than the actual one can be.³⁷

While operating the camera I observed that the projection of mixed colors was somewhat dimmer and less prominent after the placement was completed. This observation adhered to Goethe's theory that dull, muted colors were grays³⁸ that in turn created a chromatic hue distinction. For example, in Table 5.1, the final still-frame represents the complexities of the non-denoted, muted colors before exposure. At the same time, each hue represents itself according to Newton's view: "The species [hue] of color, and degree of Refrangibility proper to any particular sort of Rays, is not mutable by Refraction, nor by reflection from natural bodies, nor by any other cause..."³⁹ (Figure 35). Thus, the mixed color rays could not be altered after they passed through the condenser lens. Color rays remained true to the color being carried and nothing could change the color once light had been transmitted through the colored, sectional slides. Therefore, given sufficient exposure of centric rays, the recorded image could be assessed as saturated chromatic hues. In order to compensate for the amount of light and to paint the image,

I opened the aperture to its largest size (one thirty-second of an inch), permitting more light to strike the picture plane. It was then reduced to one sixty-fourth of an inch to make the color chiaroscuro more pronounced during exposure, therefore, revealing gradient angles of the chromatic line-tracings.

To visually track the position of the perceived objects, I followed their associative hues as they formed an azimuth angle (Plate I). Using the picture plane to place the geometries into an overall composition, the chromatic bodies were directionally positioned as planar forms until volumes were observed. Painting was the act of visually circumscribing with transitional hues and gradient-textures to create edges of planar forms. Initial composition of the subject matter allowed for the observation of only overlapping and compounded planar constructions. Once the photographs were produced as images-as-products, shade, shadow, and density were more readily identifiable, first as volumes and then as objects (Table 5.2). The following chapter will seek to analyze photographs with four means—*Order*, *Arrangement*, *Eurythmy*, and *Symmetry*—to rationalize conceptual volumes.

Endnote. Chapter Five.

1. Alberti's states "... let me simply repeat what has been said..." He appears to be implying that Protagoras (c. 490–420 B.C.) was the initial person to say this; he is just reiterating it in his two books. Alberti, op. cit., *Building*, p. 157, and op. cit., *Painting*, p. 9.

2. The act of sketching with the medium of projected light. In this text the use of "sketching" and "painting" are synonymously used.

3. Alberti defines the process of dividing for area as compartition: see Alberti, op. cit., *Building*, p. 8.

4. Matthaei, ed., Goethe, op. cit., p. 193, item no. 13.

5. Arnheim, loc. cit., (chap. 3, n. 7).

6. F. Cachin, et al., op. cit., p. 37, item no. 9.

7. As clearly defined by W. Wong, *Principles of Three-Dimensional Design* (New York: Van Nostrand Reinhold Co., 1977), p. 15.

8. Hall, ed., Gibson, op. cit., p. 180, J. J. Gibson's items no. 2–3.

9. Refer to the definition of Monoprinting within this text: (chap. 6, n. 24).

10. The actual colors of the transparent slide film sections that were loaded into the camera were based on Munsell's Student Charts (Hues 5.0/value/chroma). I. *Rectangular Shapes* primary hues: red 4/14, yellow 8/8, 8/12, blue 6/8, violet-purple 2/2, 3/8, and secondary hues: yellow-red 6/12, purple-blue (indigo) 2/4, 4/10, red-purple (magenta) 5/5. II. *Planar Figures No. 1* primary hues: green 4/4, blue 4/6, and secondary hues: green-yellow 7/8, purple-blue (indigo) 2/4, red-purple (magenta) 2/4, 5/12. III. *Planar Figures No. 2* primary hues: red 3/4, 4/12, yellow 8/12, blue 4/6, 5/8, violet-purple 3/8, and secondary hues: green-yellow 8/10, (cyan) blue-green 4/6. IV. *Planar Figures No. 2 Eased Edges* primary hues: yellow 8/10, green 4/4, violet-purple 5/6, and secondary hues: red-purple (magenta) 6/6. Munsell, loc. cit., (chap. 3, n. 22). Note: All colors listed above are not of equal amounts printed on the slide film. The amount of the color residue of any given chromatic hue was based on the abstraction process of the original image as discussed within this text in Chap. 3. Goethe, op. cit., (London, 1967), p. xlii, for a discussion on magenta. Goethe is the first to define transparent hues. Matthaei, ed., Goethe, op. cit., *Part VI: Sensual and Moral Effect of Color*, p. 193, item no. 13. The reconstruction of (Goethe's) color circle in 1932 addenda, p. 51 Ill. 49.

11. I use the terms "artist's instinct" and "artistic judgment" in line with E. H. Gombrich's usage of the terms, Gombrich, op. cit., p. 251; and Da Vinci: The Five Senses: "The ancient speculators have concluded that the faculty of judgment which is given to man is quickened by an instrument with which the five senses are connected by means of the organ of perception (imprensiva); and to this instrument they have given the name 'sensus communis.' And this name is used simply because it is the common judge of the other five senses, seeing, hearing, touching, taste, and smell." [The senses of sight or the] "... eye takes cognizance of ten different qualities of objects; namely: light and darkness—the first serves to reveal the other nine—the other serves to conceal them—color and substance, form and position, distance and nearness, and movement and rest." "How the five senses are the ministers of the soul: The soul resides in the set of judgments and judgment apparently resides in the place called 'sensus communis' [the center of human common sense or the cerebral section of the brain] where all senses meet ..." I. A. Richler, ed., L. Da Vinci, loc.cit., (chap. 2, n. 4). Also relative to perspective and common sense, see K. H. Veltman *Studies on Leonardo da Vinci, Vol. I. Linear Perspective and Visual Dimensions of Science and Art* (München: Deutscher Kunstverlag, 1986), pp. 30–31.

12. For more information on size and aerial perspective, see Hall, ed., Gibson, op. cit., pp. 180–181, J. J. Gibson's items no. 2 and 6.

13. "The perspective of texture, as distinguished from the perspective of rectilinear outlines, seems to be a fundamental basis for the impression of a dimensional environment, or what has been called space." Veltman, loc.cit., (chap. 3, n. 6). A discussion of

textural perspective, see Hall, ed., Gibson, op. cit., p. 180, J. J. Gibson's item no. 1. For *lightstrokes* within this text: (see chap. 3, n. 2).

14. Veltman, loc. cit., (chap. 2, n. 7). Gibson, Olum, and Rosenblatt (1955) identified four cues. Also see Hall, ed., Gibson, op. cit., p. 182, Item no. 12.

15. McCurdy, loc. cit., (see chap. 1, n. 5).

16. A general definition for the *World Coordinate System* is an image file that defines the relationship between pixel coordinates in the image and sky coordinates. Individual objects are each defined in their own local coordinate systems. Objects are assembled and positioned in a scene. It is the coordinate system of the scene that is the world coordinate system. Light sources and the viewer or camera's eye are positioned in this system, and animation moves the objects within it.

17. I define *shade* as an area out of the direct beam of light, i.e., an area of relative darkness where direct light is blocked or obscured. Shade is seen through a difference in hue, or chromatic value, with the values getting darker. *Shadow* can be defined as a darkened shape or surface that falls behind something blocking the light. It is relative darkness in a place which is being screened or blocked off from the direct beam of light. Shadow is a pure method of deleting color, saturation, and brightness, dulling through diminution into whiteness.

18. Wong, op. cit., *Three-Dimensional*, p. 17.

19. For a similar spatial awareness through sketching and visual perspective, please see *Summary of James J. Gibson's Thirteen Varieties of Perspective as Abstracted from the Perception of the Visual World* in Halls, ed., Gibson, op. cit., pp. 179–182.

20. “. . . dynamics of visual objects is due to kinesthetic sensations in the body of the observer.” Arnheim, op. cit., *Art and Visual: Tension IX*, p. 400.

21. Light ray color mixing: “Yet seeming transmutations of colours be made, where there is any mixture of divers sorts of Rays. For in such mixtures, the component colours appear not, by their mutual allaying each other, constitutes a midling colour. And therefore, if by refraction, or any other of the aforesaid causes, the difform Rays latent in such a mixture, be separated, there shall emerge colours different from the colours of the composition.” Newton, loc. cit., (see chap. 4, n. 5).

22. Matthaai, ed., Goethe, op. cit., *The Nature of Prismatic Colors*, p. 87 item no. 67.

23. D. T. Shape, *The Psychology of Color and Design* (Totowa, N.J.: Littlefield, Adams and Co., 1981), Chapter 6, Gestalt and color, pp. 101–103. For a painterly description of placement, see McCurdy, op. cit., *Mind*, pp. 287–288.

24. Newton, op. cit., *New Theory*, Doctrine item no. 5, p. 3082.

25. *ibid.*, item numbers 5 and 6, pp. 3083–3083.

26. D. B. Judd, Introduction, *Theory of Colours Johann Wolfgang von Goethe Translated from German* (Cambridge, MA.: The M.I.T. Press. Thirteenth reprint, 2000), p. vii, referenced Sir I. Newton, *Opticks*.

27. Newton, op. cit., *New Theory*, Doctrine item no. 2 and no. 3., pp. 3081–3082.

28. Matthaai, ed., Goethe, op. cit., *The Nature of Prismatic Colors*, p. 47, item. no. 2.

29. Generally speaking, the subtractive color theory is based on the principle that the secondary colors of light can selectively subtract the components of white light to produce other colors and when all three components are subtracted the result is black. *ibid.* Therefore, “For Goethe, light could neither be stopped nor isolated . . . relation of light and color always depends upon a tension, a resistance . . . but the action becomes visible only when light is pitted against darkness, when its energy works upon matter. Visibility, of course, requires the beholding eye, but the eye itself is matter. The morphological idea prompted Goethe to consider the eye as a simple organic sensitivity to light which gradually developed in some animals into more refined capacities of physiological response.” F. Burwick, *The Damnation of Newton: Goethe's Color Theory and Romantic Perception* (Berlin; New York: Walter de Gruyter, 1986), pp. 14–15.

30. Burwick, op. cit., *Damnation of Newton., Law of Gradation*, p. 19.

31. Matthaai, ed., Goethe, op. cit., *VI. Sensual and Moral Effects of Color, Red*, pp. 172–173.

32. For a discussion of the emotional response to visual images, see Sharpe, op. cit., p. 123.

33. F. Cachin et al., op. cit., p. 37, item no. 7.
34. Ching, op. cit., pp. 100–101.
35. For a discussion of aerial perspective relative to Impressionist painters, see Hall, op. cit., p. 82, and please see *Summary of James J. Gibson's Thirteen Varieties of Perspective as Abstracted from the Perception of the Visual World* in, *ibid.*, Gibson, p. 182, item no. 13.
36. Veltman, loc. cit., (see chap. 3, n. 10).
37. Goethe, (London, 1967), pp. xxxviii–xxxix.
38. *ibid.*, XLIV. *Intermixture, Real*, pp. 144–145.
39. Newton, op. cit., *New Theory*, Doctrine item no. 3., pp. 3081–3082.

Finding my own language of expression came through a palette of distinct visual characteristics, transforming the traditional language of sketching and painting into a language of abstraction based on light and color. The transition from a mental impression to an actual image required the clear expression of conceptual ideas. It was, for my purposes, a language of pre-architectural form. The organizational pyramid described in Chapter two became the foundation for making the necessary visual distinctions for the images-as-products. In this phase of the project, the perceived visual dimension and the physical aspects of perceptual sketching were no longer separate; they were combined as the products—analyzable image-abstractions. The organizational pyramid was to provide the criteria for determining the existence of *form*. Not every image was a compositional whole. The camera, as a light-sketching tool, had revealed perspective cues in the images-as-products. The tool's construction had produced a resolution parallax, which resulted in a means for the creation of forms. Significantly, the visual parallax accentuated a concaved or convexed pulling-sensation when the majority of the perspective cues were present.

My exploration of visual sensations by means of depth perception was guided by a selection of architectural fundamentals. This means, as presented by Vitruvius for conceptualizing the pre-architectural form, was through *Order, Arrangement, Eurythmy, and Symmetry*.³ These fundamentals are described as:

- 1) *Order*—The translation of points, lines, and planes into the dynamics of linear and planar volumes was achieved through the *sequential patterning of color* based on three attributes: a) Color Species: hue relative to primary and secondary colors and mixed chroma; b) Projecting and Massings: hue at a particular value or height relative to brightness, to establish rounding as massing; and c) Azimuth Angle: chroma—saturation, as in the hue scale gradient-textures of a vertical elevation and horizontal color-pitch as directional depth.⁴
- 2) *Arrangement*—Located within the composition as a whole, the subject matter within the figure-ground was

*Abstraction must be complemented with definition, which is the determination of a concept by deriving it deductively from the higher genius and pinpointing it through its distinguishing attributes (differentia).*¹

Rudolf Arnheim

*Design...not to explain the...hypotheses, but to propose and prove them by reason and experiments.*²

Sir Isaac Newton

relative to foreground, midground, and background. Planar shapes, volumes, objects, and forms, relative to the horizon line, represented the visual world.⁵ The depth of field was extruded along the linear orthogonal distance with vantage points, transforming all vertical and horizontal planes into parallelograms.

- 3) *Eurythmy*—The circumscription of an outer transparent surface exposed the connections among volumes, planes, and lines by positioning, direction, and space as represented through a visual-weight of chiaroscuro (shadow). Partial volume superpositioning resulted in shading. I achieved the progression of external transparency to internal translucency to opacity through a proportional interrelationship of form-harmonies.
- 4) *Symmetry*—The establishment of visual equilibrium, an inherent static sensation of totality, and the dynamic of composition were situated in the figure-ground in space relative to the totality of the environment,⁶ seen in a) optics, b) geometry, and c) perspective.

A “conventional” sketch of a three-dimensional object would include the process of perceiving the object, then physically translating it through expressive eye-hand coordination of a medium. Having “worked through” the initial markings, the artist would step-back and reflect upon the initial results. Utilization of the artist’s ability to envision the object in the totality of a three-dimensional environment would require the conceptualization of light and atmosphere on the object.⁷ An environmentally inclusive illustration could then be translated into an architectural study.

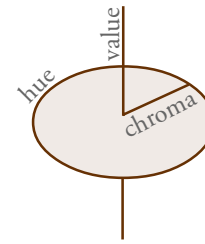
In contrast, the images-as-products were developed in tandem with the mind’s eye and eye-hand coordination. This translation was based on four groupings of perspective cues that placed the objects in binocular dynamics and atmospheric diminution. Merging these perspectives enabled my *sensus communis* to conceive the images-as-products:⁸ 1) the perspectives of texture, size, and line receding along the orthogonal distance with a loss of magnitude, 2) the perspectives of blur, diminution (disappearance of outline), and atmosphere—figure-ground

diminution, 3) the perspective of color (receding diminishment of hue saturation over a distance by shade or shadow), and 4) the perspective of parallax—binocular disparity, each eye perceiving a slightly different image.⁹ By viewing different perspectives, which were represented through the camera's sketching, I determined the optical, geometric, and perspectival impressions of the images-as-products.¹⁰ These investigations brought an understanding of the captured textures, light, and colors of the portrayed volumes as perceived abstractions. These were objects to be translated into the architectural language of orthogonal sketching, i.e., plan, isometric sketching, and isometric massing.

1) **Order in Search of Color Patterning.** In searching for color patterning I blended the theories of empiricism and rationalism. Based on a rationale of color perception, the process of perceiving the brilliancy of light was combined with the empirical determination of the dynamics of hue, value, and chroma—the dimensions of color. Accordingly, the dimensional placement of physical attributes, i.e., height, width, and depth, defined a solid object, and visual characteristics denoted the subtleties of form. In the compositional stage of loading the subject matter onto the camera's platform, I applied the additive color theory to projected light. On the other hand, in the analytical stage, I applied the classification of the species¹¹ of colors and how they interacted, using both additive and subtractive color techniques in the translation process. The language of color-design interpreted the depth of volumes.

Order. a) Color Species. The translation process facilitated the evaluation of the more overt color volumes and how they achieved such clarity (Plates I, III, and VI). The projections created a differentiation of linear and planar line-tracings. The vector of light-lines (color fringes) diminished in stages as expressed by receding hues and textures within atmospheric perspectives (Figure 38). By light-lines I mean the denotations of hue gradients and texture-densities that translate an object into form. The light-lines were expressed by the perspectives of light, color, and texture.¹²

Determining the color species was an effective way to dimensionally objectify the recorded colors. I used Newton's visible ad-



Dia. 6.1

Diagram 6.1.

A Schematic Diagram of the Three Axes of Albert Henry Munsell's *Color System Variables of Hue, Chroma, and Value*, c.1909.

Height represented by value, weight represented my hue, and depth of a color represented by chroma.

ditive spectrum¹³ to recognize the differences between simple (red, yellow, green, blue, and violet) and compound (orange and indigo) species. Plate I—Image A is a result of offsetting and superpositioning of three color slides that produced a perceived brilliancy of colors for the exploration of dimensionality:

... brightness is a major factor in the determination of advancing or receding colors. A very bright color is advancing; a dull warm color is receding. Saturation is important for the same reason... whether a color is advancing or receding depends on hue, brightness [value], and saturation [chroma].¹⁴

Image B is an inversion of Image A, or the color complement. An example of mixing colors (subtractive) is the additive color process.

See Image C as a single color slide exposed in

the camera, expressing the following colors: blue and violet-purple (Munsell 5/6/8 and 5/3/8).¹⁵ Image D shows slight color mixing by adding an additional slide with one color, i.e., dark-purple (Munsell 5/2/2).¹⁶ The final image (Image A) added a red slide, producing saturation and brilliancy of mixed hues, which became a visual trajectory of the forward and backward resonance of color. The resulting colors were the physical additive light that was altered by adding hues subtractively. This movement provided one form of dimensionality that was sought through the experiment (Diagram 6.1). Further study was required to determine the dimensionality of the simple and compound colors, in particular, those that were making the visual trajectory from bright-to-dark transitions.

Order. b) Projection and Massing. Another point of interest was within the color transitions and demarcations of the simple and compound colors, which started to create a fringe-like effect, a form in transition. The visual resonance was caused by the saturated hues moving from brightness to darkness, as a “relief.”¹⁷ This effect marked a differentiation of connecting planes, one clear indication of the existence of volumes (Figure 36).

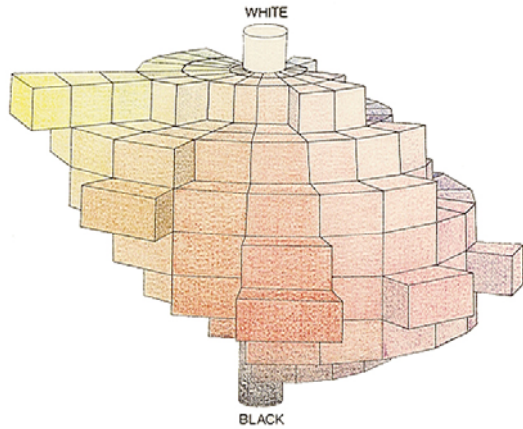


Fig. 36.

Figure 36. *Albert Henry Munsell's Color Tree*, 1915.

This illustration models the visual dynamics between hue brightness and chroma, what Munsell called “Order of Colors.” A visual dynamic order is represented in this illustration. The hues seen from left to right are yellow, orange, red, magenta, violet, blue, and green. The core top (white) is in contrast to the opposite end is (black). All the colors represented constitute his *Color System*, 1929.

The forms seen as recorded optical space, or painter's space, in the images-as-products represented a convergence of simple and compound colors. The perspective of hues was based on brightness (dull to sharp) and chromatic saturation (shallow to strong), enabling the object to move in any direction and have visual dimension.¹⁸ This movement was determined by the hue-to-form massing, the visual projection of the solidification of new forms.¹⁹ This massing necessitated a reliance on a species-recognition for determining the dynamics of the object's attributes (Diagram 6.1 and Figure 36). The direct positive studies clearly showed a vibration among species of hues (Plates I and VI). Both plates were similar in composition, but differed in the complexity of the hues (because of translation). Goethe's subtractive color process and Munsell's hue-strong-chroma circle would serve to differentiate the dimension of color.

The visual touching followed the directional movements of the perceived color dimensions: hue attributes (considered the starting point of chromatic saturation), purity (associated with visual strength of depth and brightness), and the value-direction of height or length following along a chromatic coordinate of polar opposites. For example, the dark saturated hues were visually weighted in the context of mixed colors, and yet, the dynamics of the color-dimensions caused the dark hues to recede. The cool bright hues, on the other hand, moved forward to the peripheral edges of the form. For example, the most intense orange was on the positive end of the polar scale, while the least-saturated orange, a dull-brown color, was on the other end of the chromatic polar scale. Therefore, objects' overall attributes relied on varieties of hue, value, and chroma for size and opaqueness, as well as on circumscription and directionality (Plate III). By studying the objects' values and chromatic hues, it was possible to make visual connections for the width and height of the rectangular and planar forms—elements of architectural language, another important development in distinguishing volumetric forms.

To interpret Plate VI, I identified the descriptive movement of the sketched rectilinear forms and planar figures in terms of the organizational pyramid (Diagram 2.1 and Figure 37). The

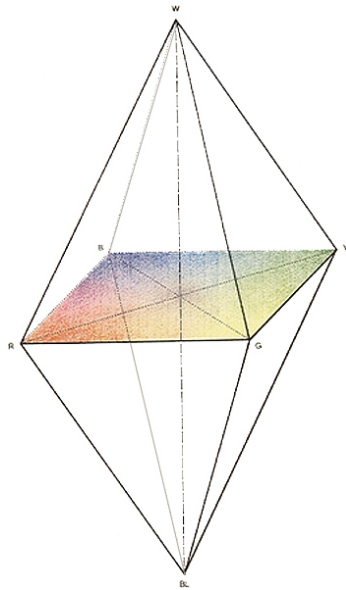


Fig. 37.

Figure 37. *Leon Battista Alberti's Visual Mixing System Based on His Visual Pyramid*, c. 1435.

The center colors fade to transparency. The saturated hues are located at the edges of the outer perimeters. The four “actual colors” of blue, green, red, and yellow are the most saturated hues with the greatest brightness located at the four corners of the base of the pyramids. The square base has been compared in use to the Newton’s color circle, so two colors equally mixed will create a third chromatic color. The vertically mirrored pyramids indicate the value dimension of the colors. The tops of both pyramids are either opaque white or black.

dynamics were contained in the connections among planes of the geometries, which encompassed, like a “skin,” the outer surfaces of transparent-to-translucent volumes. I determined that, if height, width, and depth were identifiable, then parallelograms would be evident (Diagram 6.1 and Figure 38). Through the combined perspectives of texture, color, and atmosphere enhancing the objects’ characteristics, geometric shapes would be recognized as forms.

In Plate VI, for example, the central planar walls produced a flanked corridor of increasing darkness. The vertical planes were rhythmically partitioned with different color species, and the transition between each species resulted in a concavity among the planar forms (from bright orange, light blue, blue, purple-blue, to violet, purple red and deep red, then to dark violet and dense violet-indigo). This value transition concurred with Alberti’s description of a planar surface:

I observed that plane surfaces keep a uniform colour over their whole extent, while the colours of spherical and concave surfaces vary, and here it is lighter, there darker, and elsewhere a kind of in-between colour... But if, as I explained, the painter has drawn the outlines of the surfaces correctly and determined the borders of the illuminated portions, the method of colouring will then be [visually] easy. ... The part receiving more light tinged with a more distinct colour, but the color also dissolves progressively like smoke into the areas next to each other.²⁰

This was a form of color chiaroscuro that resulted in the visual movement of solid colors and a means for understanding the rendering of light and color (Figures 36 and 37). The colors directed the eye to forms, whether horizontal, vertical, or rotational on the axis, moving and transforming themselves within the composition.

Order. c) Azimuth Angle. *Planar Figure No. 1* in Plate XIII—Image A exhibited multiple, strong, chromatic hues. The secondary chromatic colors²¹ were highly saturated: indigo or purple-blue (Munsell 5/2/4), green-yellow (Munsell 5/7/8), and

red-purple, (Munsell 5/5/12).²² All three species of purple-blue, light-green, and red-purple were at the highest saturation of chroma levels. To find the nuances within the dense hues, I digitized the image (Image A) to clarify from the studies the demarcation of circumscription to shape. The studies included: grayscale (Image B), inverted colors (Image C), and subtraction of red-Image D and blue-Image E. The inverted study clearly showed linear distinctions of complementary, continuous hues defining the circumscription of the shapes (Figure 38). This contrasting delineation was the region that had the ability to transform into a mass. Plate XIII had an extremely large quantity of obtuse and acute angles from rotational differentiation. The resulting forms were too complex for an orthographic study of an initial evaluation of shapes. This visual complexity concurred with Alberti's statement:

The outline will be said to be altered if the angles or lines in it become, not simply more numerous, but in some way either more obtuse or longer or more acute or shorter. [He further describes these obscure angles relative to the visual angle of sight]... the more acute the angle within the eye, the less will appear the quality [subject]. From this it can be clearly understood why it is that at a great distance a quality [subject] seems to be reduced to a point.²³

For purposes of finding the azimuths, I analyzed a singular translation, offset (one-fourth-inch separation) along the horizontal x-axis (*Planar Figure No. 1*, Plate XII). Superpositioning of sections, with a gradual one-half inch depth shifting along the z-axis, helped to set-apart the colors and their projections into space. Analyzing the chroma and value-projected levels of the hues served to translate them into the conventional means of orthogonal sketching, a way to convert the renderings into finite architectural volumes (Figures 38 and 39).

The accompanying diagrams describe the process for sketching the azimuths. (See the area outlined in Diagram 6.2.1.) As this quadrant was darker, it had the possibility of containing

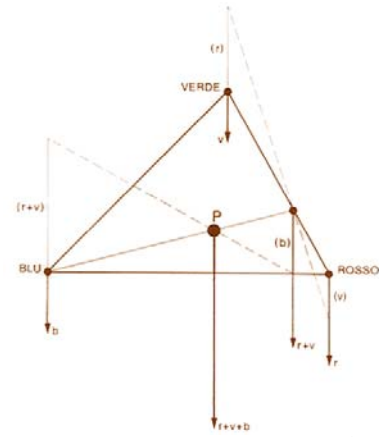


Fig. 38.

Figure 38. *Sir Isaac Newton's Triangle of Forces*, c. 1704.

This illustration indicates the three corners of simple colors (red, blue, and green) or *The Triangle of Forces Law*. (This law states when two vectors form the side of a triangle, that when placed nose-to-tail, the third side of the triangle represents the result of the two.) In mixing the primary colors a third force with a direction is created.

The color forces in this illustration correlate with Newton's *Color Circle* (Figure 31), by expanding on the visual direction of color forces. The horizontal azimuth or color pitch "Z" seen in the Color Circle, was the dashed diagonal line representing the third side of the triangle, the chromatic color pitch, e.g., "r" trailing towards "v."

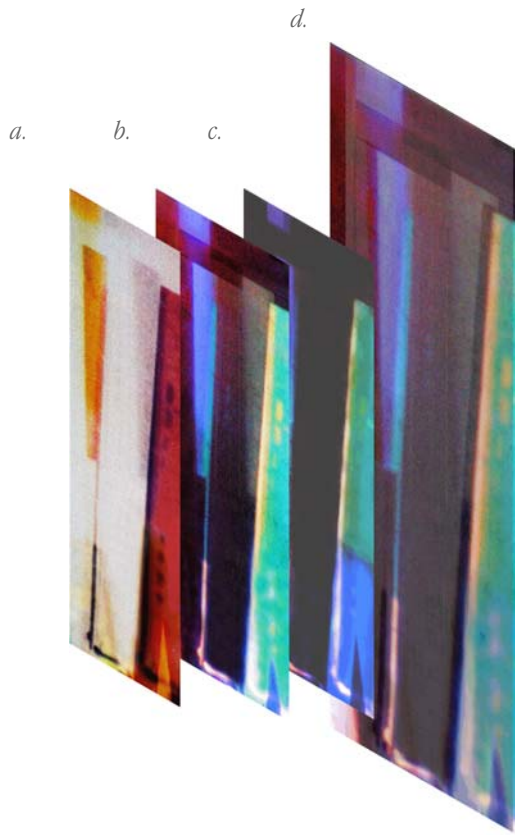
A vector is a line the length of which is proportional to the magnitude of the vector quality. The vectors are the lines with the arrows in the illustration of Newton's forces.

Continued on the following page.

1.



2.



Preceding page continued:

Figure 38.

The vector in this current experiment are referred to as “light-lines.” The parallelograms that are expressed in the images-as-products follow Newton’s alternative to the *Triangle of Forces Law*. When locating the vectors that join tail-to-tail, a parallelogram is formed by drawing two visual parallel lines of chromatic hues to the two recognizable vectors.

Diagram 6.2.1 to 2 (a.-d.) Plate XII, *Planar Figures No. 1*, 8/98.

1. The area marked with a yellow rectangle was the selected section of the image-as-product used for analysis in locating the Azimuth angle.

2. (a.-d.) The cropped section of Diagram 6.2.1 is expressed as a compound isometric view of the three digital studies of *Planar Figures No. 1*; Vignettes: a. inverted, b. brightness and contrast corrected, and c. original image. The larger image (d.) is a combination of two digital image studies (a. and b.) and is the selected study.

Dia. 6.2.1 to 2.

color-pitches among the bright and dark hues. Diagram 6.2.2 shows the cropped section of Plate XII and four digital vignettes—inverted, brighter, original, and the three combined. Studying the combined vignette, including the chroma and value, determined the potential color-pitch for finding solid forms. Connecting the angles of both horizontal azimuths with vertical elevations within the image lifted the planes off the page, joining the strong-to-weak chromatic movements. In the center of the combined vignette, there were two thin trapezoidal forms in chromatic hues of purple-blue and blue (Munsell color PB 5/4/2 and B 5/7/6). Significantly, the area appeared to be an internal compartment of the dark shapes. If the vivid hues could be determined as separate, well-defined shapes, then I would be able to isolate and extract them for volumetric study.

Utilizing the techniques of masking (similar to monoprinting)²⁴ provided the method to digitally extract the color-fringes—circumscription of the trapezoidal shapes (in Diagram 6.3.1–3). This zone-masking served to isolate the saturated hue-complements within the overall shape and digitally translated this technique as if a cross-section of the saturated hues isolated the hues and the internal mass. Thus, Diagram 6.3.1 represents a veil-like grid for graphic location of the different hues for identifying shapes. Diagram 6.3.2 indicates the masked shapes. In Diagram 6.3.3, each shape was isolated and defined by circumscription (fringe light-lines) to form a planar surface. The shapes were graphically differentiated for vertical extrusion. The diagram represents the footprint of the two-dimensional shapes that would be transformed into three-dimensional forms.

Next, the planar shapes (Diagram 6.4.1–4) were transformed into volumes by rotating the z-axis (negative ninety degrees north). The two-dimensional lines became trajectory lines for orthographic isometric study. Diagram 6.4.1 was positioned at a thirty/sixty-degree angle. Diagram 6.4.2 shows the ascending circumscribed perimeter of an orthogonal projection. Diagram 6.4.3 represents the planar location of the circumscribed shapes. The circumscribed projections of the planes were conjoined into forms according to the chromatic pitches and value levels.

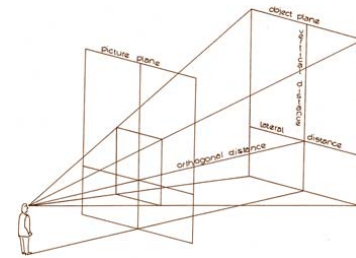
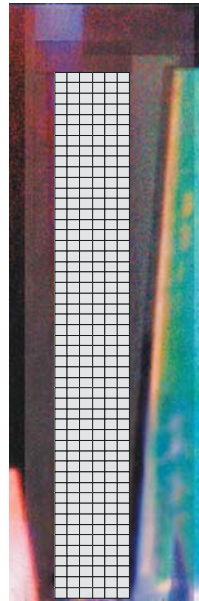


Fig. 39.

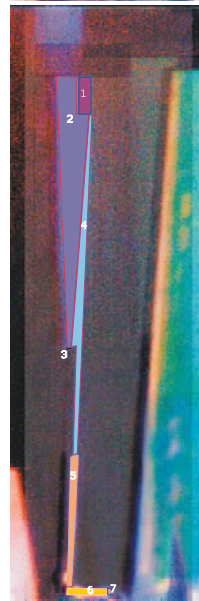
Figure 39. *Orthogonal Arrangement for Linear Perspective*, 11/04.

The orthogonal arrangement shows how all objects are proportionately onto the picture plane. The orthogonal distance is a straight line from the artist's eye to the imaginary object plane. The picture plane is divided by a horizon-line and a vertical line. The object plane visually collects the subject matter of to a composition. The artist transforms the subject matter onto a two-dimensional surface and then projects it onto the picture plane or canvas.

1.



2.



3.

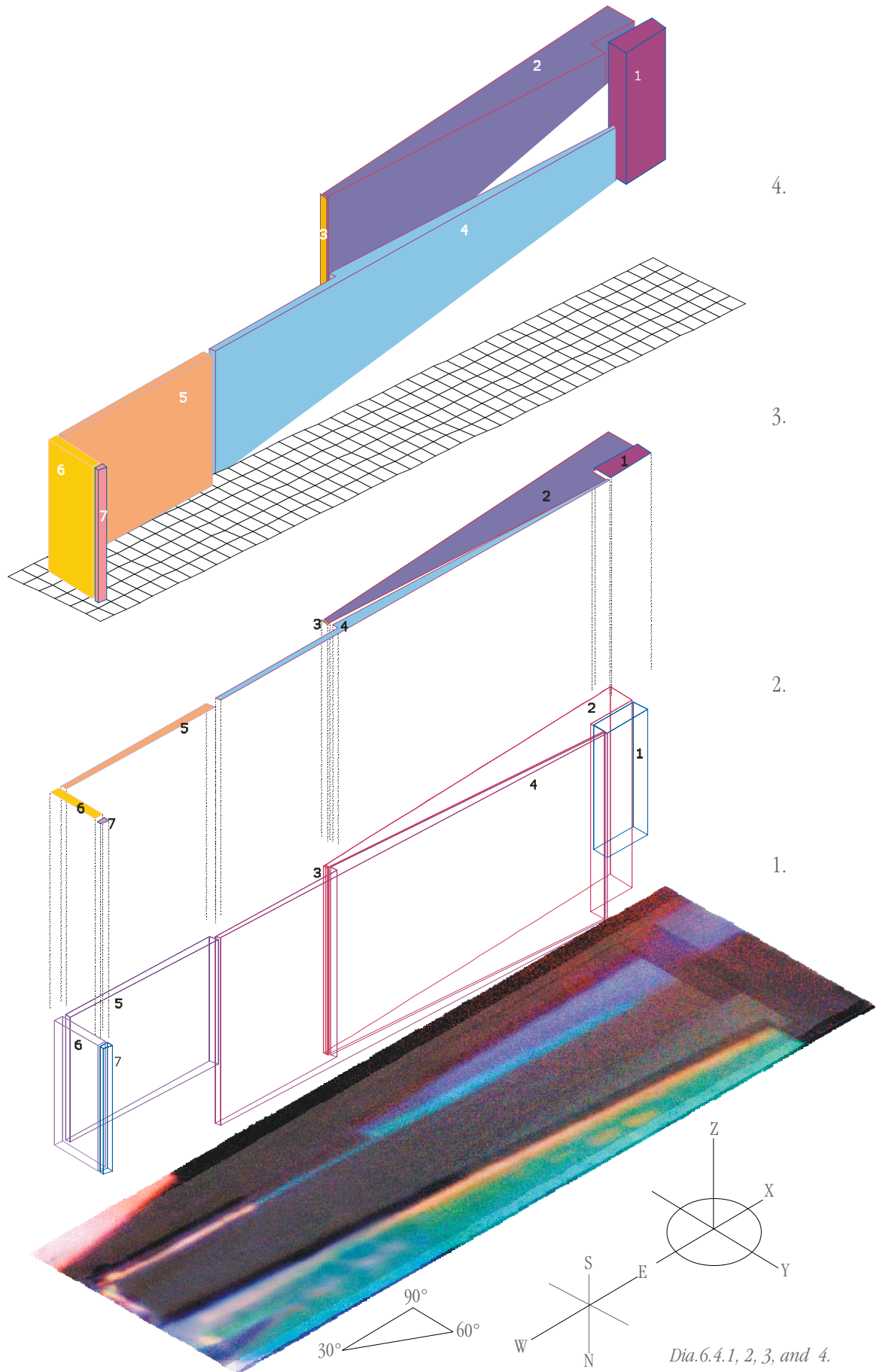


Diagram 6.3.1–3. *A Series of Amorphous Changes Through the Analytical Process.*

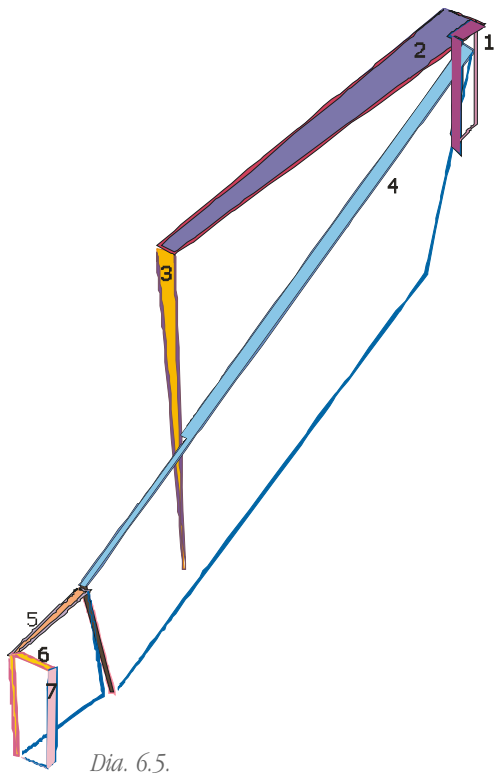
Transformation of selected Diagram 6.2.2 (e), of Plate XII, *Planar Figures No. 1*, 3/25/98.

1. The grid indicates the area of translation from a portion of a image-as-product to a graphic shape.
2. The numbers (1–7) identify the seven shapes found through visual selection of dominate hues.
3. The seven shapes isolated-out for the phase of projecting the chromatic and value changes for drawing the vertical and azimuth angle lines in an isometric view.

Dia. 6.3.1, 2, and 3.



Dia.6.4.1, 2, 3, and 4.



Preceding page: Diagram 6.4.1-4. Expanded Isometric Studies of Plate XII, *Planar Figures No. 1*, 8/11/98.

1. Diagram 6.3.3 (e) compound image rotated onto a 30°/60°/90° isometric layout.
2. A wire-frame-linear-extrusion isometric drawing of the visual dynamics of hues, values, and chromatics.
3. Planar floor plan defining shapes' location.
4. Massing study of a combined analysis of isometric line drawing and planar shapes or the final product (*Model-as-Product*).

This page: Diagram 6.5. Interpretive Design Analysis isolating out the planar forms constructed from projected points and lines; the initial Plate XII, *Planar Figures No. 1*, 8.98.

A final product (*Model-as-Product*).

Diagram 6.4.4 is a massing study with two distinguishing attributes. First, based on Goethe's Color-Circle,²⁵ the chromatic hues produced clarity, purity, and strength of pitch. Second, for the subjective selection of the hues, I relied on Goethe's *Psychological Colours* (c. 1810),²⁶ establishing a visual hierarchical judgment, the elements of which reproduced into attributes by differentiation of shapes to volumes.²⁷ Goethe describes this visual sensation thus, "When the eye sees a colour it is immediately excited, and it is its nature, spontaneously and of necessity, at once to produce another [color], which with the original colour comprehends the whole chromatic scale."²⁸ In this manner I was able to locate hues projected onto the z-axis, identifying planar figures in the third dimension. The solid volumes were produced from the warm hues of yellow, orange, and red angulating the internal color masses, respectively. Color No. 1, for example, was a mixed, simple hue (red) expressed as a rectangular mass. Colors No. 2 and No. 4 (cyan and violet) with their circumscribing lines (orange and red, respectively) were polar opposites that differentiated the chromatic pitch and value to a characteristic volumetric trapezoid (Diagram 6.5).

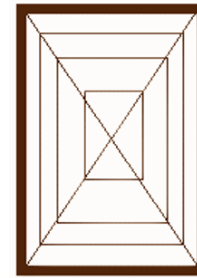
In Diagram 6.4.1, I could see diminution by way of the chromatic color shading—the stronger, more intense, saturated hues moved forward, and the weaker, less saturated, more chromatic colors receded into the background.²⁹ To create the dynamic of the visual perspective of diminution, I allowed the forms themselves to determine the azimuth angle. Therefore, the azimuth angle resulted in a trapezoidal volume based on the camera's creation of shadowing of particular hues—violet and cyan. The visual sensation of diminution characterized the color species to form the massings. By translating the color species on the z-axis, they could be represented as solid volumes in isometric projection. I selected this area as the location of forms,³⁰ achieving the perspectives of line, color, and disappearance, using Goethe's psychology to sketch architectural volumes, or mod-

els-as-products. (Refer to Munsell and Goethe's Color Circle in Chapter five.)

2) *Arrangement within Figure-Ground.* By studying the effects of texture-gradients, horizon-line, and geometric forms on the figure-ground of the composition, I explored depth perception in the images-as products. The newly recorded forms encompassed compositional complexities when I placed the planes in the three-dimensional environmental setting. In analyzing the compositional complexities, such as those in Plate VIII, *Rectangular Figures* and Plate XI, *Planar Figures No. 2*, I saw more evolved perspectives that incorporated the depth-of-focus within the rendering of three-dimensional images. In *Order*, color-patterning relationships were applied to the world coordinate system, optically transforming two-dimensional shapes into three-dimensional volumes, such as those discussed above in section c) Azimuth Angle. Plates VIII and XI show a visual progression of texture-gradients in a controlled environment.

Visual interpretations of the image abstractions incorporated Gestalt's theory of ordered perception (brightness, density, and focus). In addition, I recognized the existence of similar shapes grouped in the figure-ground through organization, configuration, and patterning³¹ (Diagrams 6.6–8). The visual field in Image A—Plate XI, for example, changed when rotated vertically or horizontally. The different views changed my perception of the forms of color within the image-abstractions.³² Each added an understanding of the visual transformation of objects-in-space versus the composition as a whole.

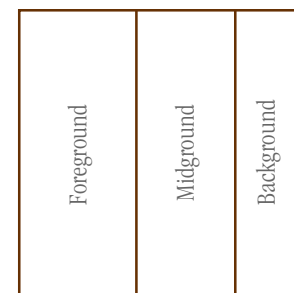
In Plate VIII, a visual shift in the placement of objects revealed how texture-gradients, shade, and shadowing served to transform mere shapes into forms. This shift occurred when I mistakenly misaligned the subject matter in one-point perspective, separating the two visual fields, the artist's eye, and the camera's aperture. The resultant visual perception of the images-as-products was a combination of two fields that could be rationalized in two ways, i.e., the psychological, tactile space of the visual world and the visually recognizable descriptive qualities of the forms. The camera's visual angle (Diagram 3.2) was the reality of the layout of the subject matter. My visual field (Dia-



Dia. 6.6.



Dia. 6.7.



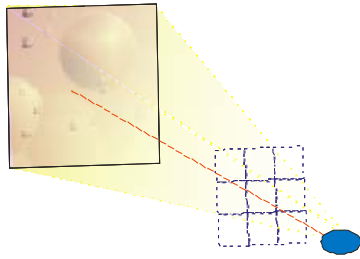
Dia. 6.8.

Diagram 6.6. *A Natural Line of Sight or Realistic Picture Plane*, 11/04.

Diagram 6.7. *A Horizontal Arrangement of the Picture Plane*, 11/04.

Diagram 6.8. *A Vertical Arrangement of the Picture Plane*, 11/04.

Continues on the opposite page.



Dia. 6.9.

Continued from the preceding page: In painting the picture plane is organized into a figure-ground. The foreground locates the immediate subject matter closest to the artist's eye. The midground is traditionally positioned in the middle of the composition relative to the horizon-line. The background goes to infinity and is the top third of the subject matter within the composition.

This page: Diagram 6.9.

Traditional Painter's Orthogonal Arrangement, 11/04.

The artist's eye, indicated in blue, looks through the object plane to the picture plane. In this case, the object plane is a "veil"—a proportional grid for locating the subject matter for arrangement of the overall composition. This picture plane is the artist's impression of the two-dimensional composition on the canvas.

gram 3.1), on the other hand, was from an aerial perspective, in which proportion, configuration, and organization were dissimilar.

Traditionally, the subject matter is behind the object plane. According to Da Vinci, "Have a piece of glass... set thus firmly in front of your eye that is, between your eye and the thing you are drawing..."³³ (Diagram 6.9).

This arrangement contrasts with the linear orthogonal arrangement for photography, whereby the linear orthogonal layout holds the subject matter in front of the object plane. For both disciplines, the artist's eye and the picture plane are the start of the visual field. In the modified camera obscura, the artist's eye and the subject matter are the start of the visual field, reversing the order of the object plane and the picture plane (Diagram 3.1).

Plate XI is an example of a perspectival environment comprised of two visual fields (the artist's and the camera's) as well as changes in contextual awareness of foreground, midground, and background. Image A, viewed vertically, had a visual progression of similar shapes, colors, and brightness which changed in scale along the central axis to demonstrate differences in size, location, and focus, creating proportional figure-ground³⁴ (Diagram 6.8). This visual progression was reversed in Image B. When rotating Plate XI ninety-degrees to the right, the central axis became the horizon-line at a location of two-thirds up from the bottom of the image (Diagram 6.7). The horizon-line was the visual demarcation for the end of the midground and the beginning of the background.³⁵ In viewing the colors of the inverted version of Image B, the image then became blue and less bright, providing a reversed visual progression. This phenomenon was due to the depth-of-focus on individual volumes that combined to create overall compositional objects in space.³⁶ (For an example of a similar composition with a more advanced expression of architectural environmental forms, see Plate XXV, *Planar Figure No. 2.*)

My revised visual angle placed the object plane in front of the picture plane. My imagined object plane, which normally would be some distance from the artist's eye, was equal to, but

below, the real object field. As noted in previous chapters, the object plane was a collaboration of the visual characteristics of the transparent slides that were transformed into compositional subject matter on the picture plane as images-as-products. The non-traditional arrangement placed observer-operator in the line of sight above the object field. The object plane traveled along the linear orthogonal distance to the picture plane, which was a reversed order of the planes (Diagram 3.3). The camera's visual angle was that of a traditional angle as understood within the discipline of photography, except that the artist's eye was in the reverse location, i.e., in front of the aperture. Depending on the unaligned, centralized, dual visual angles, two vantage points appeared, and an unexpected shift in the subject matter created two strong, complementary, and centralized visual dynamics.

Plate VIII, *Rectangular Figures* illustrates a shift from a single vantage point to superimposed dual vantage points, causing an unexpected discovery of forms. The horizon-line was a dark line stretching across the image, providing a constant for locating centric points and identifying shifts in the objects. A study of *Rectilinear Shapes* revealed two blackened vertical sections, centralized corridors located among the planar walls, that expressed horizontal and vertical shifts of the objects. The underlying volumes produced clearly visible parallelograms and angular, undulating lines. In studying this directional change I realized that the lower vertical corridor was a view from the camera's viewpoint, while the upper corridor was a view from the observer's viewpoint. This discovery transformed the *Rectilinear Shapes* in ways that could not have been conceptualized during the sketching process. These additional complexities became evident through color chiaroscuro and texture-gradients; shading and shadowing revealed the shift by objects. I related this phenomenon to Alberti's explanation of how one property of a surface is bound by outlines: "We must now speak of the property of a surface which, if I might put it this way, is like a skin stretched over the whole extent of the surface."³⁷ He later states,

Consequently the viewers of a surface appear to be looking at a particular intersection of the pyramid [visual space]. Therefore, a painting will



Fig. 40.

Figure 40. *A Building's Rectangular Arcade*, Stuttgart, Germany, 3/96. Proportionally scaled layers of a building arcade expressing a relationship of depth through superpositioning and offsetted planar figures.



Fig. 41.



Fig. 42.

Figure 41. *Rear View of Siena Duomo*, Siena, Italy, 1/96.

Building Connections as Intersecting Solid Planar Figures.

Figure 42. *Interior Volumes of Saint Galgano Cathedral*, Galgano, Italy, 1/96.

This photographic view captures the internal, interconnecting volumes of the cathedrel walls.

be the intersection of a visual pyramid [visual field] at a given distance, with a fixed certain position of lights, represented by art with lines and colours on a given surface.³⁸

I tried to imagine what it would be like to run my fingertips along the edge of forms in order to experience a tactile sensation, seeking to locate the architectural forms being expressed.

3) *Eurythmy Exposed through Transparencies*. The rationale for photographing the transparent sectional series of shape-abstractions was to depict the inherent compartments and connections formed while merging simple geometries (Figures 40–42). The transparent nature of the volumetric forms exposed what would likely be obstructed relationships among these geometries. The strength of the light exposed the interconnections of harmonious, three-dimensional forms—models-as-products. An example of these interconnections can be seen in Image B—Plate XXI—the orange horizontal planar form visually moved and connected within two rectangular volumes.

In the analytical stage of exposing different internal relationships, the knowledge of how to express fundamental forms was guided by Da Vinci’s rationale of dissection. In particular, I relied on his transparency principle for model-construction in order to see through the outer “skin” to the underlying structure. Kim H. Veltman (b. 1948) described Da Vinci’s model-making process thus:

To understand the connections between perspective and visualization in Leonardo’s terms it will prove necessary to explore his related interests in model making and geometry which can be seen as implications of the transparency principle made possible through linear perspective.

Because it establishes a method of dealing with the spatial arrangement of successive planes or layers, linear perspective introduces the possibility of conveying information from several layers at once, provided that the outer layer does not occlude whatever lies beneath. There are two

regular alternatives to achieve this: a) one can draw a solid surface of which a part is then cut away or b) one can reduce the entire surface to essential lines. In either case, if one wishes to record accurately the various layers it becomes convenient and even necessary to abandon the original body or object and replace it with a wire model or the like. In other words, where transparency is concerned, reproduction requires reconstruction: perspective leads to model making.

Models, in turn have peculiar advantages. Because they reduce the complexity of the organic world to essential lines they can readily be translated into purely geometrical figures. On the other hand, as models of the originals, they are obviously linked with the objects on which they are based. This median position which they hold between abstract geometry and concrete nature enables models to serve as go between linking the ideal and the actual.³⁹

From the point-of-focus to diminution, the transparent volumes were adjusted to create a visual movement among the compositional forms. The view in Image B—Plate XIX, *Planar Figure No. 2* revealed skeletal shape-abstractions in movement. The rotated, superpositioning arrangement created the planar action; the multiple surfaces caused various overlaps of hue relationship, exposing possible junctures among the planar forms. The circumscribed planes served much like the “skeleton” and “outer layer” of the body when sketching a human frame, as described by Da Vinci.⁴⁰ The complexities of overlapping, transparent shape-abstractions were quite unexpected. By examining texture-gradients (Plate XX, *Planar Figure No. 2*) and surface-hues, the translucent quality of the planar figures became evident as they formed a kind of “skin” that demonstrated the volumes.⁴¹ The inverted Image A—Plate XX revealed greater unity of form, because the hues projected outward, suggesting a harmonious balance among the planar surfaces. This concurred with

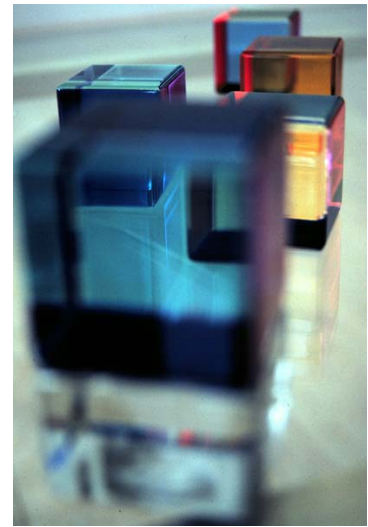


Fig. 43.

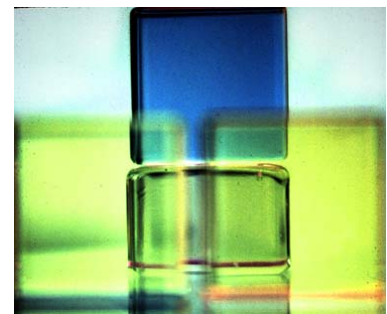


Fig. 44.

Figure 43. *Stacked Solid-Colored Glass Cubes, 7/98.*

External to internal volumes exposed through the transparency of glass.

Figure 44. *Front View of Stacked Solid-Colored Glass Cubes, 7/98.*

Viewing the through transparency to translucency while exposing forms and connections.



Fig. 45.

Figure 45. *Close-up View of Stacked Solid-Colored Glass Cubes*, 7/98.

A close-up view of the solid cubes reveals the shadowing that occurs through transparent glass when the focus is blurred, creating visual depth perception of the objects.

Arnheim's observation: "The basic principle of depth perception derives from the law of simplicity and indicates that a [light color] pattern[ing] will appear three dimensional when it can be seen as the projection of a three-dimensional sensation that is structurally simpler than the two-dimensional one."⁴²

In terms of seeing through the transparencies, a collective visual action revealed compartments and connections within the images-as-products, thus visually translating objects into tangible representations of pre-architectural forms. This visual action explored the external and internal cavities and compartments of the forms (Figure 43). Visual awareness came from an organized figure-ground relationship that was addressed through shade caused by partial obstruction, shadowing, and texture-gradients. This observation was in line with Alberti's statement: "I call a sign something which exists on a surface so that it is visible to the eye. No one will deny that things which are not visible do not concern the painter, for he strives to represent only the things seen."⁴³ For example, in Plate II, *Rectangular Figures* revealed the outer skin of tinted plum, violet, and tinted blue projected over a smaller, opaque object. This visual differentiation suggested transparency-to-translucency, or volumes within volumes (Figure 44). The visual experience of translucency of form was achieved through a density of gradients. I relied on Alberti's statement that the visual pyramid passing through transparent volumes was an interpretation of volumes.⁴⁴ Proportional placement, directionality, and a visual weight of texture-gradients through color chiaroscuro expressed space surrounding the objects—atmosphere (Figure 45).

In Plate XVIII, *Rectilinear Shapes*, the dense, granulated texture projected forward through visual lightness or away through definitive textures of translucent volumes. One of the unexpected aspects of discovering the inherent quality of painting with transparencies was that the internal volumes were expressed in the midground to background. For the analytical process of the images-as-products seen through the *Rectangular Figures*, I expected to analyze from the inside-out, but, instead, I actually

saw visual action through the transparent fabric as though looking from outside inward. The transparent objects in the foreground were proportional in scale to the midground perpendicular volumes, a fact that clearly suggested anterior corners creating a depth relationship. The background of contrasting warm hues visually pushed the lighter-value hue from the midground forward, advancing it. In contrast, the deeper hues of the dark background became visible through the transparencies, and volumes receded. Without the background of strong values and texture changes, I would not have been able to see the delicate foreground volumes. Thus, noticeable transparency-to-translucency-to-opaqueness of volumes demonstrated a delicate balance in the figure-ground, which revealed a delineation of texture-gradients. This phenomenon was in line with Da Vinci's statement: "Each object seen appears not alone or isolated but always accompanied by something else, because the visual rays surrounding it fall sometimes on objects beyond the body at which one is looking and sometimes on objects near it."⁴⁵

4) *Symmetry Relative to Visual Three-Dimensional Balance.* The compositional environment necessitated an awareness of spatial associations among forms. Equilibrium within the composition was achieved through constants—the associative linkage of attributes and characteristics among forms, including circumscription, color dimension, and compositional axes (Figures 46–50). Movement among the forms resulted from changes in brightness, diminution, selective focus, and organization. Merging of my *sensus communis* with multiple perspectives facilitated the perception of resolution parallax within the binocular dynamics, or holographic parallax patterning. The parallax view of the third dimension appeared through textures, scale, circumscription, blurring, atmosphere, color, motion parallax, and binocular disparity.⁴⁶ Through the combination of the various

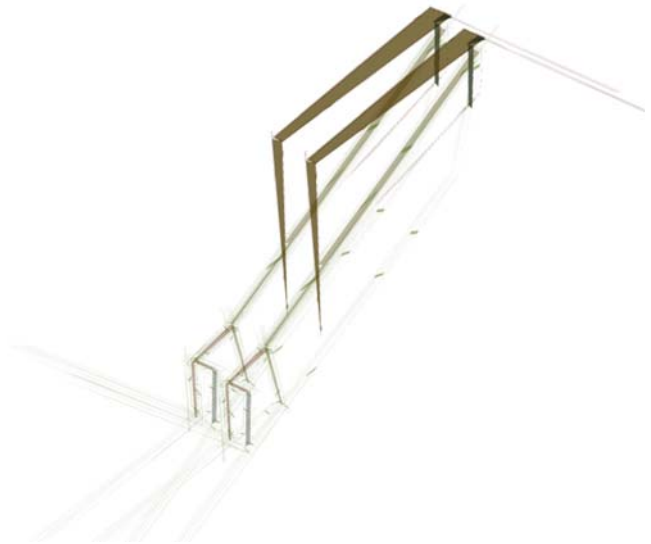


Fig. 46.

Figures 46. *A Linear, Digital Schematic Sketch of Planar Figures No. 1, 7/98.*

This digital sketch was produced by offsetting of the isometric planar forms of Diagram 6.5. The perimeter lines of the planes became circumscribed vectors that extended to the distance of the dimensional color. The transparent planes allowed for connections to other planar forms.



Fig. 47.

Figure 47. *A Digital Illustration Model No. 1 of an Environmental Stage Set of Planar Figures No. 1, 7/98.*

This digital illustration was produced by further development of Figure 46, placing the study sketch in an environmental stage of a rocky cliff. The dimensionality was achieved through painterly techniques of color chiaroscuro, blurring brushstrokes, and texture density.

perspectival cues and form-linkages, the environmental balance caused me to no longer isolate singular objects, but instead to take-in the compositional whole. In the experiment, dimensionality served as an important aspect of transforming form into visual representation. The compositions were translated into the descriptive, architectural language of optics, geometry, and perspective.⁴

Symmetry. a) **Represented World within the Optical Language.** The length of time for the exposure of the direct-positive images and atmosphere—a distinctive but intangible quality surrounding the forms—contributed greatly to the depth of field. The controlled environment within the camera simulated a natural environment of distance, atmosphere, and light (Plate XXIII, *Planar Figure No.2*). This plate had a twelve-hour exposure time through six transparent sections. In Image A, the in-

verted colors intensified the effects of atmosphere on the visual weight and solidification of the forms. Through superpositioning, perspectival translation of texture-density, confluence of line-tracings, and brightness, the forms concaved and convexed to create visual weight and massing (Figure 46). This work was informed by Cézanne's statements, "Everything in nature is modeled according to the sphere, the cone, and the cylinder... One must become classic again through nature, which is to say by means of sensation."⁴⁸ In Cézanne's painting, *Rocks at Fontainebleau*, I detected a similar perception in his depiction of space: within the groupings of the rocks and among the trees, unified by directional brushstrokes contrasting the hues within color chiaroscuro expressing atmospheric perspective. This effect of confluence of outlines, texture, and brightness undulated his massings of the rocks through a diminished space⁴⁹ (Figure 47).

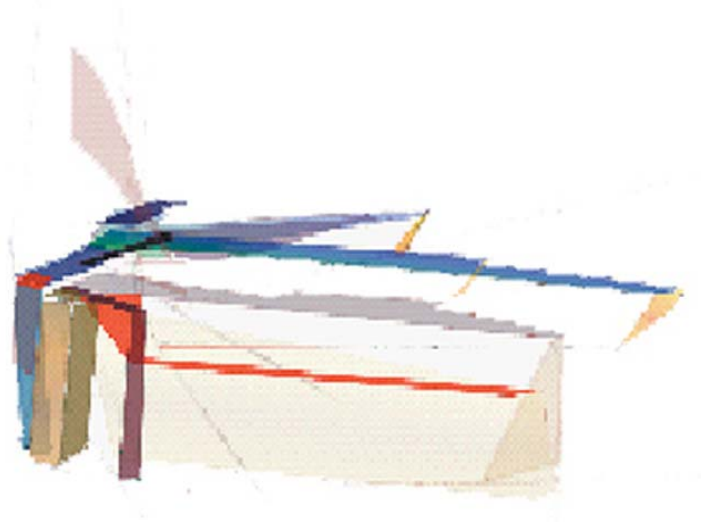


Fig. 48.

Symmetry. b) **Represented World within the Geometric Language.** Focus blur—the act of decreasing clarity through hazy or dim indistinct representations of forms—was evident (Plates IV and XVI, *Rectangular Figures*). Some objects in the image faded as if one were changing focus, while suggested attributes remained. With other objects, the sensation was different; however, focus diminution produced similar results. I compared the diminution complexities in the image-abstractions with Cézanne's *Large Pine and Red Earth*, noting his use of perimeter blur. The movement between the centric and extrinsic rays, similar to direct-focus and peripheral vision, created a focal point that simultaneously directed the eye outward. Cézanne's emphasis on thermal hues and his distinctive brushstrokes directed this sharp-to-blur focus (Figure 48 and 50).

Figures 48. *A Schematic Sketch of Digital Massing of Planar Figures No. 1, 7/98.*

This digital massing study was produced by analyzing the colored forms of the outer perimeter of Diagram 6.3.2. The transparent planes lifted upward according to the hue's dimension of color.

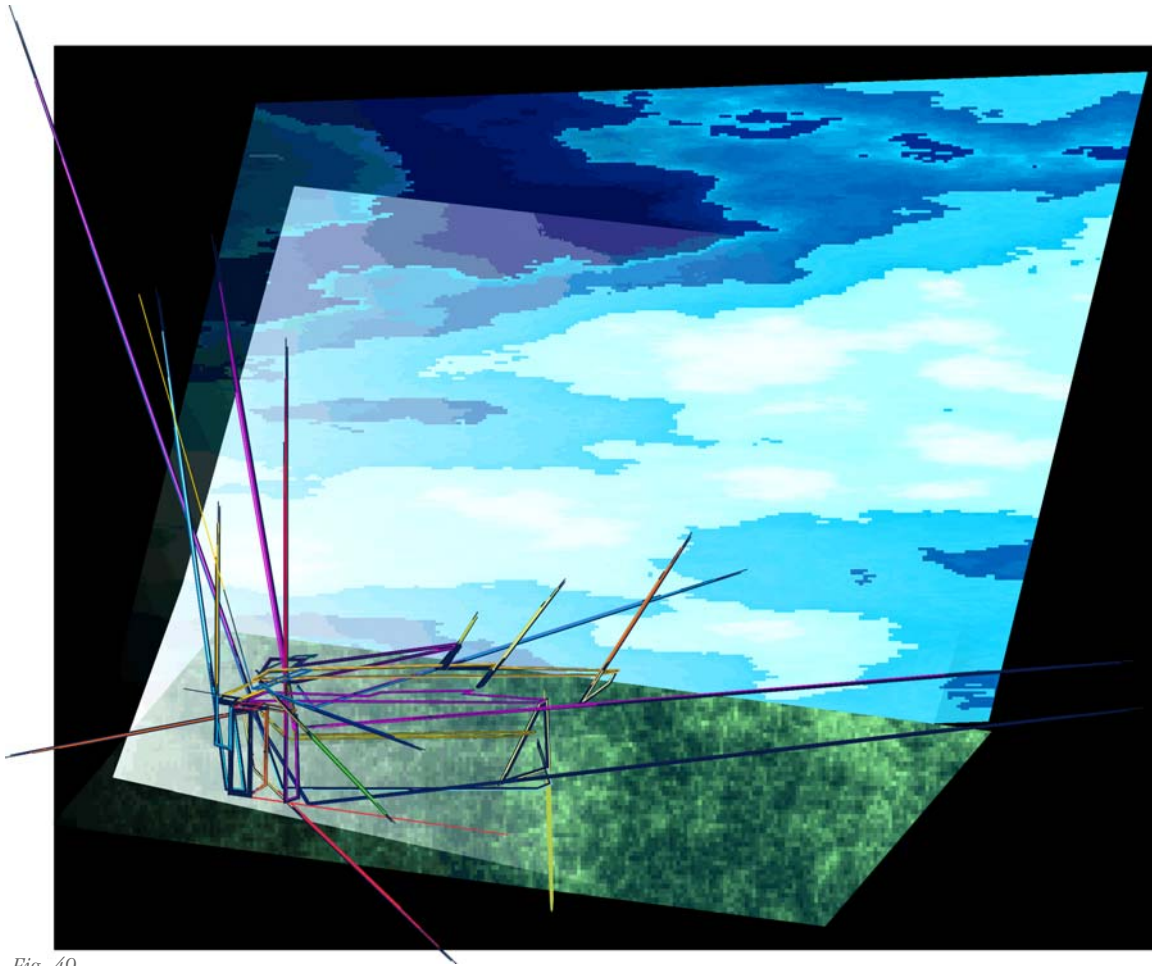


Fig. 49.

Figure 49. *A Digital Illustration Model No.2 of an Environmental Stage Set of Planar Figures No. 1, 7/98.*

This digital illustration was produced by expanding the massing study of Figure 48. By taking the lines of the planes and turning them into vectors, movement of depth-projection was translated into a building's structural frame placed in an environmental stage of a mountain-side.

In the experiment, I utilized the critical focus of the camera (the distance between the condenser lens and the aperture) in a similar manner to produce focus blur, attempting to directionally guide the focus (Plates IV and XVI). Blur perspective consciously altered the focus of the images, in particular, the dimensional forms. Focus, not color, caused the advancing and receding of forms in a series of stepped plateaux (Plate XVI). Blur provided translucency through the interior spaces (Plate IV) with various geometric forms expressed in the midground to background. The camera controlled the focus and created depth perception expressed through diminution of form.

Symmetry. c) Represented World within the Perspective Language. Visual movement—the changing of perceptual direction within a composition—was a key consideration in analyzing the image-abstractions (Plate XV, *Planar Figure No. 2*). In order to perceive the movement of depth-projections in the environment, it was necessary to go beyond the visual interpre-

tation of linear perspective principles and study the nature of interplay among geometric forms⁵⁰ (Figure 49). “Chiaro-scuro exhibits the substance as substance, inasmuch as light and shade [and shadow] inform us as to degrees of density.”⁵¹ For that purpose of establishing degrees of density, I examined the forms for subtleties of color chiaroscuro and Post-Impressionistic examples of dimensional density.⁵² Without shade and shadow, as represented by the perspectives of color, line, atmosphere, and motion blur, the forms’ dimensionality and dynamic relationships would not be complete⁵³ (Figure 50). As Cézanne explained: “Painting after nature is not copying the objective, it’s realizing our sensations.”⁵⁴ The resonant hues and brightness in the green foliage of Cézanne’s *Bend in the Forest Road* contrast with the bright orange of the path, creating an unsettled depiction. However, Cézanne skillfully wove the shading and shadowing to cause the viewer’s eye to recede into the density of the trees within the forest composition. The foliage can be viewed as a convexity of planar forms. As Cézanne explained, “To read nature is to see it beneath the veil of interpretation, as color patches succeeding one another according to a law of harmony. Thus these colors are analyzed by modulations. To paint is to register these color sensations.”⁵⁵

In a similar fashion, vertical, saturated hues in Plate XV were partitioned by dark, vertical lines and shading. On both sides of the center axis, the subtle modeling of the tonal shifts within and among the planes of color contrasted with the smaller, stepped planar shapes, causing convexity and rotating motion inward. The shading that flanked the central (red) form resulted in a directionally-focused visual motion caused by the shifting interplay of color, shading, and lines. Luminance caused directional movement in this particular image-abstraction by contrasting horizontal hues and chromatic strengths with changing vertical values. The value-range appeared to work in tandem with chromatic, saturated hues to sheer the planar forms. Chiaroscuro caused the forms to actively recede through the perspectives of diminution of line, color and motion parallax. All the perspectives served to express a visual resolution parallax of balance and harmony.⁵⁶

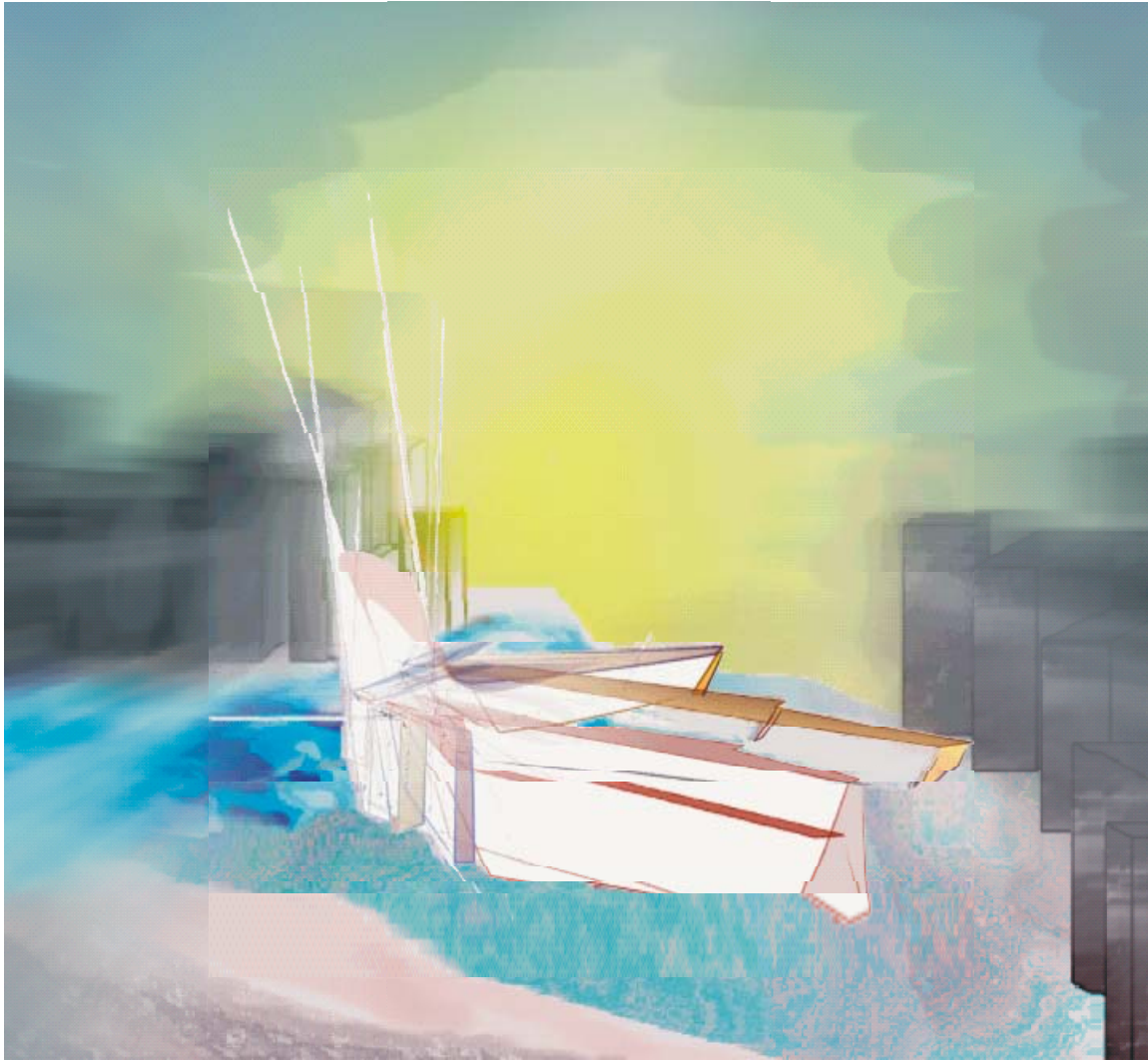


Fig. 50.

Figure 50. A Digital Illustration Model No. 3 of an Environmental Stage Set of Planar Figures No. 1, 7/98.

This digital illustration was produced by further development of Figure 48, placing the massing study in an environmental stage of a city park. The use of blurring was in an attempt to use focus blur for depth perception.

I explored Cézanne's concepts and modeling in order to understand and apply techniques that would affect the observer's focus. In the experiment, I knew I could not control the observer's eye as it moved about the images-as-products. I could, however, learn from Cézanne to guide the observer's eye from foreground to background through techniques of chiaroscuro, color, blur, texture, scale, line, parallax, and atmosphere to create the sensation of three-dimensional movement.

Multiple perspectives and visual techniques served to create dimensional forms within environmental image-abstractions. These forms became the images-as-products that were analyzed through four of Vitruvius's means, *Order*, *Arrangement*, *Eurythmy*, and *Symmetry*. This analytical process rationalized the sketched abstractions to produce conceptual products.

Endnote. Chapter Six.

1. R. Arnheim, *Visual Thinking* (Berkeley and Los Angeles: University of California Press. Ltd., 1969, Reprinting 1997), p. 10.
2. Newton, op. cit., *Opticks*, p. xxv.
3. Vitruvius, loc. cit., (see chap. 1, n. 24).
4. “Color space [color dimensions] is commonly referred to as all possible variations on the three dimensions of color—hue, brightness [value], and saturation [chroma].” Shape, op. cit., p. 54, and “color dimensions: hues, value, and chrome. These dimensions of a box describe its length, breadth, and thickness; color attributes.” A. H. Munsell, *A Color Notation* (Baltimore, Maryland: Munsell Color Macbeth, a Division of Kollmorgen Corp., 1981), p. 59. In reference to elevation and azimuth angle in three-dimensional physics, it is understood in terms of “polar coordinates,” in which the location of an object is defined by a distance from the origin of the coordinate system, along with an angle defining “azimuth” (rotation in the horizontal plane) and an angle defining “ascension” or “elevation” (rotation in the vertical plane). In two dimensions, this reduces to a length and an angle. See G. Goebel, *Newton’s Law of Motion. Vol. 2.1.2.* Chapter 1.1, *Coordinate Systems, Displacement, Velocity, and Acceleration* (Public Domain Sept. 1, 2004.) Also available online at <http://www.vectorsite.net/tpecp1.html>.
5. I define *horizon-line* in a perspective sketch as a horizontal line marking the location where all projection lines from the observer converge to a centric point. The placement of the *horizon-line* on the picture plane depends on the vantage point of the artist. The horizontal line is formed by the actual or implied meeting point of earth and sky.
6. Vitruvius, op. cit., pp. 84–86, paragraphs 12 and 14.
7. “Among all the studies of natural causes and reasons Light chiefly delights the beholder; and among the great Mathematics [perspective] the certainty of its demonstrations is what preeminently (tends to) elevate the mind of the investigator.” J. P. Richter, ed., L. da Vinci, op. cit., See paragraph 13, p. 15.
8. “*Sensus communis* is defined as common sense for visual direction of the eye instinctively moving up, down, left, and right, in order to record a designated dynamics of objects.” See Veltman, loc. cit., *Studies on Leonardo da Vinci Vol. I*, pp. 30–34.
9. J. P. Richter, ed., Da Vinci, op. cit., see paragraphs 14–17, 28 and 29, pp. 16–18, 21.
10. K. H. Veltman, *Leonardo’s Method: 5. Themes, Figure 4, Branches of Leonardo’s Studies of the Represented World*. (Brescia: Centro Ricerche Leonardiane, 1993. Revised online edition: 2004.) Also available online at <http://www.mmi.unimaas.nl/people/Veltman/books/Leonardo’s%20method/index.htm>, see fig. 3 and 4.
11. For *Order* see Vitruvius, op. cit., p. 13, paragraph 2, for species “The admixture of white, therefore, does not alter the basic genera of colours, but creates species. Black has a similar power, for many species of colours arise from the addition of black.” Alberti, op. cit., *Painting*, p. 45. By “species” of color I mean a distinctive kind of chromatic color or hue, namely the primary and secondary classification of color. Newton, op. cit., *New Theory*, p. 3082, item numbers 5 and 6.
12. J. P. Richter, ed., Da Vinci, op. cit., see paragraphs 281, 286, 289–293, pp. 151–152, 157–158.
13. Sir Isaac Newton stated: “. . . Species of Things [color] [was] endowed with an occult specific Quality by which it acts and produces manifest Effects. . . [the visual sense of color.]” “Things else were well ordered, and the Sun shone clear, and I held my Eye very near to the Paper on which the Lens cast the Species of the Lines. I could see pretty distinctly the Species of those Lines by that Part of the violet which was next the indigo; and sometimes I could see them by above half the violet, being in comparison so very little, deserves not to be considered [color spectrum.]” Newton, op. cit., *Opticks*, pp. 91 and 401.
14. Shape, op. cit., p. 107.

15. Munsell, loc. cit., (see chap. 3, n. 22).
16. *ibid.*
17. “Similar hues and/or degrees of brightness will be perceptually grouped. Similarity is an excellent device for handling large areas, because however widely dispersed the items may be, they are perceptually pulled together as a unit.” Shape, op. cit., p. 105.
18. *ibid.*, p. 2.
19. Morris, op. cit., color definition and solid color, p. 263.
20. Alberti, op. cit., *Painting*, p. 83.
21. *Strong colors* are defined by A. H. Munsell as “a color of pronounced chroma, found in the neighborhood of the seventh to tenth step [level] of chroma, the saturation of intensity (purity) of the color.” See Munsell, op. cit., *Notation*, pp. 63, 62, and 58.
22. Munsell, loc. cit., (see chap. 3, n. 22).
23. Alberti, op. cit., *Painting*, pp. 38–39, 41–42.
24. *Monoprinting: Monotype* is one graphic print with multiple processes through the printing press with no duplication. In creating a graphic print one uses colored printer’s ink applied to translucent or opaque geometric shapes. A subtractive application is used to apply ink to the paper surface in two ways: 1) literally cuts the aluminum plate to the shape that is to be transferred to or additively composed by the shapes and 2) masking-out a section of the paper surface to control the placement or the pattern of the ink.
25. Goethe’s Color Circle refer to pp. 40, 55–56, Matthaei, ed., Goethe, op. cit.
26. Goethe refers to the colors that the eye perceives as *physiological* (subjective observation or *necessary condition of vision*) color, meaning, a physical attribute to an object, today we refer to them as psychological colors. *ibid.*, *Part I. Physiological Colours*, pp. 78–95 and Paragraphs 1 to 38, pp. 1–15 in Goethe, (London, 1967).
27. Matthaei, ed., Goethe, op. cit., *Part VI, Sensual and Moral Effects of Color*, Paragraphs 758, 816–818, 849–853, pp. 168, 177, and 181.
28. *ibid.*, *Completeness and Harmony*, Paragraph 805, p. 174.
29. “Brightness [and saturation] is a major factor in the determination of advancing or receding colors.” See Sharpe, op. cit., p. 107.
30. “We naturally place these colours first [psychological colors], because they belong altogether, or in a degree, to the *subject*—to the eye itself. They are the foundation of the whole doctrine, and open to our view the chromatic harmony on which so much difference of opinion has existed.” Goethe, op. cit., (London, 1967), paragraph 1, p. 1.
31. Sharpe, op. cit., pp. 101–111. “Psychological colors will be considered basic standards and guiding principles for all visual perception.” Also see Matthaei, ed., Goethe, op. cit., p. 7.
32. Traditional color awareness, red being brighter than blue is the figure and the blue is the ground. See Sharpe, op. cit., p. 66.
33. J. P. Richter, ed., Da Vinci, op. cit., see paragraphs 523, pp. 260–261.
34. James J. Gibson states, “Scale, not size, is actually what remains constant in perception.” See Arnheim, op. cit., *Art and Visual*, p. 290.
35. J. P. Richter, ed., Da Vinci, op. cit., See paragraphs 522, p. 260.
36. Arnheim’s comments about J. J. Gibson’s finding on reading depth perception provide a salient point: “he emphasized texture gradients, such as the gradually changing density of grain or shading, the coarser textures being correlated with nearness, the finer with distance.” Arnheim, *Art and Visual*, op. cit., p. 276.
37. Alberti, op. cit., *Painting*, p. 39.
38. *ibid.*, p. 48.
39. Veltman, op. cit., *Studies on Leonardo da Vinci Vol. I*, p. 15.
40. See Veltman’s analysis of Da Vinci’s sketchbook with drawings of the human body. Veltman, op. cit., *Studies on Leonardo da Vinci Vol. I*, pp. 202–218.
41. Alberti, op. cit., *Painting*, p. 37.
42. Arnheim, op. cit., *Art and Visual*, p. 148.
43. Alberti, loc. cit., (see current chap., n. 41).
44. “They [artists] should understand that, when they draw lines around a surface, and fill the parts they have drawn with colours, their sole object is the representation on

this one surface of many different forms of surfaces, just as though this surface which they colour were so transparent and like glass, that the visual pyramid passed right through it from a certain distance and with a certain position of the centric ray and of the light established at appropriate points nearby in space.” *ibid.*, p. 48.

45. K. H. Veltman, *loc. cit.*, (see chap. 3, n. 10). Also available online at <http://www.sumscorp.com/books/contin/p3c3.htm#3>.

46. For a description of *holographic parallax patterning*: (within this text see n.10 and 11 in chap. 1), *Motion Parallax*, defined as optical flow or a pattern reflected from a surface of the eye. See Veltman, *loc. cit.*, (see chap. 2, n. 7); *Resolution parallax* is defined as the number of different perspective views available to the viewer, and *binocular disparity* is defined as the binocular depth cue effected by the slight differences between the two retinal images seen by each eye. The depth sensation caused by binocular disparity is called stereopsis. See Luncente, et al., *loc. cit.*, (see chap. 1, n. 11).

47. Veltman, *loc. cit.*, *Leonardo's Method*, (see current chap., n. 10).

48. F. Cachin, et al., *op. cit.*, pp. 37–38, item no. 10 and 14.

49. The Impressionist color stroke and application are defined thus: Artistic aim: 1) the coming to terms with a optical, atmospheric reality, where colours dissolve loosely and alter from object colour towards the perceived colours sensation (*valeur*), and continuous outlines are broken up. . . 2) painters rarely mix their final colours on the palette, but on the canvas which itself plays a role in tonal value [chromatic values]. The actual color mixture is left to the observing eye. The artist aims at spontaneous jotting down of an optical “impression,” rather than meticulous reportage. See Schorer, George F., ed., *Dictionary Der Pelikan. A Compendium of Art Terms for Drawing Class And Studio* (Hannover: Guenther Wagner, 1973), p. 18.

50. “If linear perspective displays the gradation of objects in their apparent size as affective by distance, aerial perspective shows us their gradation in greater or less distinctness, as affected by the same cause.” As quoted by J. W. von Goethe in Matthaei, ed., Goethe, *op. cit.*, *Part VI, Sensual and Moral Effects of Color, Maintaining Color*, Paragraph 867, p. 182.

51. As quoted by J. W. von Goethe, in Goethe, *op. cit.*, (London, 1967). *Part VI. Effects of Colours with Reference to Moral Association, Chiaro-scuro*, Paragraph 852.

52. J. J. Rishel description of *Bend in the Forest Road* in *Cézanne*, “The bands of horizontal planes. . .nearly perpendicular to the fluidly interwoven vertical strokes. . . the dynamic descent. . . adds a third directional element. . .” “The overall effect is a steadily ascending scroll of color unrolled before us in a nearly hallucinatory fashion.” “. . . the distinctly drawn lines and panels of color are still more complexly [visually] merged and blended.” J. J. Rishel, et al., *op. cit.*, p. 516.

53. Veltman, *loc. cit.*, *Leonardo's Method*, (see current chap., n. 10).

54. F. Cachin, et al., *op. cit.*, p. 37, item no. 4.

55. *ibid.*, item no. 6.

56. As Da Vinci noted, the perception of depth requires color shadow: “Why Beautiful Colours Must Be In The [Highest] Light. Since we see that the quality of colour is known [only] by means of light, it is to be supposed that where there is most light the true character of a colour in light will be best seen; and where there is most shadow the colour will be affected by the tone of that [shadow.]” J. P. Richter, ed., Da Vinci, *op. cit.*, p. 151, paragraph 284.

The journey described in this work represents less a technical examination of creating pre-architectural forms than an explorative study that allowed the unexpected to prevail. The initial questions that spurred the exploration were: Is it possible to “sketch” with light in order to create pre-architectural forms? Can the characteristics of depth perception be used to create form?

Using the organizational tools of renowned scholars, I have attempted to develop a framework for exploring the hypothesis, define the concepts, and observe and analyze the abstractions of the experiment. As events unfolded, I continually searched for guidance from multiple disciplines—painting, sculpture, graphic arts, color theory, optics, and photography. Overall, the study evolved in three steps: 1) proposition (finding the expected, anticipated, and unforeseen), 2) concessions (yielding as the operator), and 3) examinations of the subject (conceding as the observer).²

In seeking to create pre-architectural forms, I created twenty-five plates to translate image-abstractions. This exploratory, empirical study incorporated a rationale based on the ideas of Vitruvius, Brunelleschi, Alberti, Da Vinci, Newton, and Goethe. Vitruvius provided the rationale for the investigative strategy, including: reflecting on what I perceived to be happening, answering intricate questions about the products, and affirming the principles of architectural form. Brunelleschi’s modification of the camera obscura to explore optic, atmospheric, and linear perspectives was the impetus for my own modifications of the camera obscura for finding multiple perspectives. I applied Alberti’s mechanics of separating the perceived and the perceptual, utilizing the visual angle in perspective for conceptualizing lineaments. Following Da Vinci, I added color chiaroscuro and atmosphere through diminution to identify three-dimensional, modeled forms. Newton’s postulation that light is comprised of tangible rays provided the reasoning for the manipulation of light, which impacted the exposure time and resulted in the pitch of the compound colors. Goethe’s principles of bringing “light, shade, and color together” served to distinguish “objects from objects, and parts of an object from each other.” Following Go-

*The eye, which is called the window of the soul, is the chief means whereby the understanding may most fully and abundantly appreciate the infinite works of nature.*¹

Leonardo da Vinci

ethe, I was able to distinguish both circumscription and compartmental qualities of the transparent massings.

The sensations that inspired me as an artist to initially start the design process came from the inherent qualities of light. As Da Vinci pointed out in his notebooks,

You may also have seen how the light that penetrates through stained glass windows in churches assumes the colour of the glass of these windows. If this is not enough to convince you watch the sun at its setting when it appears red through the vapour, and dyes red all the clouds that reflect its light.³ I ask, let it be granted that all rays passing through the air be of the same kind and travel in straight lines from their source to the objects that they strike.⁴

The architectural process provided me with a rationalization and the restraints of order, arrangement, eurythmy, and symmetry, while the camera obscura provided the means.

In Chapter one, three-dimensionality was clarified through the differentiation of the object plane and the picture plane. The subject matter, composed on the picture plane, was both subjective and objective, depending on whether it was viewed from the visual field or the optical space. This linear orthogonal layout set the stage for the operation, observations within the experiment, and the analysis of the images-as-products. Chapter two served to organize the translation of shapes to volumes, and volumes to objects, identifying perspectival characteristics for this process. Chapter three described the “sculpted palette” that was used to create the environmental field, the delineation of visual characteristics of textural surfaces, and the placement of transparent sections in terms of focus within the depth of field, creating depth perception within the composition. The sketching tool (the modified camera obscura) described in Chapter four combined Euclidean physical space and non-Euclidean perspective cues. It also established a depth of focus for the compositional figure-ground, allowed viewing through transparent volumes, and combined multiple perspectival cues for visual parallax. In addition, Chapter four provided thirteen require-

ments for sketching capabilities. In Chapter five, the roles of the observer and the operator were intertwined while composing on the picture plane. Primary (media) and secondary (technique) variables for painting with light were identified in order to produce the projected images. In Chapter six, analyzing the image-abstractions through the organization of the “visual pyramid” served to determine pre-architectural forms. Through an interpretation of Vitruvius’s *Order, Arrangement, Eurythmy, and Symmetry*, as well as four groupings of perspective cues, I was able to categorize the visual sensations expressed through images-as-products to models-as-products.

Results of this experiment included:

- 1) use of a “visual pyramid” to distinguish between perceived and perceptual sketching (Chapter one);
- 2) a rationalization for dissecting the original photographic images (Chapter two);
- 3) digitally extracting visual characteristics by distinguishing attributes (Chapter three);
- 4) utilizing depth to reapply visual characteristics through the sketching field to the picture plane (Chapter four);
- 5) translating the medium of light for locating and recording pre-architectural forms (Chapter five);
- 6) determining sequential patterning of colors for locating objects’ attributes (Chapter six);
- 7) dual visual angles (the linear/camera and ariel/observer) achieving multiple vantage points (Chapter six);
- 8) objects obstructing other objects, depicting connections among volumes (Chapter six);
- 9) three-dimensional hyperbolic geometries in a controlled environment (Chapter six).

These results paralleled the techniques exhibited in later works by Cézanne. Cézanne was the artist whose work showed me how to create abstractions through the means of subtraction of subject matter. This directed my observation to a visual movement to read the densities, textures, and hues. I studied the abstractions in his later landscapes in order to formulate my visual pyramid. By abstracting elements of subjects in nature, I as the artist isolated geometric attributes. Cézanne utilized diminish-

ing elements, spiraling movement, textural brush strokes, chromatic harmonies, and dimensional shadings to create the visual characteristics of depth through visual touching. In his paintings, Cézanne used a visual mixing to create chromatic colors that resonate as undulating massings. He directs the viewer's focus with various techniques that alter depth of focus and the vantage points through non-Euclidean perspective. These effects correspond with the techniques I sought to utilize in my experiment. Creating the models-as-products was the final formulation of my architectural language for creating pre-architectural forms.

Endnotes. Conclusion.

1. I. A. Richler, ed., Da Vinci, op. cit., p. 4.
2. *ibid.*, Chapter 1, *True Science: Mathematical Demonstration*, p. 7.
3. *ibid.*, p. 144.
4. *ibid.*, Chapter 1, *True Science: Mathematical Demonstration*, p. 8.

Following page: Figure. 51.
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Superposition of multiple detailed
images of Plate XII, 3/25/98.
Quotation: Johann Wolfgang von
Goethe, *Introduction to the*
Propyläen: Paragraph 43,
Periodical, 1798.

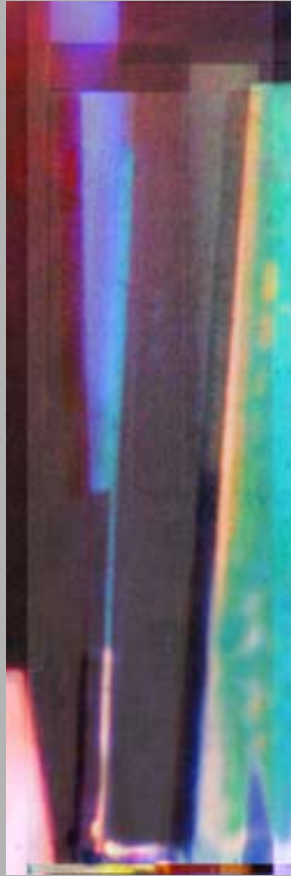
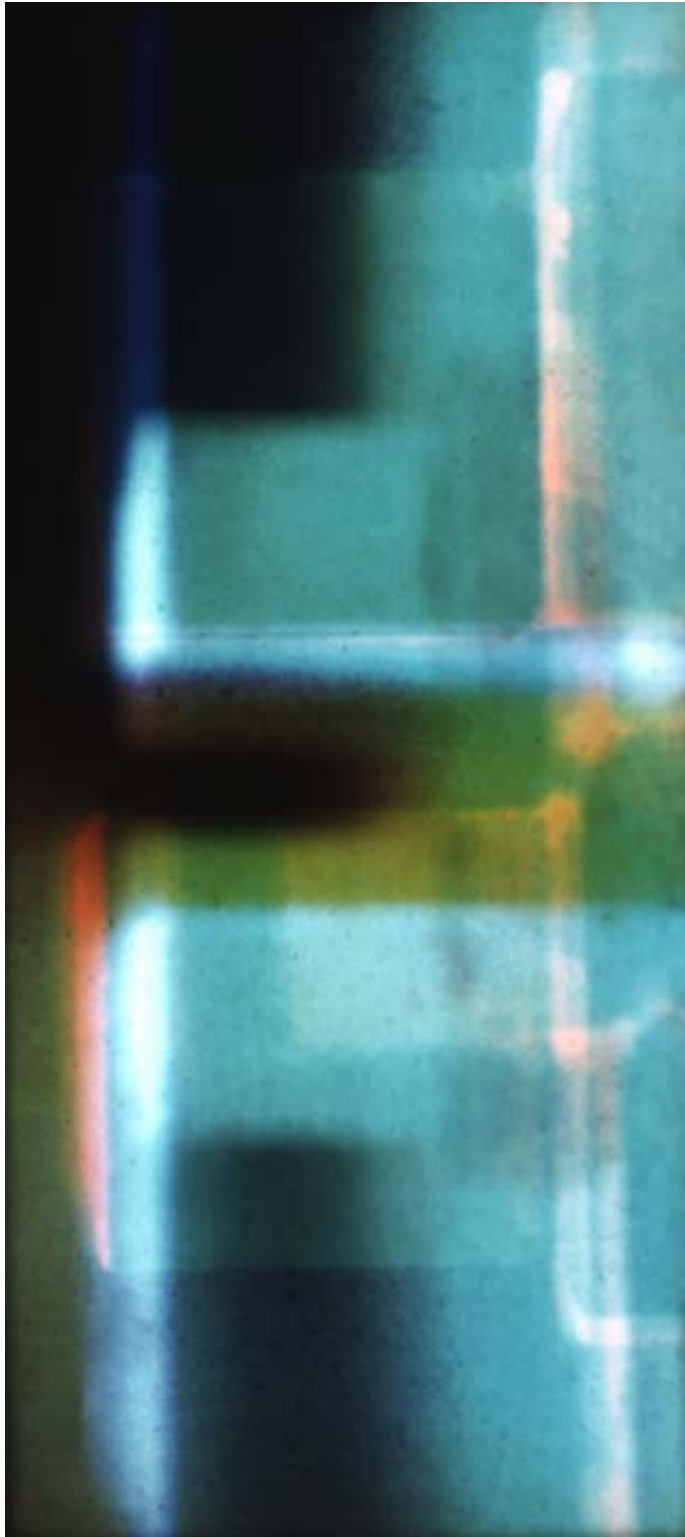


Fig. 51.

The genuine law-giving artist strives for the truth of art, the lawless artist who follows a blind impulse strives for the reality of Nature; through the former, art reaches its highest summit, through the latter its lowest stage.

Johann Wolfgang von Goethe
(1749–1832)



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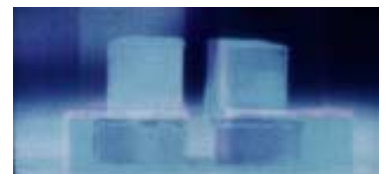
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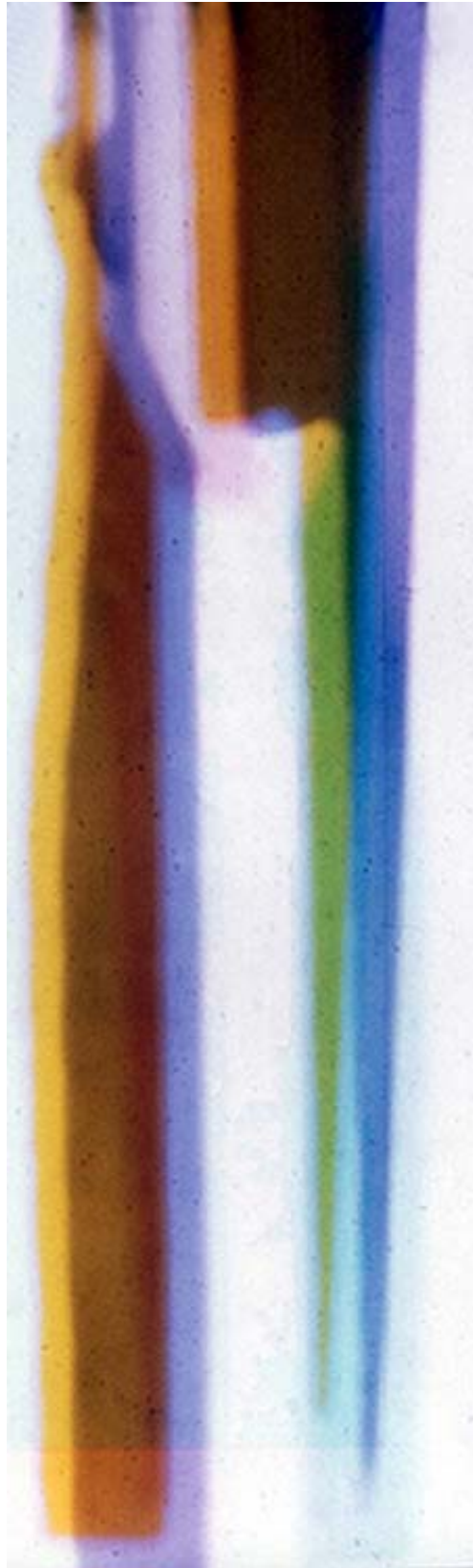


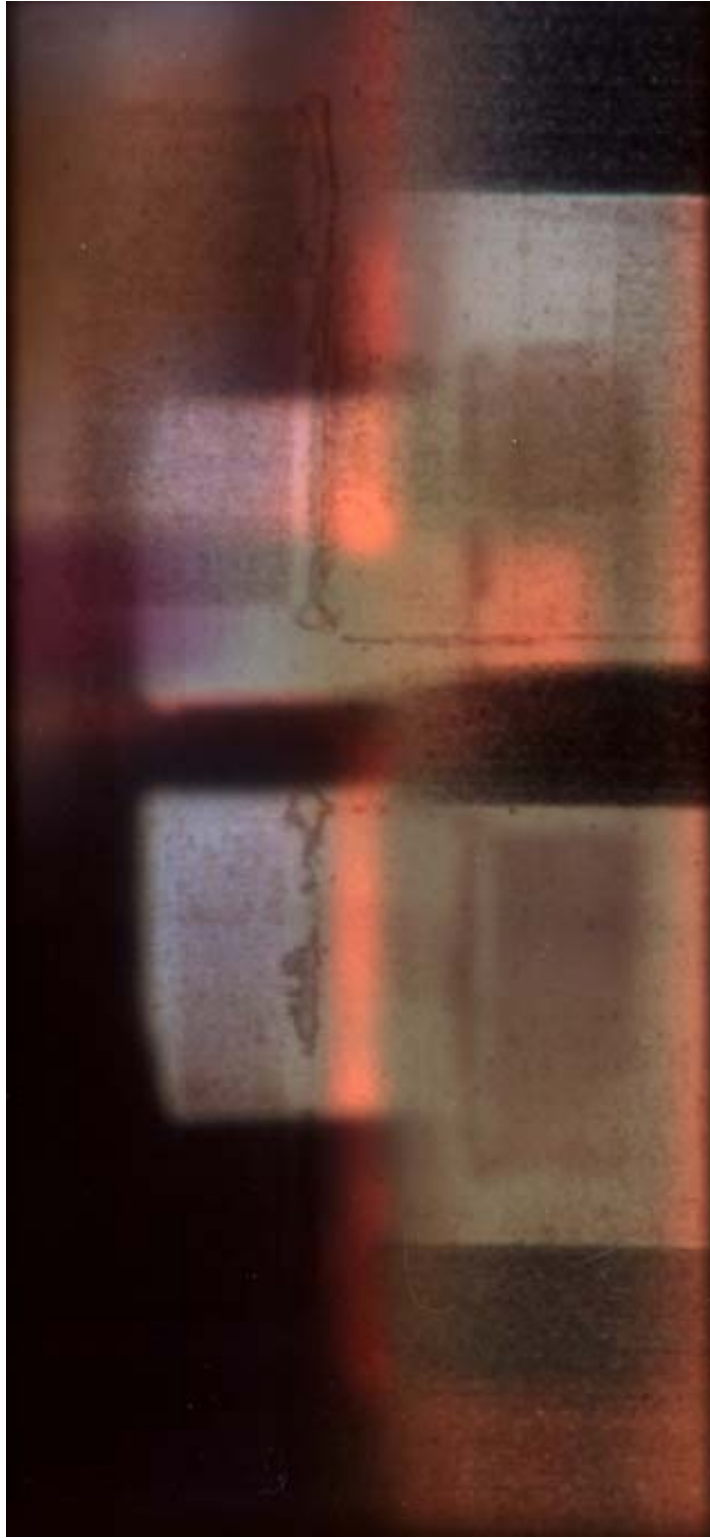
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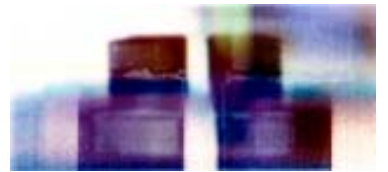
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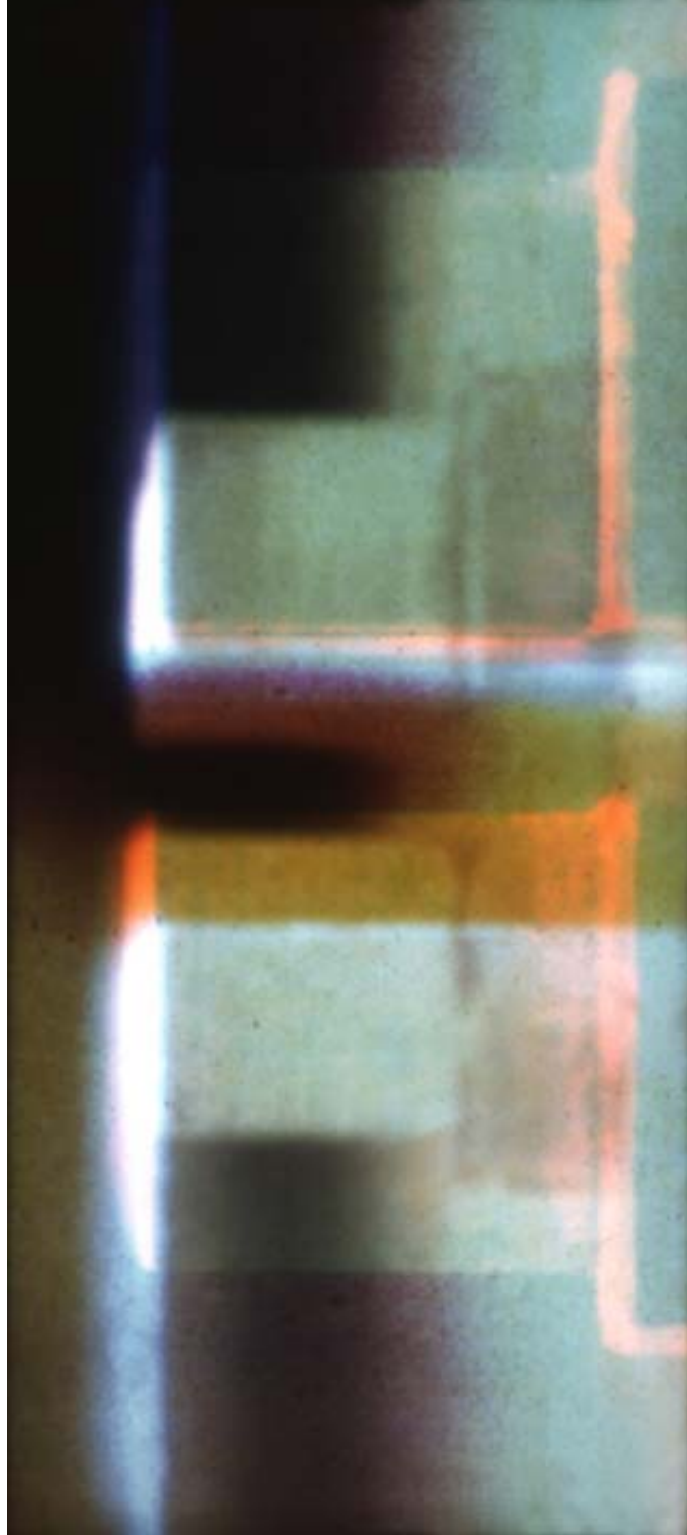
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B.

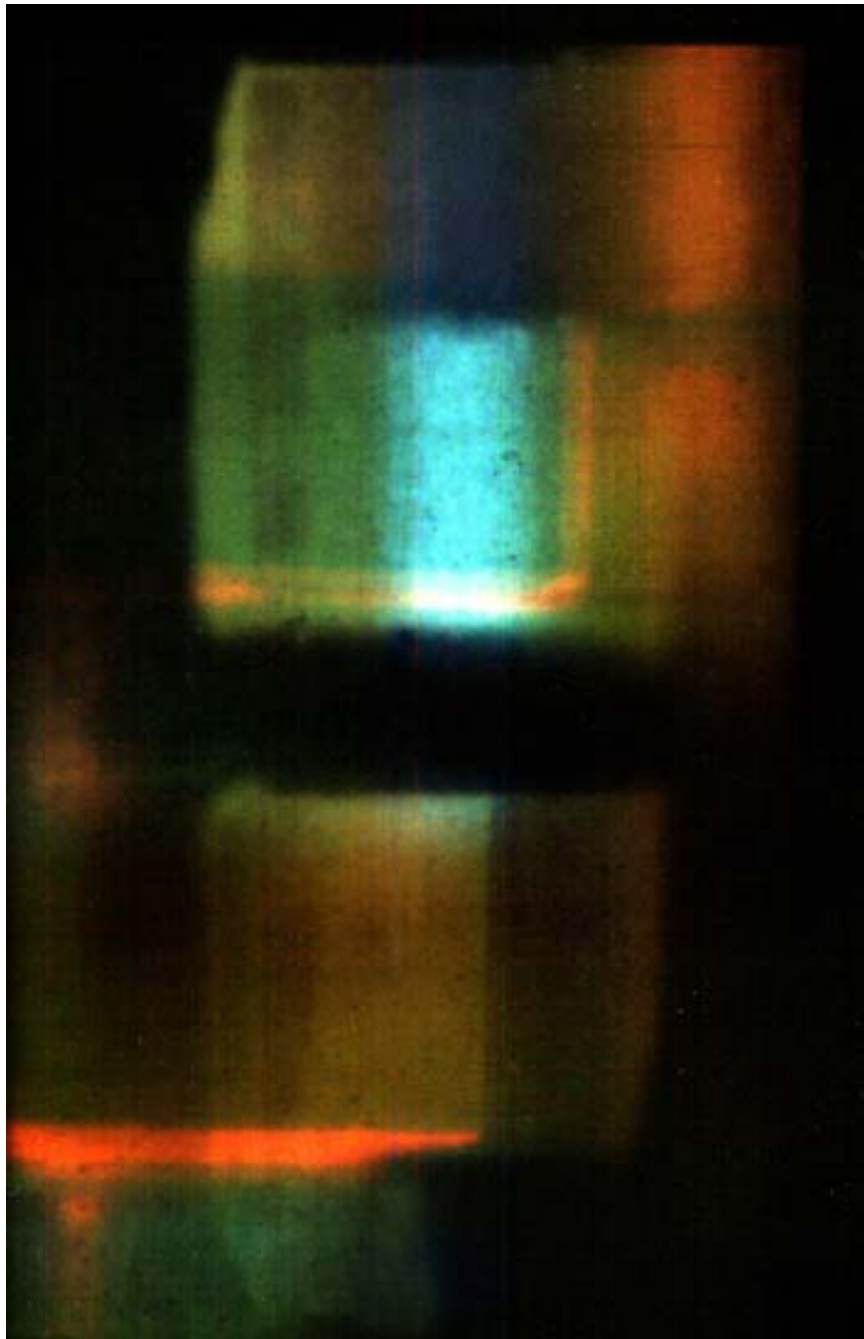


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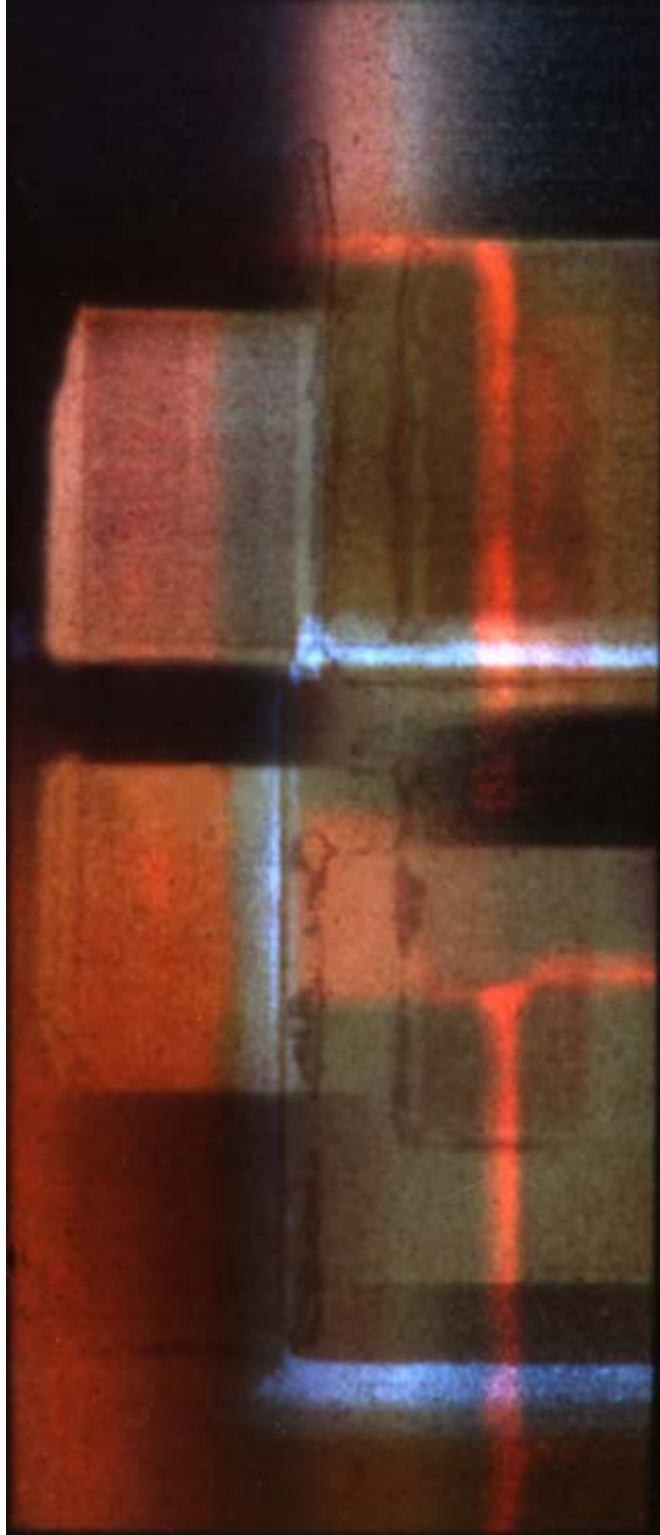
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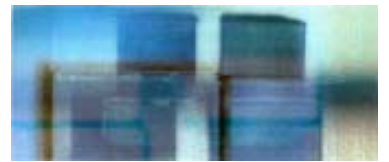


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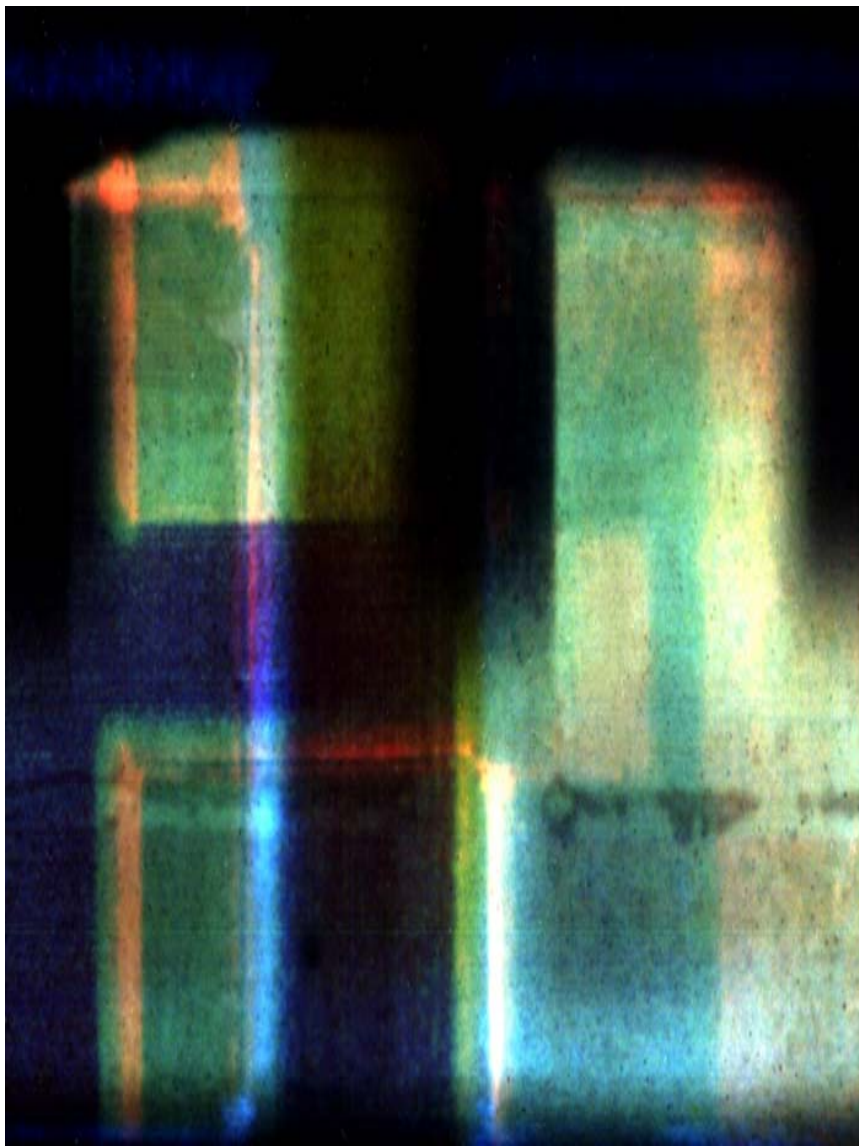


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A.



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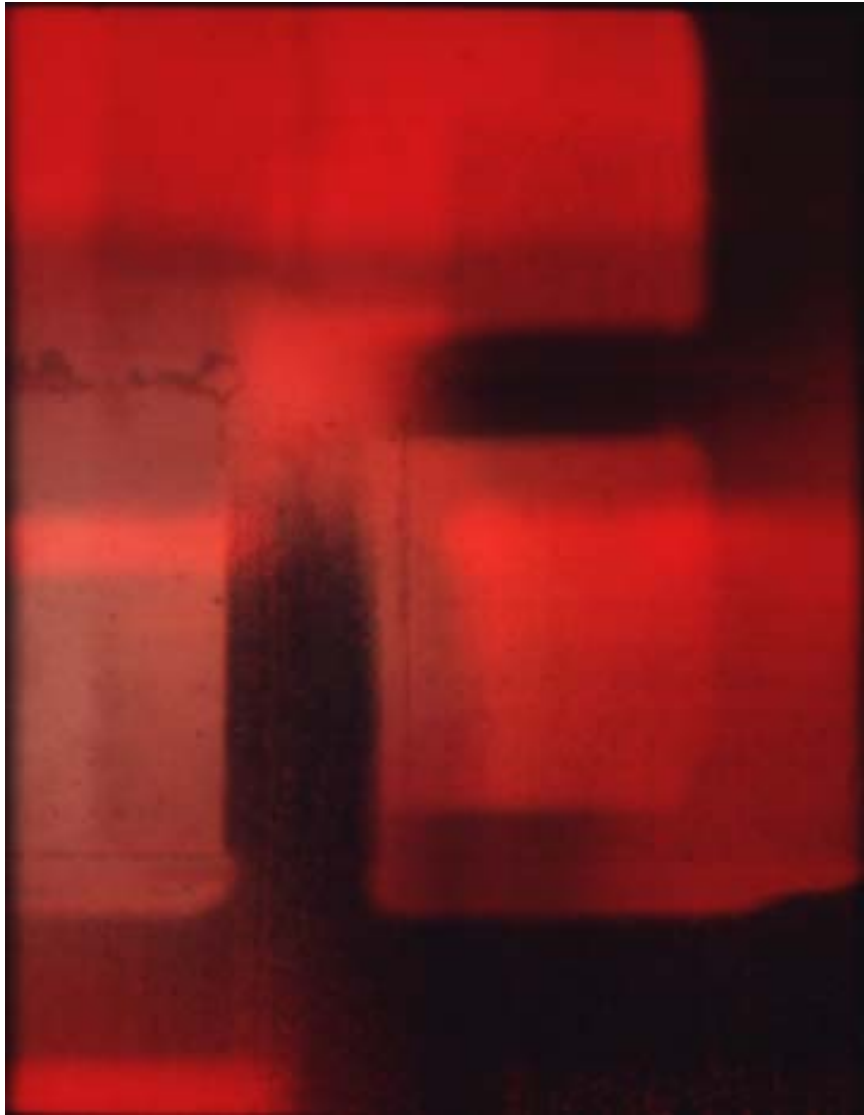
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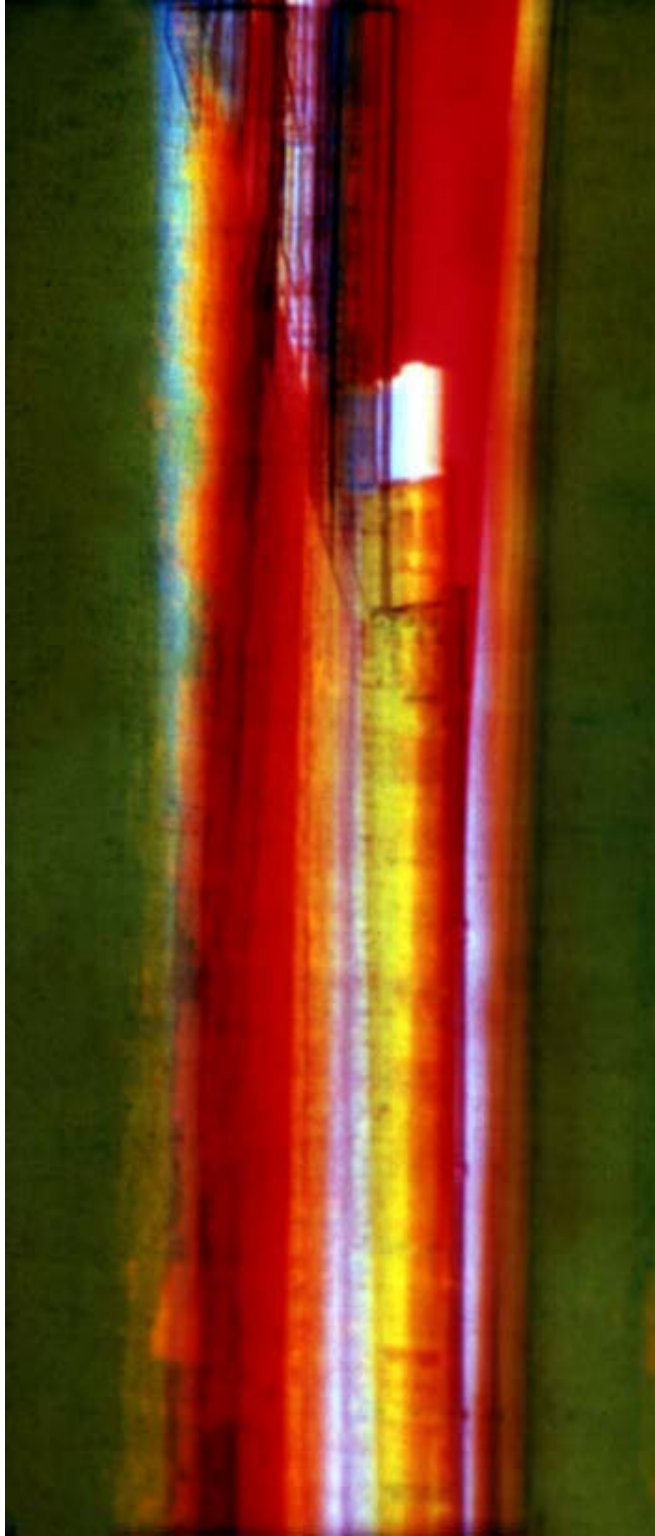


D.



E.





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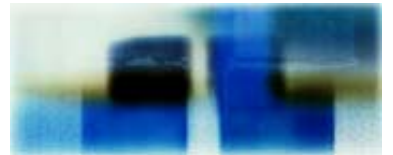


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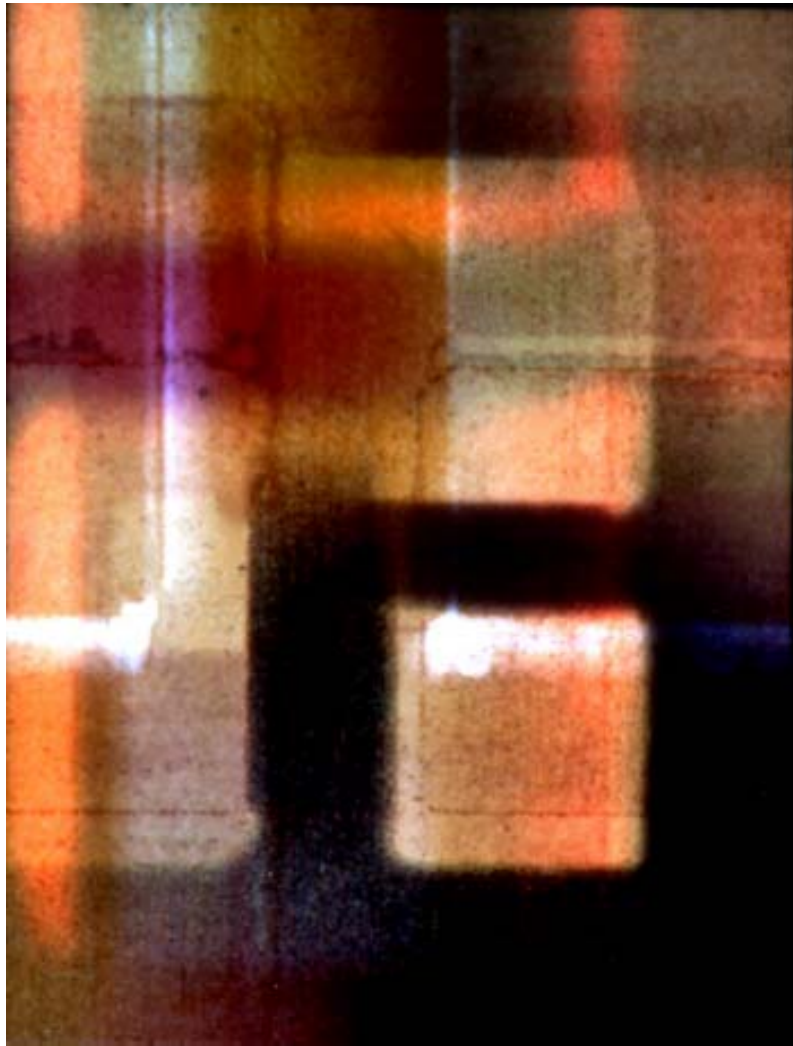


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B.



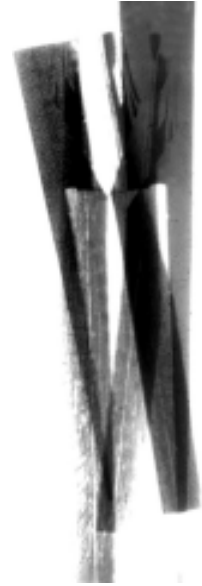
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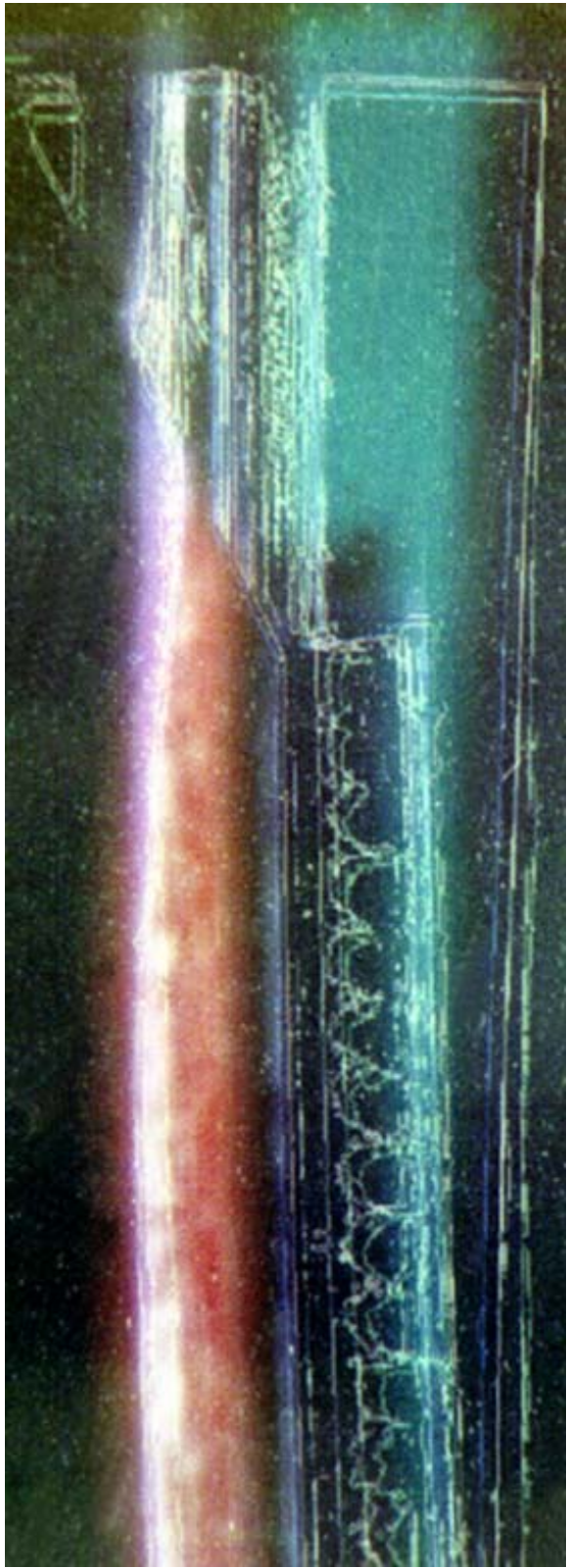
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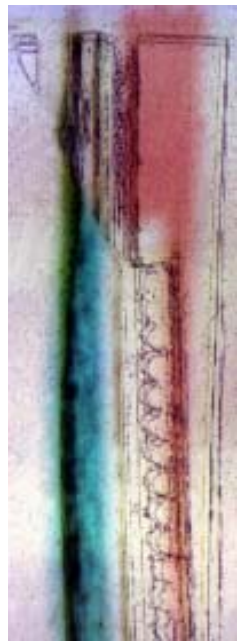


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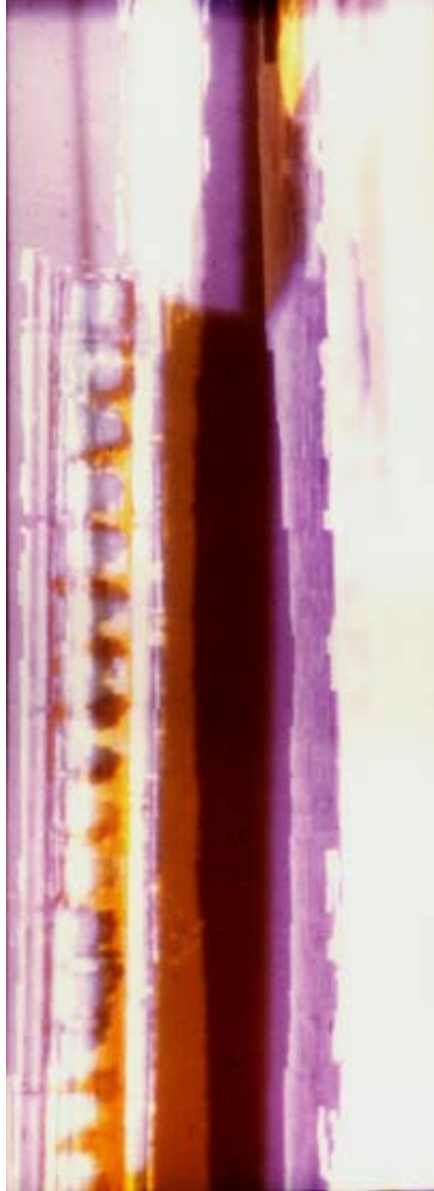




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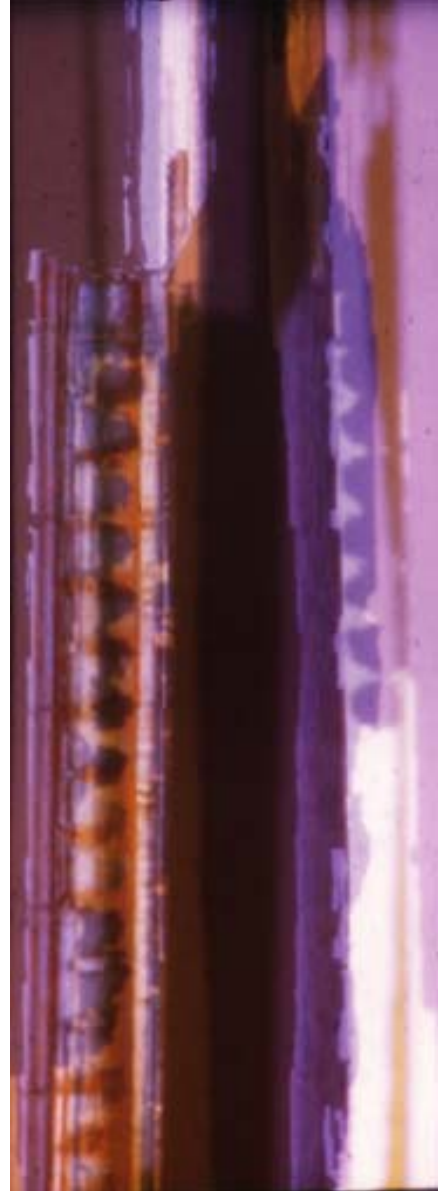


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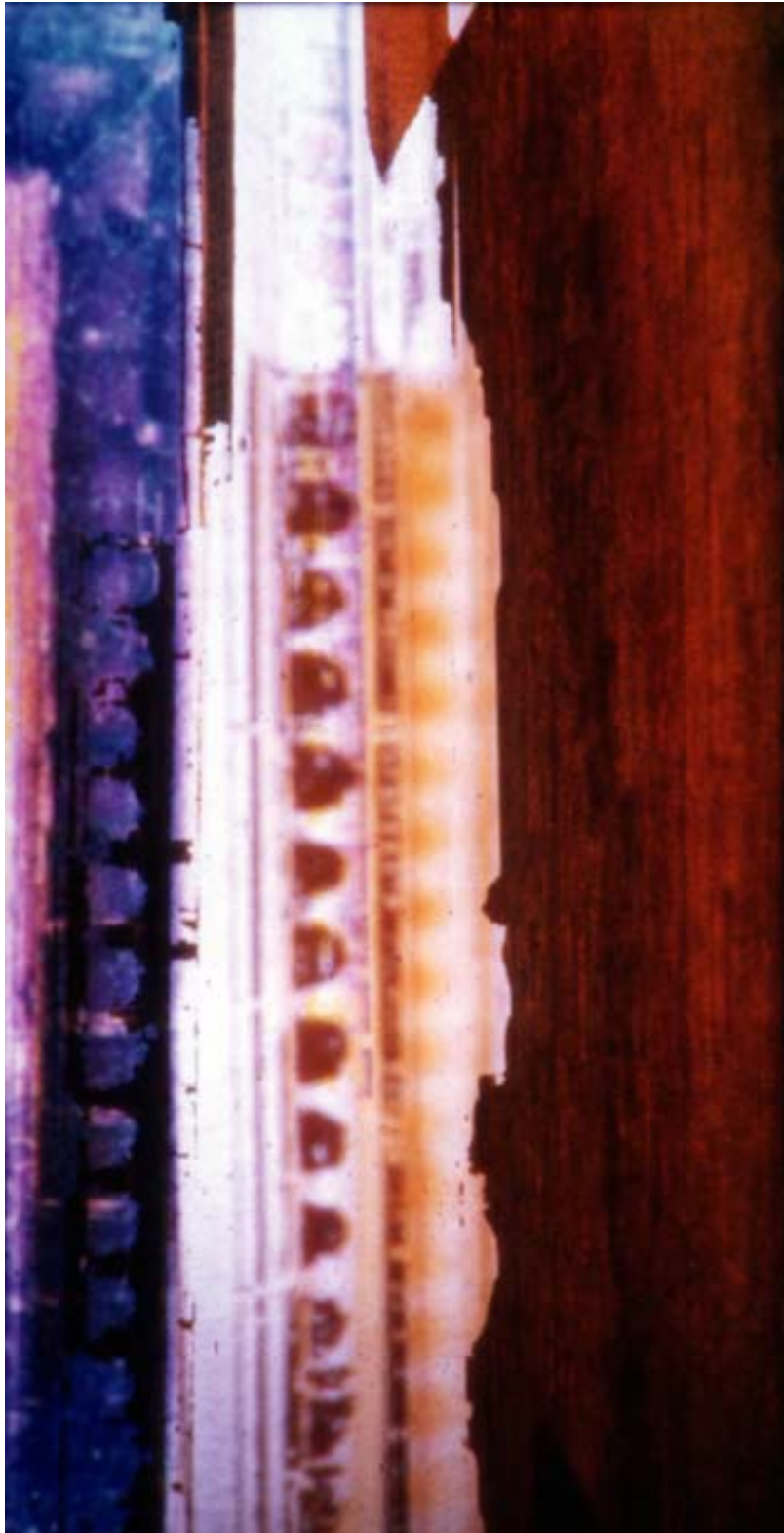
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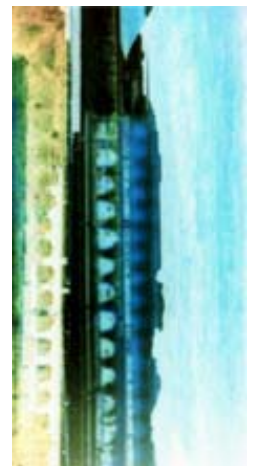
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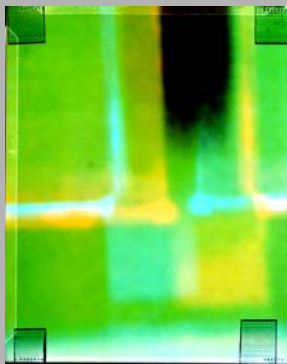
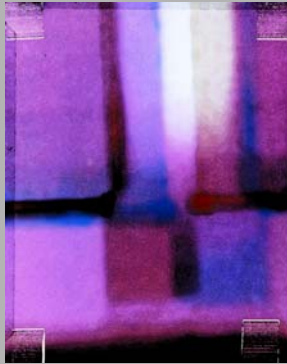


Fig. 52.

*A*h, when to the heart of man
Was it ever less than a treason
To go with the drift of things,
To yield with a grace to reason,
And bow and accept the end
Of a love or a season?

Robert Frost
(1874–1963)

For this body of work that has consumed most of thoughts and energies for many years, I give a heart felt *Thank You* to all who inspired, advised, contributed, and supported me.

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Preceding Page: Figure 52.

Top: T6_2 Two Transparent

Sections, Equidistant Offset. 2/98.

Bottom: T6_2 Two Transparent

Sections, Equidistant Offset

Complementary Hue Invert. 2/98.

Poem: Robert Frost, A Boys Will:

Reluctance, Forth Verse, c. 1913.

To My Friends and Family, who brainstormed, listened, and encourage me:

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***Rectangular Figure Studies* and *Planar Figures Studies No. 1* and *No. 2* as a Derivative Work—The original modified camera obscura’s image on Ilfochrome photographic medium was digitally modified, by either/or/combination of: digitally cleaned for clarity, transformed to emphasize a particular attribute and characteristic, digitally retouched for the correction of darkness due to underexposure of the medium to show a brighter image. Classification of Work: *Rectangular Studies* and *Planar Figures Studies No. 1* and *No. 2*: Ilford Ilfochrome Classic CPM.44M Pearl Surface Photographic (Direct Positive) Medium, Modified Camera Obscura, 8.5 to 11 inches, 3/98 to 4/98. Digitized Media Art, Digital files (.tiff) or (.jpg). Reproduction Printed Media: A. Tapestry, Ink Jet Media #221–11–50, 7 mil., Photomatte, 8.5 x 11 inches or B. High Quality Ink Jet Matte Paper, 720 or 600 dpi printing, 8.5 x 11 inches.

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abstract (-tion). 1) Designating a **genre** of painting, the intellectual and affective content of which depends solely on intrinsic form; 2) The act or process of removing or separating.

additive process. 1) Color *additive* mixture starting from black, three projected light colors of red, green, and blue adding up to white at the intersection. Sir Isaac **Newton**'s color spectrum theory; 2) White light contains all the colors of the spectrum.

aperture. In **optics** usually an adjustable opening in an optical instrument that limits the amount of light that passes through a lens; 2) For artistic and scientific minds the eye's aperture or iris is similar to the **pinhole**.

arrangement. 1) "Include the putting of things in their proper place, and the elegance of effort which is due to adjustments appropriate to the character of the work." (Marcus **Vitruvius** Pollio); 2) Pleasing display: a group of things organized in a way that is meant to be pleasing to look at, or the arrangement of such a group; 3) Organization: the way in which something is organized.

atmosphere (-ic). 1) A specific distance in space; 2) An air mass surrounding a body, object, or form.

attributes. 1) A quality or characteristic belonging to a thing; distinctive feature, i.e., height, width, depth, weight, opacity or **translucency**, structural form; 2) Physical features.

axis (-es). 1) A straight line about which a body or geometrical object rotates or may be conceived to rotate; 2) An unlimited line serving to orient space.

azimuth. 1) The horizontal angular distance measures clockwise in degrees along the horizon from a point of reference, usually the observer's bearing due south from a fixed reference direction to a position, object, or object referent; 2) In three-dimensional physics in terms of "polar or world coordinates," in which the location of an object is defined by a distance from the origin of the coordinate system, along with an angle defining "*azimuth*" (rotation in the horizontal plane).

b. Born.

background. The space in pictorial representation, usually appearing as if in the distance, arranged to provide relief for the principal objects; the general scene or surface against or upon which designs, patterns, figures, etc. are seen or represented.

brightness. 1) Value; Luminosity; Brilliance; 2) Lightness or Darkness of a color; 3) Color (Hue or Species) can be visibly recognized as *brightness* (highest) to darkness (lowest) intensity gauge that can be recorded through the saturation (purity) level of the chroma/value ratio.

brushstrokes. The movement of the paintbrush as it appears on the painting surface. "**Lightstrokes**," on the other hand, are the perceived movements by the visual characteristics, i.e., shape, texture, color, etc. applied to the directed light; a "sculpted palette."

c. *Circa* (Latin) about.

chap. Chapter.

camera obscura. 1) *Camera* (Latin) for room. *Obscura* (Latin) for darken; 2) Comparison relative to the human eye; 3) Sketching device for artist called dark chamber; 4) Darkened boxlike chamber using light to project through a lens an image of proper forms and color to a distant surface; 5) Chamber, boxlike apparatus into which an analysis of an outside image from light is projected through a convex lens creating a detailed image in one-point perspective; used to make precise drawings or photographs.

capture (-ing). To gain possession of or control of **media**; the projected **visual characteristics** being applied to the light.

centric point. Relative to **perspective** drawing: This is the point in the picture directly opposite the viewer's eye. It is also known as the "point of convergence," or the "vanishing point."

characteristic. Defining feature or quality that makes something recognizable, i.e., material properties, color, surface finish responsive to light, texture, and proportion relative to size. Expressive

features.

chiaroscuro. 1) Shade and light or dark, referring to the modeling of volume by depicting light and shade by contrasting them boldly; 2) A method for applying (**grayscale**) **value** to a two-dimensional piece of artwork to create the illusion of a three-dimensional solid form.

chroma (-tic). 1) Color intensity or saturation of the perceived color; 2) A color appears to differ from a gray of the same lightness or **brightness**.

circumscription. 1) The process of delineating the external outline; 2) The recording of the external outlines. (Leon Battista **Alberti**.)

CMYK. 1) Cyan, Magenta, Yellow, and Black; 2) Johann Wolfgang von **Goethe**'s theory of color involves color subtraction which leads to the idea that cyan, magenta, and yellow are the primary colors.

color. 1) **Hue** and **saturation**: the property or aspect of something that involves hue, lightness, and saturation; 2) In the case of light, hue, **brightness**, and saturation.

color fringes. 1) Luminance and intensity distribution at a point, along line, on a surface realized as a color fringe; 2) Chromatic aberration, 3) *Fringes*: holographic patterning that can be computed and used to generate three-dimensional images.

complementary. Hues that appear opposite one another on a color circle. When placed next to one another, complementary colors are intensified and often appear to vibrate.

composition. 1) **Arrangement**: the way in which the parts of something are arranged, especially the elements in a visual image; 2) Product: a thing created by combining separate parts.

compound colors. 1) Secondary or mid-way projected colors; 2) Colors produced by the spectrum of light viewed through a prism as being either simple, or *compounded*, i.e., a combination of primary and secondary. Then mutual aligning rays of different species, i.e., color origins, produce "midling" or intermediate color. (Sir Isaac **Newton**;) Also see **mixed** colors.

conal. Being cone-shaped.

concave (-ity). 1) Curved like the inner surface of a sphere; 2) The condition of being *concave*; 3) parallel *concave*: positive union of forms.

confluence. Point of juncture; gathering together.

contrast. 1) Properly causing a **visual** sensation: the property of objects that depends on the light that they reflect and that is perceived as a **hue**. (Johann Wolfgang von **Goethe**;) 2) Juxtaposition of different things: an effect created by placing or arranging very different things; for example, colors, shades, or textures, next to each other; 3) Degree of lightness and darkness: the difference or the use of differences between the lightest and the darkest parts of something.

contextual (-ly). 1) To join together; 2) The act of weaving, expressing, or depicting parts together upon the context.

convex (-ity). 1) Having a surface or boundary that curves or bulges outward; 2) A state of being convex; 3) parallel convex: negative intersection of forms.

create. To be first to portray and give character to.

deduct. To take away.

density. The degree of optical opacity of a medium or material, as of a photographic negative.

depth. The extent, measurement, or dimension downward, backward, or inward.

depth of field. 1) When a lens focuses on a subject at a distance, all subjects at that distance are sharply focused. Subjects that are not at the same distance are out of focus and theoretically are not sharp. However, since human eyes cannot distinguish very small degrees of unsharpness, some subjects that are in front of and behind the sharply focused subjects can still appear sharp. The zone of acceptable sharpness is referred to as the *depth of field*; 2) Total focused area in front of and

behind an object held in focus of a camera or lens; 3) Zone of acceptable sharpness is referred to as the *depth of field*. Thus, increasing the *depth of field* increases the sharpness of an image. We can use smaller apertures for increasing the *depth of field*.

depth perception. 1) Perception of spatial relationship, especially of distance between objects in three-dimension; 2) Perception Cues: refer to James J. Gibson's depiction of visual *depth perception*, including:

A. *Perspective of Position.*

1. *Texture*—gradual increase in the density of the texture of a surface as it recedes in the distance.
2. *Size Perspective*—as objects get further away they decrease in size.
3. *Linear*—parallel lines that join at a single vanishing point at the horizon.

B. *Perspective of Parallax.*

1. *Binocular*—operates very much out of awareness. It is sensed because, owing to the separation of the eyes, each projects a different image.
2. *Motion*—as one moves forward in space, the closer one approaches a stationary object, the faster it appears to move.

C. *Perspectives Independent of the Position or Motion of the Observer.*

1. *Aerial*—is derived from the increased haziness and changes in color due to the intervening atmosphere [or air].
2. *Blur*—objects in a visual plane other than the one on which the eyes are focused will be seen less distinctly.
3. *Shift in the amount of double imagery*—the gradient in the shift is a cue to distance; a steep gradient is read as close, a gradual gradient as far.
4. *Completeness or continuity of outline*—the manner in which one object obscures (eclipses) another determines whether the one is seen as behind the other or not. [Offsetting or superposition].
5. *Transitions between Light and Shade*—an abrupt shift in brightness [is] interpreted as an edge. Gradual transitions in brightness are principal means of perceiving molding or roundness. [Color massing.]

design. 1) To conceive; invent; contrive; to form a plan for; 2) A visible composition; 3) A reason, purpose, or intention.

differentiate (-ion). 1) To perceive or show the difference in or between; discriminate; distinguish; 2) By developing differences through alteration or modification.

digital images. Continuous-tone images are produced by analog optical devices, which accurately record image data methods, such as a sequence of electrical signal fluctuations that vary continuously over all dimensions of the image. In order for a continuous-tone or analog image to be processed or displayed by a computer, it must first be converted into a computer-readable form or digital format. This process applies to all images, regardless of the origin and complexity, and whether they exist as black and white (**grayscale** or **chromatic hue**) or full color. A digital image is composed of a rectangular (or square) pixel array representing a series of intensity values and ordered through an organized (x,y) coordinate system.

dimension (-al). 1) A measure of spatial extent, especially width, height, and length; 2) **One-dimensional**; as a point moves, it leaves a trace of a line; 3) **Two-dimensional**; as the line shifts in a direction other than its own, it defines a plane, a two-dimensional element; 4) **Three-dimensional**, the plane, extended in a direction oblique or perpendicular to its surface, forms a three-dimensional **volume**; having or appearing to have depth.

diminution. 1) A lessening, decreasing, or reduction of something, or the result of such a reduction; 2) Disappearance.

dissect (-ion) (-ing). 1) To examine, analyze in minute detail; 2) To cut apart or separate.

dynamic. 1) Visual directional motion; 2) Variations on intensity of colors.

École des Beaux-Arts. (French) 1) School of Fine (Beautiful) Arts; 2) King Louis XIV of France (1643–1715), in 1683 founded Royal Academy of Fine Arts and Royal Academy of Architecture in Paris, France. The schools were free to artists whose previous training enabled them to pass the entrance examinations. By elevating artisans to classical academicians and training, the power of the medieval guilds was eroded and centered instead on the patronage of the king. Although the Royal Academies nominally were abolished in 1793 by the National Convention, their schools continued to exist and in 1819 were reorganized as one institution that eventually became the *École des Beaux-Arts*; 3) In 1861, Paul **Cézanne** arrived in Paris, failed the examination of entry of the School of Beautiful Arts, then returned to Aix-en-Provence, in order to work in the paternal bank. Initially opposed to his son's desire to become a painter, his father ended up allowing Cézanne to have this vocation, and paid a revenue to him.

e.g. Exempli gratia (Latin) for example.

Empirical (-ism). 1) Relying upon or derived from observation or experiment; 2) Guided by practical experience, and not theory; 3) Natural sciences. (John **Locke**); 4) Primarily, and in its psychological application, the term signifies the theory that the phenomena of consciousness are simply the product of sensuous experience, i.e., of sensations variously associated and arranged.

equilibrium. Situation of balance: a state or situation in which opposing forces, shapes, objects, or factors balance each other out and stability is attained.

et al. Et alii (Latin) and others.

etc. Et cetera (Latin) and so on, and the like, and other things.

eurythmy. Structural harmony: inherent harmony of proportion or structure.

experiment. To determine the efficacy of something previously untried.

explore (-ation). 1) To search into or range over for the purpose of discovery; 2) An investigation or search.

extracting. To remove for separate consideration.

extramission. A theory of how visual rays function; light rays go out from the eye.

extruded. 1) To shape by forward motion through another material; 2) To protrude or project.

fabric. A material from which something is constructed, especially a building, or the physical structure of something.

figure. 1) The outline of the form of a thing; 2) Those elements which appear to stand out from or in front of their background; 3) A surface or space bounded on all sides by lines or planes.

focal length. 1) The distance of the **focal point** from the surface of a lens; 2) The distance from the center of a lens or the surface of a mirror to the point at which light passing through the lens or reflected from the mirror is focused.

focal point. 1) State of maximum distinctness or clarity of such an image; 2) The **centric point** is the start of the *focal point* located on an axis.

form. The contour and structure of something as distinguished from its substance.

genre. A category of art distinguished by a definite style, form, or content.

geometry (ies). 1) The branch of mathematics that is concerned with the properties and relationships of points, lines, angles, curves, surfaces, and solids; 2) Euclidean *geometry* according to the principles of **Euclid**, as described in his *Elements*, in which only one line parallel to another given

line may pass through a given point are constant distance; 3) Non-Euclidean *geometry* describes both hyperbolic (parallel lines do exist but can be curved away from each other) and elliptic (parallel lines do not exist and curve towards themselves and intersect) geometries; there are infinitely number of lines through *a point* parallel to a *line*. These geometries are in contrast to Euclidean geometry.

Gestalt. 1) (German) Form; 2) An organized or unified whole; 3) Whole, **figure, form**, pattern, meaning, and configuration; 4) *Gestalt* psychologists, about 1912, advanced the theory which explains psychological phenomena by their relationships to total forms rather than their parts.

gradation. Advancement by successive stages, tones, or shades, as from one color to another.

gradients. The rate at which the slope increases.

grayscale. 1) Digital scaling for **value**; 2) An image type that uses black, white, and a ranges of shades of gray. The number of shades of gray depends on the number of bits per pixel.

ground. 1) **Fore**: is close at hand; 2) **Mid**: including horizon; 3) **Back**: to infinity.

hierarchic (-y). In the visual field, objects are seen in a hierarchic relation of dependence. The spontaneous organization of the **visual field** assigns to certain objects the roles of framework, on which others are seen to depend. The field represents a complex *hierarchy* of such dependencies.

holograph (-y) (-ic). 1) *Hologram*: *holo* (Greek) whole, and *gramma* (Greek) meaning; 2) The technique of producing images by wavefront reconstruction on a photographic plate from which the diffraction pattern of a three-**dimensional** image can be projected; 3) Early method of producing a *holograph* was with a single light source (mercury arc lamp) and several pinholes on film transparencies; 4) In optical holography, a record and reconstruction of a physical phenomena interference and diffraction patterning of a **third dimensional** image with an extremely high degree of accuracy. A *holographic* pattern – called fringes – can be computed [brain computation] and used to generate a three-dimensional image. *Holography* is the only imaging technique that can produce all the depth cue; To reconstruct an image, the recorded interference pattern modulates an illuminating beam of light. The modulated light diffracts (bends and focuses) and reconstructs a 3-D replica of the wavefront that was scattered from the object scene. Optical wavefront reconstruction makes the image appear to be physically present and tangible. The image possesses all of the depth cues exhibited by the original object, including continuous **parallax** (vertical and horizontal) and ocular accommodation. Both the image resolution and parallax resolution of an **optical** holographic image is virtually unlimited.

horizon-line. In a **perspective** sketch, a horizontal line marking the location where all projection lines from the observer converge to a centric point. The placement of the *horizon-line* on the **picture plane** depends on the **vantage point** of the artist.

hue. 1) Species of color; 2) Shade of color: a specific gradation of a particular color; 3) A property of a color that enables it to be perceived; 4) The distinctive characteristic of any chromatic color distinguishing it from other hues. Typical primary hues: red, yellow, green, blue, or violet; 5) the name of a color. Strictly speaking *hue* is the family name for a group of chromatic colors.

hyperbolic geometry (-ies). 1) Non-Euclidean geometry; the “feel” of the *hyperbolic* plane (*hyperbolic* third-space) is a negatively curved space; 2) The parallel planes have an appearance of “saddle-surfaces.”

ibid. *Ibidem* (Latin) in the place.

i.e. 1) *Id est* (Latin) that is; 2) In other words.

image. 1) A reproduction of the appearance of someone or something, especially a sculptural likeness; 2) An optically formed duplicate; a representation of an object, especially optically; 3) Actual or mental picture: a picture or likeness of something, produced either physically by a sculptor, painter, or photographer, or conjured in the mind.

intellect. Somebody's ability to think, reason, and understand.

intromission. 1) Introduction, admission; 2) A theory of how visual rays function and images come into the eye.

invert (-ed). 1) An interchange of position, especially of adjacent objects in a positive form to a negative form; 2) To turn upside down.

inversion. The state of being inverted.

judgment. An opinion formed or given after consideration.

light-lines. 1) The denotations of hue gradients and texture-densities that translate an object into form. The *light-lines* can be expressed by the perspectives of light, color, and texture. 2) The *light-lines* are the recorded *line-tracings*.

light-sketching. 1) The act of sketching with the medium of projected light; 2) Light-sketching involves the action of "Lightstrokes," on the other hand are the perceived movements by the visual characteristics, i.e., shape, texture, color, etc. applied to the directed light; a "sculpted palette." See **brushstrokes**.

light-tracings. Is the characteristic of visual residues being transmitted by light-rays as they pass through each of the sectional transparencies, such as, a line extending from a point moving in a direction as a "ray;" each section alters the strength, quality, and condition of the light-rays. The physical altering and capturing of the light-rays was a perceived graphical recording of the perceptual trajectory **light-tracings** among the sections within a one-point transparent perspective study.

lineament. 1) Deriving from the mind, a feature or contour. (Leon Battista **Alberti**); 2) Lines, liner characteristics, schematic outlines.

loc. cit. *Loco citato* (Latin) in the place cited.

luminous (-ance). 1) Full of light; brightly illuminated forms; 2) Quality of being luminous: the condition or qualities of emitting or reflecting light; 3) The amount of **brightness**.

magnification. **Optics**, degree of enlargement: the amount by which an image is enlarged by scaled proportions.

mass (-ing). 1) Painting, areas of unified light, shade, or color; 2) To gather or form into a *mass*; 3) Solidity in **form**.

means. 1) How a result is obtained or an end is achieved; 2) Instrumentality used to achieve an end; 3) "*The rules of composition of outlines in three dimensions may be derived... "means" [such as arithmetical, geometrical, and musical] whose object is to find, given two other numbers, an intermediate one, which will correspond to the other two by a fixed rule, or, to put it another way, by a family relationship [or species].* (Leon Battista **Alberti**.)

medium (media). A specific type of artistic technique or means of expression as determined by the material used or the creative methods involved.

mixed colors. 1) Compound color, i.e., entirely mixed and blended together; compositional mixing with projected light resulted in **compound** colors, i.e., "indefinite variety of Intermediate gradations" (Sir Isaac **Newton**); 2) Mixing by **additive** (Newton) process: white light contains all colors or subtractive (**Goethe**) process: black contains all colors; 3) color obtained on a palette; 4) Light ray *color mixing*: "*Yet seeming transmutations of colours be made, where there is any mixture of divers sorts of Rays. For in such mixtures, the component colours appear not, by their mutual allaying each other, constitutes a midling colour. And therefore, if by refraction, or any other of the aforesaid causes, the difform Rays latent in such a mixture, be separated, there shall emerge colours different from the colours of the composition.*" (Sir Isaac **Newton**.)

motile. Capable of or demonstrating movement by independent means.

monochrome (-atic). 1) Single color, working in one color; 2) Three-dimensionally through gradients of shades of color.

monoprinting. A single print with multiple processes through the printing press with no duplication.

n. Endnote.

object (-ivity). 1) Anything perceptible by one or more of the senses, especially something that can be seen and felt, a material thing; 2) External or material reality.

offset. 1) Something set apart: anything set apart from something else; 2) Occlusion, overlap: monocular depth cue effected when one part of an image is obstructed by another overlapping part.

op. cit. *Opere citato* (Latin) in work cited.

optics (-cal). 1) The study of light e.g., visible white spectral light; 2) Any lens, prism or mirror used to direct light (as in an instrument); 3) The branch of physics that deals with light and vision, chiefly the generation, propagation, and detection of electromagnetic radiation having wavelengths greater than x-rays and shorter than microwaves; 4) *optical window*: the parts of the visible spectrum, i.e., approximate wavelength of 400–750 nanometers, of white light humans can see.

order. 1) “*Order gives due measure to the members of a work considered separately, and symmetrical agreement to the proportions of the whole. It is an adjustment according to quality. By this I mean the selection of modules from the members of the work itself and, starting from these individual part of members, constructing the whole work to correspond.*” (Marcus Vitruvius Pollio;) 2) Height, width, and depth of the member of a geometrical shape or object relating to a form, i.e., a line, plane, volume; 3) **Arrangement** of items or patterning sequence: the way in which several items are arranged, as an indication of their relative importance or size.

ortho (-gonal) (-graphic). 1) Distance or projection; method of representing views: a way of providing a two-dimensional graphic view of an object in which the projecting lines are drawn at right angles to the plane of projection. In so doing this type of presentation appears to give the feeling of three **dimensions**; 2) Made-up of vertical lines: composed of vertical lines.

orthogonal line. 1) Line of sight along the *orthogonal* distance from the **centric point** located on the **picture plane**; 2) **Optical axis** is the straight line of the *orthogonal* line.

painterly. Characteristic of a painter; artistic.

painting. 1) Direct application of pigment to a surface to produce by tones of color as arrangement of natural or imagined forms; 2) In this text the use of “sketching” and “*painting*” are sonorously used.

palette. 1) The range of colors used in a particular painting; 2) Assortment of colors on a *palette* typical of an artist’s work.

parallax. 1) An apparent change in the position of an object when the person looking at the object changes position; 2) Resolution: the number of different **perspective** views available to the viewer; 3) Motion: a (monocular) depth cue sensed from the apparent change in the lateral displacements among objects in a scene as the viewer’s eye moves. A display which provides parallax allows the viewer to move around the object scene; **Visual touching**.

perceive. 1) To become aware of directly through any of the senses; especially, to see or hear; 2) To become aware of in one’s mind; achieve understanding; 3) Operate within one’s **visual field**.

perception (-tual). 1) The process, act, or faculty of perceiving; in art, visual recognition of the surrounding environment; 2) Any insight, intuition, or knowledge gained; 3) Observing of the **visual world**.

perspective. 1) One-point: a drawing portrays a realistic three-**dimensional** view from a specific point in space; “*is method of sketching a front with the sides withdrawing into the background, the lines all meeting in the centre of a circle.*” (Marcus Vitruvius Pollio;) 2) Linear: renders depth by using actual or suggested lines that intersect in the background to delimit relative size from background to foreground; 3) *It is possible therefore to think of perspective as a more general science than the rules*

of representative drawing, or the description of visual sensations or even the transformations of forms on one abstract plane to forms on another plane. It would be the geometry of the ways in which the light is reflected. Linear *perspective* of the classical sort would be only a small part of it, for that is merely the perspective of the edges of rectangular objects. There is also the *perspective* of the textures of inclined surfaces, the gradients of texture-density, the steps of density at the edges of objects, the ratios of densities in different directions and still other variables of higher order. (John J. Gibson.) [For Aerial, Blur, Textural, Linear, Dimensional, Binocular, and Motile, see *depth perception*.]

photogram. Drawing or tracing of an object with a light source and an open **aperture**, or no camera, onto photographic paper.

physical space. 1) **Euclidean**, geometrical space, optical space: the space represents geometrically an exhibit at every point and in all directions; 2) Euclidean space is three-**dimensional**; e.g., there are three independent directions that objects within the space can move: up/down, left/right, and forward/backward; 3) Objective, geometrical space, **visual world**; 4) Broadly, the distance between two points or the area or **volume** between specified boundaries.

picture plane. 1) Any geometrical plane placed between an object and the eye that will intersect the **visual pyramid** projecting from the object to the eye; 2) Referred to in photography as focus plane.

pinhole camera. 1) Lensless camera: a basic form of camera with a tiny hole for the aperture and no lens. Light passes through the hole to form an inverted image on the picture plane; 2) A small light-tight box with a darkened interior and a tiny hole in the center of one end.

planar figure. 1) Any flat or level surface, outline or shape, or form; 2) A surface or space bounded on all sides by lines or planes.

plane (-ar). 1) A two-dimensional surface containing the straight lines connecting any four points; a flat and level surface; 2) *Plane* geometry, a branch of geometry dealing with plane figures.

platform. Any horizontal surface raised above the level of the adjacent area.

pre-architecture. Preliminary or preparatory work through sketching or diagramming shapes or objects.

primary colors. 1) The colors red, green, and blue are classically considered the *primary colors* because they are fundamental to human vision; 2) These are assumed to be inherently more essential than certain other colors which result from **mixing** or blending of the *primary* colors; 3) There are three kinds of primary colors: light primaries or color as an optical concept, closely defined by wavelengths in numerical units ranging from red 780 to violet 390 nanometers (visible spectrum); pigment-mixture primary or chemical color is the study of paint or matter, and **psychological** primary is seen mainly from lightness to darkness; colors that affect emotion; 4) *Primary* equals **simple** or original color. (Sir Isaac Newton.)

product. A direct result.

proportion. Relative size of things: the correct or desirable relationship of size, quantity, or degree among two or more things or parts of things.

psychological colors. Wolfgang von **Goethe** refers to the colors that the eye perceives as *physiological* (subjective observation or *necessary condition of vision*) color, meaning, a physical attribute to an object. Today we refer to them as psychological colors.

Rational (-ism). Pure reason (i.e., reason independent of experience) can yield informative knowledge, knowledge of (some aspects of) the world rather than just of the relations between our concepts. Such rational knowledge is labeled *a priori*, to indicate that it is prior to and independent of experience. (**Plato** and Rene **Descartes**.)

ray of light. 1) *Centric*: the central and most concentrated portion of the ray of light for a conal-shaped beam going straight forward; 2) *Median*: the mid-portion of the light ray from a conal-shaped beam splaying away from the center with moderate spray; 3) *Extrinsic*: the ray of light

going towards the outline of a surface; weakest part of the rays of light form a conal-shaped beam.

record (-ed) (-ing.) To set down for preservation in permanent form.

rectilinear. Moving in, consisting of, bounded by or characterized by a straight line or lines.

reflexion. “Is careful and laborious thought and watchful attention directed to the agreeable effect of one’s plan” (Marcus Vitruvius Pollio).

RGB. 1) Red, green, and blue; 2) Sir Isaac Newton’s theory of color involves color addition, which leads to the idea that Red, Green and Blue are the primary colors.

relief. The projection of figures or forms from a flat background or such a projection that is apparent only, as in painting.

resonate (-ing). To have an extended effect or impact beyond that which is immediately apparent.

saturation. 1) Color (hue or species) purity or intensity; 2) **Chroma**, strength or weakness of a chromatic color; 3) The degree to which a color (hue or species) is free from mixture with white (color tinting).

scale. A system of proportion by which magnitudes are defined.

section. 1) Distinct part: a distinct part that can be separated or considered separately from the whole of something; 2) View of something cut through: a view or representation of something cut through to show its internal structure; 3) A thin skin sliced away.

shade. 1) Area out of direct sunlight: an area of relative darkness where direct sunlight is blocked or obscured. The appearance of that portion of a surface which lies in **shadow**; 2) The color evoked when looking at the mixture of a chromatic hue with a darker hue; 3) A gradation of a **hue** mixed with black

shadow. 1) Gray *shadow*: shadow casting by the sun, in its full **brightness**, on a white surface, giving us no impression of color; it appears black or weaker, half-light, and gray. (Johann Wolfgang von Goethe); 2) Color *shadow*: two conditions are necessary for the existence of color shadow: principal light tinges the white surface with **some hue**; secondly, that a contrary extent casts a shadow. (Johann Wolfgang von Goethe)

shape. The outline or characteristic surface configuration of a thing; contour; **form**.

simple colors. 1) Primary projected colors, i.e., red, green, and blue (Sir Isaac Newton.) Also see **primary colors**.

sketch (-ing). 1) A spontaneous and rough notation of a first idea, drawn or from the imagination. It may broadly capture a position or gesture, or suggest the proportions or **arrangement** of subject in a composition; 2) In this text the use of “*sketching*” and “*painting*” are synonymously used.

space. 1) The infinite extension of the three-dimensional field; 2) The distance between two points, or the area or volume between them.

species. A distinctive kind of **chromatic** color or **hue**, namely, the primary and secondary classification of color.

static. 1) Pertaining to bodies or forms at equilibrium; 2) A condition that exists when the value of some parameter remains constant.

stereogram. 1) A picture or diagram designed to give the impression of solidity; 2) A type of **hologram** that is composed of a series of discrete two-dimensional **perspective** views of the object scene.

stereoscopic. A three-dimensional display type that presents left and right views of the imaged scene without special viewing aids. Examples include parallax barrier, slice stacking, and **holography**.

study. A preliminary sketch, as far as a work of art; the pursuit of knowledge, as by reading, observation, or research.

subjective. Characteristics of reality as perceived rather than as objectively true outside of the mind.

subject matter. 1) *Subject:* the *matter* dealt with in a composition, discussion, or other pursuit; 2) Defining characteristic: in logic, the characteristic or set of characteristics that makes up the meaning of a term and thus defines the objects to which a term can be applied (light, color, shade or shadow, and background).

subtractive process. Color *subtractive* mixture starting from white light; three projected filter colors of Cyan, Magenta, and Yellow add up to Black, meaning at the overlay, all light is absorbed and appears black, Johann Wolfgang von **Goethe** color theory.

superposition. To place or lay one object on top of or above another.

symmetry. 1) A perceived and perceptual balanced proportion: harmony or beauty of **form** that results from balanced proportions; 2) An **arrangement** or balanced design in which similar or identical elements have been organized in comparable order on either side of an **axis**; 3) A **Gestalt** perceptual principle stating that similar or identical objects seen on either side of a possible axis of rotation are more likely to be seen as a group.

tabula rasa. (Latin) clean slate.

texture. A grainy or dimensional quality that represents the structural surface.

third dimensional. 1) The quality of depth in an object; 2) The attributes of a solid object whereby from differs from a two-dimensional drawing of it. Also see **dimension (-al)**.

translate (-ion). To convey for one form or style to another; convert.

transference. The act of transferring something from one form to another.

translucent (-cy). 1) Transmitting light, but causing sufficient diffusion to eliminate perception of distinct images, to shine through; 2) Transmitting light with distortion.

transparent (-cy). 1) Capable of transmitting light so that the object or image can be seen as if there were no intervening material; 2) Transmitting light readily.

value. 1) **Brightness**; 2) Lightness or darkness of the color; 3) **Color values:** are loosely called tints and shade, i.e., tint is a light value and shade is a dark value.

vantage point. A position that affords a broad overview or **perspective**.

veil. The “intersection” also known as the *veil*; threads were tied to a frame in a parallel square section, the frame was then placed between the painter and the object or landscape, an imaginary line was then perceived between the painter’s (only one eye) being **Alberti’s “centric point”** and the object beyond the frame. (Martin **Kemp**.)

vibrate. A visual oscillation among **hues**.

viewpoint. A position from which something is observed.

visual. 1) Pathways for the understanding of an object; 2) Touching or feeling; an emotional response to something being viewed following the object’s characteristics in order to recognize its form.

visual characteristics. 1) Defining feature: a feature or quality that makes something recognizable (shape, proportion, texture, contrast, density, and gradation); 2) Of the object, descriptive qualities such as line contour, **plane**, and **volume**.

visual field. 1) Concrete as the physical world is observed; 2) The area in space that may be visualized by constantly shifting light patterns recorded by the eye or retinal images; 3) That which is recognized from or pertaining to the sense of sight with the eyes fixed at one point.

visual pyramid. 1) The **perspective** projection is the intersection of a plane with the pyramid or cone of sight; 2) Cone of vision using geometry, the theory of **perspective** describes how to project a three-dimensional object onto a two-dimensional surface; 3) “Let us imagine the [light] rays, like extended very fine threads gathered tightly in a bunch at one end, going back together inside the eye

where lies the sense of sight. There they are like a trunk of rays from which, like straight shoots, the rays are released and go out towards the surface in front of them. This is why it is usually said that sight operates by means of a triangle whose base is the quality seen, and whose sides are those same rays which extend to the eye from the extreme points of that quality." (Leon Battista **Alberti**.)

visual space. 1) Non-Euclidean, result of experience, painter's space, **physiological** space, photographic and tactile space; 2) Subjective **physiological** space, visual field.

visual touching. My term *visual touching* can be defined by John. J. **Gibson** thus: "The perspective of surface texture is not shown, only what are called outlines. In both notes that it is the optic array that is the stimulus, not the image." The **perspective** of texture, as distinguished from the perspective of rectilinear outlines, seems to be a fundamental basis for the impression of a three-dimensional environment, or what has been called space.

visual world. Perception of the whole of what man perceives through his **visual fields**.

volume (-tric). The size or extent of a **third dimensional** object or region of space.

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Alberti, Leon Battista (1404–1472)



Genova, Italian: Philosopher, Architect, Musician, Painter, Sculptor, and Author: *De Pictura* (written 1435 published 1511). “Linear Perspective—all lines converge to a singular point in the distance or vanishing point.” If Brunelleschi was a builder, Alberti was a theoretician: he gave a scientific basis to works of art and ennobled the figure of the artist, placed painting, sculpture and architecture on the same level as literature and philosophy. The craftsman became an intellectual.

<http://easyweb.easynet.co.uk/giorgio.vasari/albert/alberti.html>

<http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Alberti.html>

Aristotle (384–322 B.C.)

Greece: Author of physical subjects, mathematical method, emphasized the role of the senses, experience and learning, in the development of spatial vision and representation. Empirical thought process.

<http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Aristotle.html>



Arnheim, Rudolf (b. 1904)

Author of psychology and philosophy, historian of arts



and music: Rudolf studies Gestalt psychology because it related closely to his interests in the arts, in that, it deals “with the problem of wholeness, of filed processes, situations, in which the whole is entirely determined by its parts, and the other way around.” *Art and Visual Perception: A Psychology of the Creative Eye*, where he intends to “narrow the gap between scientific and artistic knowledge; to use scientific finding to better understand the arts while

preserving the equally pivotal role of subjectivity, intuition, and self-expression.”

<http://pages.slc.edu/~psychology/biographies/arnheim/>

Berlin School (1890–1967) Frederic Carl Stumpf (1848–1936)

German: Philosopher and Psychologist: Claimed that objects were immediate and that sensation, contents, and existential processes were derived from these by inference and abstraction. Concerned with the unbounded, stable space of Euclidean Geometry; what we know, World of Reality or World Space. The school later became the Gestalt Psychology.

<http://www.sumscorp.com/perspective/Vol3/ch3.htm#5>

http://en.wikipedia.org/wiki/Berlin_School



Brunelleschi, Filippo (1377–1446)



Florentine, Italian: Builder, Architect, Goldsmith, Sculptor, and Inventor: Invented one-point perspective flat-panel tool similar device to a pinhole camera. The person who is credited with the first correct formulation of linear perspective is Brunelleschi. He appears to have made the discovery in about 1413. He understood that there should be a single vanishing point to which all

parallel lines in a plane, other than the plane of the canvas, converge. Also important was his understanding of scale, and he correctly computed the relation between the actual length of an object and its length in the picture depending on its distance behind the plane of the canvas.

<http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Brunelleschi.html>

Cézanne, Paul (1839–1906)

French: Post-Impression-
the volumetric treatment
direct influence of Syn-
pushed the old perspec-
the notion that there was
Art critic Riehl referred to
Perspective.”



ist Painter: In his later year’s
of form abstractions became a
thetic Cubism. Cézanne had
tative aside and had destroyed
only one correct perspective.
Cézanne’s work as a “Kind of

His painting has a quality
deep space and flat design. Using colors for perspective, Cézanne chose to
rediscover a more substantial reality of simple forms behind the glimmering
veil of appearances.

<http://campus.northpark.edu/history/WebChron/WestCiv/Cezanne.CP.html> ; Text copyright 1996-9
by David W. Koeller. dkoeller@northpark.edu.

Cézanne developed a new type of spatial pattern. Instead of adhering to the
traditional focalized system of perspective, he portrayed objects from
shifting viewpoints. He created vibrating surface effects from the play of flat
planes against one another and from the subtle transitions of tone and
color. In all his work he revealed a reverence for the integrity and dignity of
simple forms by rendering them with an almost classical structural stability.

The Columbia Encyclopedia, Sixth Edition. Copyright © 2001 Columbia University Press <http://www.globalgallery.com/artist.bio.asp?nm=paul+cezanne>

da Vinci, Leonardo (1452–1519)

Florentine Italian: Scientist, Inventor, Italian Painter, Sculptor, Architect,
Musician, and Engineer. Leonardo made an unequivocal statement in
(1492) concerning the instantaneous nature of light on : “perspective:
Immediately the air is illumined, it is filled with infinite species, which are
caused by various bodies and colours which are collected in front of it; of
which species the eye acts as a target and magnet.”

Speed of Light, Vision, The Simile of Percussion, Continuity and Discovery
in Optics and Astronomy,

Studies on Leonardo da Vinci ,Vol. II. Dr. Kim H. Veltman (07/99), <http://www.sumscorp.com/books/contin/p1c3.html>

Leonardo Da Vinci not only knew the
camera obscura but also described the
ment that goes under this name (exclud-
He recognized that the same principle of
obscura should apply to the eye.



principle of the
optical instru-
ing the lens).
the camera

Other aspects of Leonardo’s interests in
techniques do not come out of the Eu-
tion. Euclid was concerned with rules for the vision of single objects, and at
most three objects, and always out of context. Leonardo, by contrast, wish
to determine effects of context and background on perception. Da Vinci
was aware that background affects the size, brightness, shadow, colour and
relief of an object. Each of these would be considered in turn. “No evident

body can be well comprehended and judged by human eyes except through the variety of the background where the extremities of these bodies terminate and border”

Survey of Secondary Literature, Introduction, Continuity and Discovery in Optics and Astronomy, Studies on Leonardo da Vinci ,Vol. II. Dr. Kim H. Veltman (07/99), <http://www.sumscorp.com/books/contin/title.html#2>

Euclid of Alexandria (c. 325–226 B.C.)

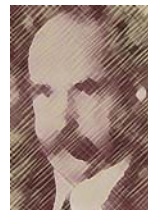


Egypt/Greek: mathematician, Author: Elements published (1482), antiquity best known for his treatise on mathematics The Elements. (Euclidean Geometry) In Antiquity, Euclid’s Optics focused on how things appear to the eye, a concern which is now termed psychological optics. Euclid’s treatise also contained four propositions on surveying. This introduced a quantitative dimension into an otherwise qualitative discussion.

<http://www.sumscorp.com/articles/art10.htm>

Gestalt Psychology (1890–1967) Max Wertheimer (1880–1943)

(German) Gestalt means Form. German school: founders Kurt Koffka, Wolfgang Köhler and Max Wertheimer. The school or theory in psychology holding that psychological, physiological, and behavioral phenomena are irreducible experiential configurations not derivable from a simple summation of perceptual elements such as sensation and response. A branch of psychology that behavior and perception as an integrated whole simply the sum of individual stimuli and response. The Gestalt theory was restricted to the explanation of organizations in abstract 2-D pictorial patterns. The principal proponents of Gestalt theory which emphasized higher-order cognitive processes in the midst of behaviorism. The focus of Gestalt theory was the idea of “grouping”, i.e., characteristics of stimuli cause us to structure or interpret a visual field or problem in a certain way (Wertheimer, 1922). The primary factors that determine grouping were: (1) proximity - elements tend to be grouped together according to their nearness, (2) similarity - items similar in some respect tend to be grouped together, (3) closure - items are grouped together if they tend to complete some entity, and (4) simplicity - items will be organized into simple figures according to symmetry, regularity, and smoothness. These factors were called the laws of organization and were explained in the context of perception and problem-solving. Two directions are involved: getting a whole consistent picture, and seeing what the structure of the whole requires for the parts.”



able from
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The
phasized

<http://tip.psychology.org/wertheim.html>

Gibson, James Jerome (1904-1979)

American: Ecological Psychologist, Was a Professor at Smith College and Cornell University, Part of the *Visual Science*.

Author of *The Perception of the Visual World* (1950) and *The Senses Considered as Perceptual Systems*

(1966). In a sense Gibson combined the Leipzig School as his Visual Field or Visual Space with Gestalt principles of the Berlin School, the two-dimensional geometrical space to the three dimension world. He became a leader of a new

movement in the field of Psychology by considering perception to be direct, without any inferential steps, intervening variables, or associations such as the ambient array, including invariance of shadows, texture, color, convergence, symmetry and layout that determine what is perceived.



(1955) identified four cues that were needed to see the distance of a given object in space: binocular parallax or disparity; linear perspective; aerial perspective, superposition, shading; and motion parallax.

(1960) greatly expanded the traditional meaning of perspective: It is possible therefore to think of perspective as a more general science than the rules of representative drawing, or the description of visual sensations or even the transformations of forms on one abstract plane to forms on another plane. It would be the geometry of the ways in which the light is reflected. Linear perspective of the classical sort would be only a small part of it, for that is merely the perspective of the edges of rectangular objects. There is also the perspective of the textures of inclined surfaces, the gradients of texture-density, the steps of density at the edges of objects, the ratios of densities in different directions and still other variables of higher order.

<http://www.sumscorp.com/perspective/Vol3/ch3.htm#5>

Gibson called visual space the visual field and linked geometrical space with the visual world. There is more to this change of terms than is at first apparent. In the nineteenth century it was generally assumed that visual space was subjective and geometrical space was objective. In Gibson's approach both are susceptible to measurement and hence in some sense objective. In Gibson's formulation there is also no opposition between vision and geometry. Geometry applies to both physical space and to (psychological) visual space. The question remains whether the same branch of geometry applies to both kinds of space? Those who claim that (linear) perspective is dead often mean that artists have given up trying to record physical space and are focussing on visual space with its non-Euclidean surfaces. There is something to this but it is not the whole story.

<http://www.sumscorp.com/articles/art10.htm>

Goethe, Johann Wolfgang von (1749–1832)



German: Author, Novelist, Playwright, Courtier, Scientific Researcher, Exploratory Experimenter, and Natural Philosopher: *Theory of Colours* (1810); scientific interest in color was inspired by the natural optical phenomena and the coloristic traditions of Renaissance painting that he encountered during his first journey to Italy (1786–88); systematically varied the experimental conditions—the

shape, size, color, and orientation of the images viewed; Goethe's more empirical approach led him to recognize the essential role of (nonspectral) magenta in a complete color circle.

Exploratory Experimentation: Goethe, Land, and Color Theory, Neil Ribe and Friedrich Steinle, <http://www.physicstoday.com/vol-55/iss-7/p43.html#fig1>. © 2002 American Institute of Physics.

Gábor, Dennis (1900–1971)

Hungary: British Physicist. He invented holography in 1947, and received the Nobel Prize for his invention and development of holography in 1971. His early method used a single light source (mercury or bon-arc lamp) or single beam construction and several pinhole filters of film transparencies.



<http://www.hungary.org/~hipcat/gabor.htm>

<http://www.holophile.com/history.htm>

Kepler, Johannes (1571–1630)



German: Astronomer and natural philosopher. Part of the *Visual Science*: In (1604) explored the analogy of eye and camera obscura. "I say that vision takes place when the image of the whole hemisphere of the world in front of the eye and even a little more, is formed upon the concave reddish surface of the retina."

Retinal Images, III Vision and Representation, *The Sources and Literature of Perspective*, Volume III, Dr. Kim Veltman.

Elaborate analysis of pinhole and small aperture image with various lenses; portable tent camera obscura for perspective drawings.

Bibliography of Pinhole Optics in science and art from the 5th Century B.C. to 18 A.D., Eric Renner.

Leipzig School (1879 on) Gustav Theodor Fechner (1801–1887)

German: Physicist. German School: Mind, Brain, and the Experimental Psychology of Consciousness. A professor of physics, found the formal beginning of experimental psychology. He carried out the classical experiments on tactual and visual distance, visual brightness. Published *Elemente*, was to establish an exact science of the functional relationship between physical and mental phenomena. Distinguished between inner (the relation between sensation and nerve excitation) and outer (the relation) (psy-principle that of the stimulus cal relations. a way of truth: mind ceiving one and the same reality.



<http://serendip.brynmawr.edu/Mind/Consciousness.html>

Focused on the reduced, unstable space of visual geometry; was concerned with what we see; World of Appearance, Visual Space, or Visual Field.

<http://www.sumscorp.com/perspective/Vol3/ch3.htm#5>

Locke, John (1632–1704)

English: Philosopher: Founded the School of Empiricism, Locke's empiricism emphasizes the importance of the experienced of the senses in pursuit of knowledge rather than intuitive speculation or deduction. The empiricist doctrine was first expounded by the English philosopher and statesman Francis Bacon early in the 17th century, but Locke gave it systematic expression in his *Essay Concerning Human Understanding* (1690). He regarded the mind of a person at birth as a *tabula rasa*, a blank slate upon which experience imprinted knowledge, and did not believe in intuition or theories of innate conceptions. Locke also held that all persons are born good, independent, and equal.



Empiricism, Encyclopedia Article from Encarta.

Munsell, Albert H. (1858–1918)

Boston, Massachusetts: Professor of Fine Arts, Colorist, Artist, and Inventor: Author of *A Color Notation* (1905) and the *Atlas of the Munsell Color System* (1915). He developed the first widely-accepted color order system to make the description of color accurate and convenient and to aid in the teaching of color. The Munsell color order system has gained international acceptance and has served as the foundation for other color order systems. Albert Munsell founded the Munsell Color Company in 1917.



<http://www.cis.rit.edu/mcsl/about/munsell.shtml>

Newton, Sir Isaac (1643–1727)

English: Scientist, Physicist, Mathematician and Author: *New Theory about Light and Colours* concluded that color was an inherent quality of light, that each spectral color had its own degree of Refrangibility, and that colors could be simple or compound.



Exploratory Experimentation: Goethe, Land, and Color Theory, Neil Ribe and Friedrich Steinle, <http://www.physicstoday.com/vol-55/iss-7/p43.html#fig1>. © 2002 American Institute of Physics.

Plato (428–347B.C.)

Greek: Philosopher. Rational School of thought.

Veltman, Kim Henry (b. 1948)

Netherlands: Science Historian, Author, Biographer Leonardo da Vinci, Professor, Scientific Director of Maastricht McLuhan Institute (MMI): *Leonardo da Vinci Studies I: Linear Perspective and the Visual Dimensions of Science and Art* among other publications. "We associate with da Vinci and Michelangelo and others whose interest was in the arts and not the sciences. Perspective, he argues, began with shifts in human cognition and the way it was conceived in the vulgar languages (i.e., not Latin) which provided a wider variety of ways to describe colour, light or perspective itself."

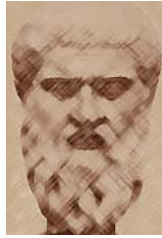


<http://www10.org/program/culture/veltman.html>

<http://www.fact-index.com/p/pe/perspective.html>

Pollio, Marcus Vitruvius (c. 90–20 B.C.)

Roman: Engineer, Architect and Author: The ten books of Architecture. Def. *Architect*: “the architect should be equipped with knowledge of many branches of study and varied kinds of learning, for it is by his judgment that all work done by other arts is put to test. *Architecture*: depends on Order, Arrangement, Eurythmy, Symmetry, Propriety, and Economy.”





NAN MICHELLE RUSHTON

Born in Haddonfield, New Jersey in 1964, Nan Michelle Rushton comes from a large family of seven children. She studied interior design with a minor in print making at Moore College of Art and Design, spending her junior year at Syracuse University's pre-architecture program in Florence, Italy, and receiving her BFA in 1987. From 1988–1993, she worked in southern New Jersey as a construction executive along with her elder brother in their firm, Rushton Construction Company, Inc. During these years, Ms. Rushton also attended the Shelter Institute in Bath, Maine (1988) and designed exhibits for the Newark Museum in Newark, New Jersey. She obtained professional status in interior design in 1992 through the National Council for Interior Design Qualification, and is currently a professional member of the American Society of Interior Design. During her master studies at Virginia Tech's College of Architecture, she attended a semester at their European Studies Program at Riva San Vitale, Switzerland.

She has eleven years of work experience in designing, coordinating, and producing the built environment. Upon completing her Master's Degree in Architecture at Virginia Tech, she plans to continue her work by exhibiting and applying for private funding to publish future work. Currently, she aspires to start her own Architecture and Interior Design Firm.

PROFESSIONAL EXPERIENCE

- 6/96–Present Residential Projects, Color and Lighting Designs, Interior Architecture & Interior Design, Consultant/Sole Practitioner. *Rushton's Designs for Interiors, Audubon, New Jersey.*
- 07/88–02/94 Designed/Built Residential, Light Commercial, Project Designer/Manager/Estimator. *Rushton Construction Company Inc., Haddon Heights, New Jersey.*
- 02/01–10/02 K - 12 Schools and Churches, Associate's Assistant Architect. *DWKCB Architects, Philadelphia, Pennsylvania.*
- 03/99–12/99 Light Retail Commercial, Project Architect/Manager. *Sargenti Architects, Lodi, New Jersey.*
- 06/00–10/00 Mid to Light Retail Commercial, Project Manager. *Weber and Company Architects, Philadelphia, Pennsylvania.*
- 02/00–04/00 Restaurant, Multi-Family Housing, Intern Architect. *Kitchen and Associates, Collingswood, New Jersey.*
- 05/96–08/96 Residential Projects, Intern Architect/Draftsperson. *Robert Thompson Architect, Haddonfield, New Jersey.*

EDUCATION

- 08/94–12/98 Master of Architecture. *Virginia Polytechnic Institute and State University, Blacksburg, Virginia.* Cum Laude. *Masters Thesis Concentration: An Exploration of Visual Sensations: The Use of Depth Perception to Create Pre-Architectural Forms*—Creating transparent three-dimensional visual models studied through depth Perception via color, linear, and atmosphere diminution perspectives, optically drawn with light and color. *Expected Degree Awarded, 12/05*
- 09/84–05/87 Bachelor of Fine Arts in Interior Design. *Moore College of Art and Design, Philadelphia, Pennsylvania.* Cum Laude.
- 07/93–05/94 Course of Study: Computer Aided Drafting. *Camden County College, Blackwood, New Jersey.* GPA: 3.8.
- 01/86–05/86 Course of Study: Pre-Architecture. *Syracuse University, Florence, Italy.* GPA: 3.5.
- 09/90–12/90 Course of Study: Customer Relations. *Dale Carnegie and Associates, Inc., King of Prussia, Pennsylvania.*
- 08/87 Course of Study: Passive Solar Construction and Post and Beam Construction. *Shelter Institute, Bath, Maine.*

RELATED WORK EXPERIENCE

- 05/96–05/98 Student Assistant: Computer Operation, Instructional Video Editor, Promotional Projects Design/
09/97 Production for Multi-Media Presentations. *New Media Center, Blacksburg, Virginia.*
Academic Graduate Assistantship: Computer Technician of Graduate Lab, Teaching Assistantship for Computer Aided
Years 95–97 Drafting, and Facilities Assistant for the College of Architecture Foundations Lab. *College
of Architecture and Urban Studies, Virginia Polytechnic Institute and State University,
Blacksburg, Virginia.*
- 02–07/94 Exhibit Designer. *Newark Museum, Newark, New Jersey.*
- 05/87–06/88 Designer/Salesperson. *Continental Custom Made Furniture Inc., Cherry Hill, New Jersey.*

PROFESSIONAL AFFILIATIONS

CERTIFICATION

- 1987–Present Professional Member. *American Society of Interior Design.*
- 10/92 Professional Member. *National Council for Interior Design Qualification: Certification No. 010387.*

EXHIBITS

PUBLICATION

AWARDS

- 12/98 Art Exhibitor. *New York International Independent Film and Video Festival. New York City.*
- 05/96 Student Exhibition of Design Studios. *Virginia Polytechnic Institute & State University. Blacksburg,
Virginia and Riva San Vitale, Switzerland.*
- 04/97 Collected Work Virginia Tech Center for European Studies and Architecture Spring 1996 (*Blacksburg,
Virginia.: College of Architecture and Urban Studies, Virginia Polytechnic Institute and State
University, 1997*).
- 92–95 *J.L. Pellam, Editor, Who's Who in Interior Design 1992–1993, 1994–1995 International Editions.
(Laguna Beach, California.: Barons Who's Who, 1992, 1994).*
- 93–94 Who's Who of American Women 19th Edition. (*New Providence, New Jersey.: The Marquis Who's Who Publication
Board, 1993–1994*).
- 12/98 Iwaszkiewicz - New Media Award. *New York International Independent Film and Video Festival.*
- 08/96 William E. Wine Academic Scholarship. *Virginia Polytechnic Institute & State University.*
- 12/92, 12/90 President's Award and Outstanding Service Award. *South Jersey Chapter of the National Association of
the Remodeling Industry.*
- 10/85 Recipient of the Pennwalt Competition. *Philadelphia Chapter of the Foundation for Architects.*
- 05/85 Honors Convocation Academic Year 1984–85. *Moore College of Art and Design.*
- 06/83 Recognition of Achievement Award. *Haddonfield Rotary Club.*

VOLUNTEER WORK

- 06/04–Present Architectural Branch Volunteer. *Independence National Historical Park, Philadelphia, Pennsylvania.*
- 01/99–05/99 Stage Set Design for a Masters Thesis Production. *Brooklyn University, Brooklyn, New York.*
- 08/97 Monitor. *New Media Center Summer Video Camp, Blacksburg, Virginia.*
- 92–94 Docent. *Haddonfield Historical Society, Haddonfield, New Jersey.*
- 88–94 Board Member and Newsletter Editor. *American Society of Interior Designer, Pennsylvania East Chapter.
National Board Member and Local Representative. National Association of the Remodeling Industry,
Chicago, Illinois and Washington, District of Columbia, 92–94. Board Member. South Jersey Chapter,
88–94. First Vice President, 1/93–6/94. Vice President, 91–92. Chairman of Education and Certification,
1990. Newsletter Editor, 88–94.*
- 04/93 Monitor. *National Council for Interior Design Qualification Examination, Philadelphia, PA.*
- 10/93 Juror for Senior Thesis Critiques. *Moore College of Art and Design, Philadelphia, Pennsylvania.*
- 92–93 Mentor for Senior Thesis Student. *Moore College of Art and Design, Philadelphia, Pennsylvania.*

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