1972

On some functions of line and contour in the visual arts

David J. Swann
Lehigh University

ON SOME FUNCTIONS OF LINE AND CONTOUR IN THE VISUAL ARTS

An Abstract of a Thesis

Presented to

The Faculty of the Graduate School

Lehigh University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

David J. Swann

September 1972

"On Some Functions of Line and Contour in the Visual Arts" is an explication of line: what it is and how it functions on the surface of the picture plane. It looks at line first as a geometric entity, and second as an expressive element. The major sections discuss axial balance; the illusion of movement; line as contour; and the illusion of three-dimensional space, concluding with a brief discussion of the phenomen of hyper-dimensional shifts.

The paper is limited to line as involved in the visual and graphic arts, particularly the arts as influenced by Kepes, Moholy-Nagy, and Arnheim. It does not deal with the aimless and inconsequent line of a Pollock or the autographic scribble of a Soulages, a Mathieu or a Hartung; but rather the sensible line, obvious in its relation to the general planning of the design of a Klee, and the pure plastic symmetrical line of a Mondrian: the line of the Gestalt, the organized, simple, and "Satisfying" line-- the line of *Prägnanz*.

ON SOME FUNCTIONS OF LINE AND CONTOUR IN THE VISUAL ARTS

A Thesis

Presented to

The Faculty of the Graduate School

Lehigh University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

---

by

David J. Swann

September 1972

Certificate of Approval

This Thesis is accepted and approved in partial fulfillment of the requirements for the degree of Master of Arts.

Date: 12 September 1972

R. F. Barnes
Professor in Charge

J. R. Lindgren, Chairman
Philosophy Department

PREFACE

In this paper we will examine line: what it is and how it functions on the surface of the picture plane. We will look at line first as a geometric entity, and second as an expressive element. The major sections will discuss axial balance; the illusion of movement; line as contour; and the illusion of three-dimensional space, concluding with a brief discussion of the phenomen of hyper-dimensional shifts.

It is important that the reader be aware of one significant limitation of this paper. Line, as examined in the following pages is line as involved in the visual and graphic arts, particularly the arts as influenced by such notables as Kepes, Moholy-Nagy, and Arnheim. It is not the aimless and inconsequent line of a Pollock or the autographic scribble of a Soulages, a Mathieu or a Hartung; but rather the sensible line, obvious in its relation to the general planning of the design of a Klee, and the pure plastic symmetrical line of a Mondrian: the line of the Gestalt, the organized, simple, and "Satisfying" line-- the line of <u>Prägnanz</u>.

1

There is no unified theory common to all visual experience; and there is no scientific formulation of the fundamental principles of a visual grammar and syntax.[1] Perhaps it is as Wittgenstein finds it in his Tractatus that such a theory cannot be put into words:

> It is clear that ethics cannot be put into words. Ethics is transcendental. (Ethics and aesthetics are one and the same.)

However, there are those (i.e., Moholy-Nagy, Arnheim, Weismann, to name a few,) who feel there is need to clarify the basic concepts common to all instances of visual expression; and, furthermore, a need to articulate these basic concepts into a comprehensive theoretical formulation.

With regard to the visual arts, none of the value system con-

---

1. Mirlo Basaldella, "Visual Consideration", Education of Vision (New York: George Braziller, 1965), p. 182.

structs have proven adequate where they appeal to absolute values or universals. However, we shall not attempt to develop such an alternate value theory or construct even a theory of perception in this paper, rather our purpose will be to explicate some of the principles about which the visual arts are constructed. Our investigation will be based upon the premise that when engaging an art object we enter into a visual experience. The terminating point of this visual experience is a structure of visual objects constructed out of a set of basic visual elements, (i.e., planes, shapes, colours, etc.) by bringing them together through a conceptual operation called 'plastic organization'.[2] A particular kind of visual experience shall be called an aesthetic experience in so far as the viewer reacts to the emotional qualities created by the abstract relationships of the visual elements.[f]

The correspondence of plans, shapes, lines, points, and colours are the organizing elements of a visual expression,[3] and line is one of the most essential elements in the visual arts.[4] The eye perceives the finished pattern as a whole together with the interrelationships of its parts, whereas the act of making a picture might require that each part be made separately. Thus we are tempted

---

2. We shall see this term later on. 'Plastic organization is a term used to describe the formative shaping of sensory impressions into unified wholes.

3. L. Moholy-Nagy, Vision in Motion (Chicago: Paul Theobald and Company, 1947, p. 128.

4. Reid Hastie, and Christian Schmidt, Encounter With Art (New York: McGraw-Hill, 1969), p. 243.

f It should be understood that when I say abstract relationships of visual elements have emotional qualities I mean that they have the potentiality to incite the viewers reaction which is emotional in nature.

to concentrate on the part at hand in isolation from its context. Isolated qualities do not convey the particular emotional qualities that lines in relationship to one another in a particular composition express;[6] however, to facilitate the understanding of what it means to experience the emotional qualities created by the abstract relationships of lines it will be helpful to note the dominant characteristics of the lines used, even to isolate line from any representational context.

My paper is expressly about line, and my approach will be to look at how line functions in a communicative medium, i.e., the visual arts, in much the same way a language philosopher might look at 'line' and how it is used in another communicative medium, ie., a particular language. Of course there are those (i.e., Beam, Elton, and Kepes to name a few,) who might want to go so far as to insist that the visual arts <u>is</u> a language, but it is not my intention to either aggressively challange this analogy or enter into a dialogue in its defense. It cannot be denied that graphic art is a communicative medium. Whether it fulfills the criteria of a language (i.e., grammar, dictionary, index, syntax, etc.,) is quite another matter for consideration; one which will not concern us in this study.

---

5. Rudolf Arnheim, <u>Art and Visual Perception: A Physhology of the Creative Eye</u> (Berkeley, Los Angeles: University of California Press, 1957), pp. 416-7.

6. Allen Leepa, <u>The Challenge of Modern Art</u> (New York: A.S. Barnes and Company, Inc., 1961), p. xlii.

'Line', in ordinary language, is used in many ways:

1. When it comes to Harold, there's a fine line between being ignorant and being naive.

2. Daniels used to be on the defensive line for the Detroit Lions.

3. They announced a completely new product line at the Fall Sales Conference.

4. Honestly Janet, don't tell me you fell for that old line again.

5. The 3rd Regiment advanced to the front line at 0900 hours.

6. The Mann Act prohibits taking a girl across the state line for immoral purposes.

7. Is a 4 lb.-test line adequate for trout?

8. He came from a long line of artisans.

9. Plant the azeleas in line with the other rhododendrons.

10. It is axiomatic that lines do not exist in nature, only contours.

'Line' is used in the above expressions to mean: (1) a distinction or difference; (2) a position on the scrimmage in a game; (3) an integrated series; (4) a persuasive device; (5) a row of soldiers or area of demarcation between armies in a military engagement; (6) a boundary or border; (7) a string; (8) a continuous series of descendants from a common progenitor; (9) an imagined mark to show direction or position; and (10) a two-dimensional stroke.

In short, 'line' can have many meanings depending upon the context in which it is used. Of particular interest here are (9) and (10). In (9), we are not referring to a real line or an actual mark connecting one object to another and extending horizontally along and beyond their bases *ad infinitum*, but rather an imaginary or envisioned

---

horizontal extention or a row of objects. This imaginary extended horizontality is what I shall refer to as "line". Line will be understood to mean ———— ,  ,  , etc. 'Line' can be a linguistic description of a line or "line" depending upon the language-game employed. In (10), 'line' is clearly to be understood as line, or <u>actual</u> lines.

Capers and Maddox write that by accepting (10) we limit the meaning of the word too sharply. "What of the division between the dark branch of a tree and the lighter sky against which it is silhouetted?", they ask; "Or the edge of a white house against the foliage of trees?" They conclude that in our visual experience of the world around us "lines mark the limit of things; they delineate the shapes of things that have little substance, like leaves."[7]

Capers' and Maddox's difficulty arises partly out of a misunderstanding of what is being said, and a failure to make two very important distinctions: the distinction between lines and edges; and, the distinction between <u>real</u> lines (lines) and <u>suggested</u> lines ("lines"). We will discuss the different functions of lines and contours later in this paper, but it should be noted here that it is the function of contours, not lines to describe an object's shape and to determine its spatial position.[8] We see contours in nature because of the difference in colour and value between different surfacts although physiologically the mechanisms of colour edge and brightness edge are different.[9]

---

7. Roberta Capers, and Jerrold Maddox, <u>Images and Imagination</u> (New York: The Ronald Press Co., 1975), p. 270.

8. Leepa, p. 100. Arnheim, as we shall see, introduces the notion of a 'structural skeleton' as a mere precise means of description.

9. <u>Ibid</u>., p. 96.

Line can be suggested by the abutment of one colour area against another, hence "line". In this sens, we imagine a line around the edge, but there really is no line there.[10]

Even though actual lines do not bound shapes, we feel that they do. This is what we seem to continually experience in looking at things in the outside world. This becomes somewhat obvious when we attempt to graphically demonstrate outline shapes. We know these lines do not exist physically as part of the object, but we employ them because they correspond to the way the object appears to us. While the outline shape is rarely the sole aspect of our visual experience, out comprehension of it is so instantaneous that for the most part we are not even aware that we first see an object in this fashion until we attempt to make a record of what we see, and then we often do so according to only this one aspect of our visual experience.[11] In this sense then, "line" can be thought of as "a visual phenomenon produced by the proximity of elements or images which by their closeness and sequence establish a direction that in turn implies line. And line is also implied or suggested by the edges of shapes and by the boundaries of areas of color."[12] Implied line, or "line," may also be thought of as the axis or dominant direction of a shape or as the contour of a solid object.[13] Our axiom is about lines, not "lines."

---

10. Joshua C. Taylor, Learning to Look (Chicago: University of Chicago Press, 1957), p. 47.

11. Bates Lowry, The Visual Experience: An Introduction to Art (New York: Harry N. Abrams, Inc., 1964), pp. 25-6.

12. Donald L. Weismann, The Visual Arts as Human Experience (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970), p. 33.

13. Dale G. Cleaver, Art: An Introduction (New York: Harcourt, Brace and World, Inc., 1966), p. 3.

THE FUNCTION OF LINE IN THE VISUAL ARTS

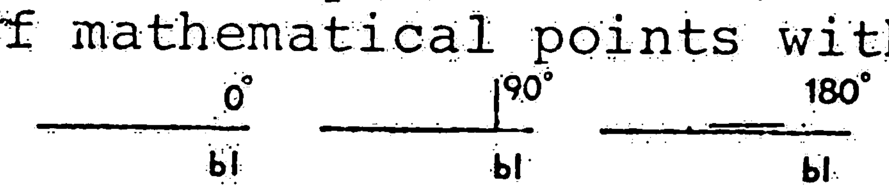
Line exists only in the visual arts and the industrial graphics. It is a two-dimensional stroke distinguished from its surroundings by brightness and colour, and can be thought of as the path of a moving point.[14] To understand this more clearly we have to take into account the generative structure of a line. An artistic line is made up of a concatenation of artistic points, each being the physical expression of a geometric point in a given medium. The geometric point, which we assume to be a disk of area πr^2 (where r takes the limiting value zero), has no physical extension.[15] A mathematical point, governed by geometric axioms, can only move through an angle.[†] A point moving uniformly on a plane produces a visible trajectory and the speed of the movement determinint its linear dimensions.[16] Where the angle equals zero degrees, there is no movement; where the angle equals 180° and time is unlimited, the point moves indefinitely and the resulting trajectoryis an unending straight line.[17] When time is limited, the resulting trajectory is a rectilinear segment of a definite extension or dimension. Curvilinear lines in varying degrees are produced by modulating angle and time.[18]

---

14. Cleaver, p. 3.

15. Joseph Schillinger, The Mathematical Basis of the Arts (New York: Philosophical Library, 1966), p. 363.

16. Ibid.

† 'Angle' in this context is to mean the point where two lines meet: one line being the concatenation of mathematical points with respect to a hypothetical base line. e.g., 

17. Schillinger, p. 363.

18. Ibid.

In the graphic arts both movement and time is limited, but line does not remain only a line:

> The line is no longer the apparition of an entity upon a vacant background, as it was in classical geometry. It is, as in modern geometries, the restriction, segregation, or modulation of a pregiven spatiality.[19]

Line, in the context of art, is a 'dramatic element' and, as we shall attempt to show, functions on the surface of the picture plane. When grouped with other lines and elements in a pattern it can assume a recognizable form, express energy and control, or, in certain contexts, bring into play associations with identifiable shapes and convey an idea.[20] In order to understand how a line functions on the surface of a picture plane it will be necessary to introduce the "pregiven spatiality" in which it functions; namely, the plane, the surface, and the picture plane.

In mathematics, a plane is defined as a flat surface,[21] or more explicitly, a surface such that every straight line joining any two points in it lies wholly in that surface, or such that "the intersection of two such surfaces is always a straight line."[22]

In art, a plane is considered as any surface which is delineated by one or more of its edges, the most fundamental of which is the picture plane. It is the basic tool or art. Defined by four edges, the picture plane is one of the more basic visual elements to be articulated: it is the flat surface of the support, (i.e., the canvas), on which the painting or drawing is made. The picture plane

---

19. Merleau-Ponty, "Eye and Mind", Changing (New York: E.P. Dutton and Co., Inc., 1971), p. 170.
20. Philip Beam, The Language of Art (New York: The Ronald Press Company, 1958), pp. 120-22.
21. Leepa, p. 95.
22. Weismann, p. 154.

actually exists in space only at the position in three-dimensional space where we happen to come upon it,[23] but every line put upon it is governed by its two-dimensionality. (We will discuss the illusion of depth and three-dimensional space in another section.)

In other words, the surface of the canvas is a closed plane. It is a fully defined plane bounded by edges which the movement of every form or visual unit created within it, (the qualifying effect of the framing shape was a matter of study for Pirenne but will not concern us here). Every mass of colour, every line placed upon it is in turn considered a plane for each represents a surface. According to Schillinger, planes are created on the surface of the picture plane as surfaces from line according to the inherent qualities of the angles through which they move:

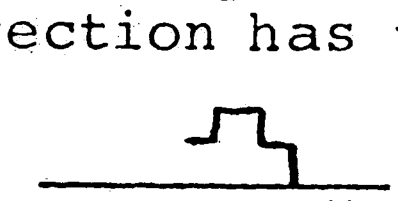
> Continuous progression of rectilinear segments moving in one direction produces closed forms, (or with a tendency to close,) according to the arithmetical property of the angles [through] which they move,...each angle being the divisor of a divident of 180° or its multiple, with various coefficients.[24]

What happens when a line is placed on a surface? A single line can be placed anywhere on the surface of the picture plane to help articulate the third dimension, functioning as one edge of a plane. Line does this by dividing the picture surface into two planes giving it a spatial significance:

---

23. Weismann, p. 154.

24. Schillinger, p. 363. Our base line is assumed to be a straight line (180°), therefore to say that each angle is the divisor of a dividend of 180° (or its multiple) is to describe the relationship between two planes by virtue of which any rectilinear segments "moving" in one direction has the tendency to produce closed figures. e.g.,



> Lines formed by the edges of separate but adjacent color or value planes can act in part independently of the separate planes which help form it, for the combining of several edges create varied linear and spatial directions."[25]

We say line functions on the surface of the picture plane. A line can function as a self-contained visual object, which is seen lying on top of a homogeneous ground; but as soon as a line or a juxtapositioning of lines embrace an area, its character changes radically and it becomes an outline or contour. "It is now the boundary of a two-dimensional surface that lies on top of a throughgoing ground."[26] The transformation of a line into an outline or contour is somewhat analogous to the auditory transformation which occurs when musical tones with individual tonal qualities are played together; their individual characteristics retreat and something entirely new appears: the chord. This is what Arnheim, in his Art And Visual Perception, calls the double function of line.

---

25. Leepa, p. 96.

26. Arnheim, p. 168. This is true for most elementary figures, but a figure-ground shift, or, as we shall see in a latter section, the introduction of concave figures may change this.

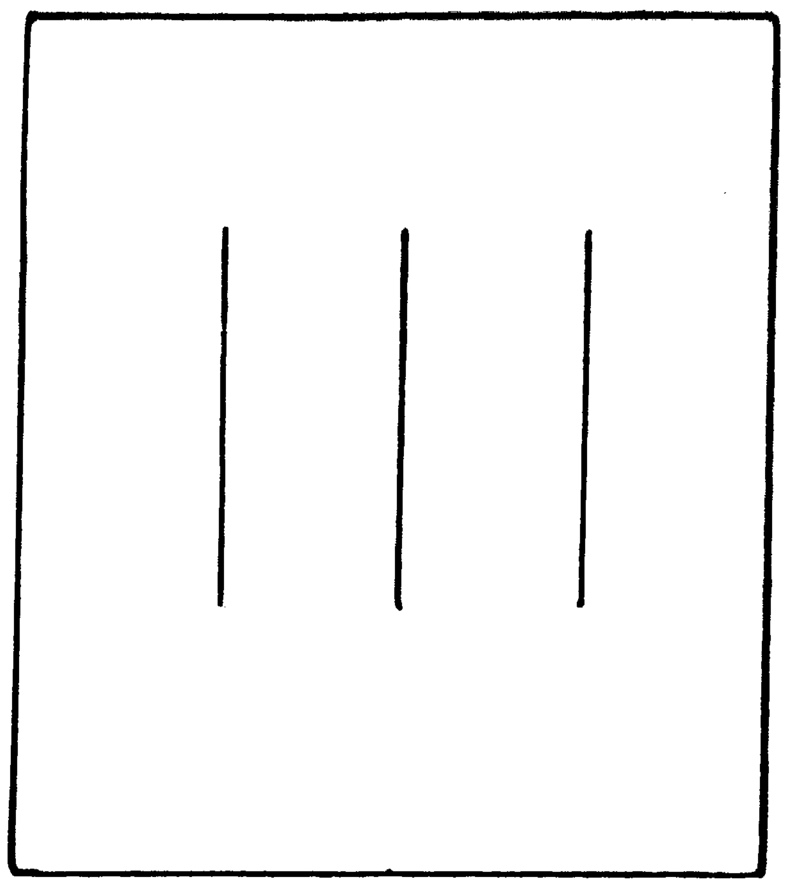


Fig. 1

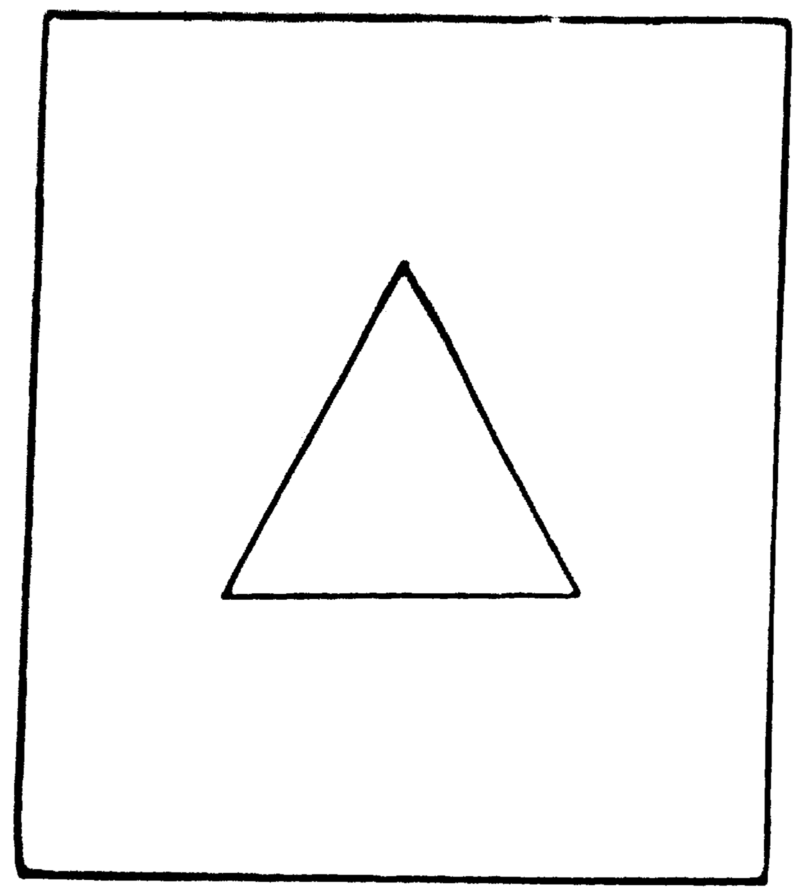


Fig. 2

For example, in Fig. 1, there are three distinct visual elements, each of equal length, and each resting parallel to one another on the surface of the picture plane. Each line can be identified as a self-contained visual object lying on top of a homogeneous ground. Each has a separate and unique identity. "We see three lines." In Fig. 2, the optical units have been organized into a spatial configuration. No new visual elements have been added. The three lines have been organized so they have become more than the sum total of their component parts. In Fig. 2, their individual characteristics retreat and something entirely new appears: "We see a triangle."

One explanation for this transformation is that every linear unit has 'kinetic inertia', that is to say, that every linear unit tends to be continued in the same direction and with the same movement which "binds together heterogeneous elements and reduces the picture-image to the number of units which can be fully comprehended in one attentive act."[27] This 'kinetic inertia' is the simplest

27. Gyorgy Kepes, Language of Vision (Chicago: Paul Theobald and Co., 1951), p. 49.

condition for what Kepes calls the 'plastic' organization in the visual arts which is the formative quality or the "shaping of sensory impressions into unified wholes."[28] Arnheim goes on to point out that in the "painterly" style, line loses its double function when it ceases to be used as a contour or edge and is limited to the representation of actually linear objects:

> Solid objects are conceived as volumes rather than through their boundaries, and the 'dry manner, full of profiles' is replaced with the juxtaposition of masses.[29]

But even in the linear mode, line functions as more than that of defining the outline or the edge of visual objects; it can create a sense of structure and express mass and movement:

> Lines and repetition of lines build up' a quality of motion which is intrinsic in the line itself rather than in the motion of the object or thing represented.[30]

Line, as we suggested earlier, is a 'dramatic element'. By this we mean that line (<u>qua</u> line) has an expressive potential. Line can be of even or varied thickness and the range of personality it may express is wide: line can be quick, slow, still, nervous, majestic, rigid, soft, etc. Heavy diagonal lines create a feeling of power. By reducing the width of these lines, boldness changes to tenderness; hardness to a soft impression. Line, by its expressive character, can play a vital and dramatic role in the emotional content of any work of art.[31]

---

28. Kepes, p. 15.
29. Arnheim, p. 199.
30. Hastie and Schmidt. p.244.
31. Leepa, p. xlvi.

Line can also express moods or feelings. It can exert varying degrees of force and these forces act upon each other in any visual configuration.[32] We shall discuss this matter more fully when we talk about movement and tension in the linear mode, but it is worth noting here that we often classify lines by their general character. For example, horizontal lines are seen as lines of rest, of peace, monotony or relaxation. Vertical lines are seen as poised, ready for action; while diagonal lines issue the greatest feeling for action, force and movement.[33]

Lines can also create the illusion of depth on the flat surface of a picture plane. This phenomenon is commonly referred to as linear perspective. "Parallel lines in a plane pointing into space appear to converge at a vanishing point on the horizon established by our eye level."[34]

We have introduced the concept that line functions on the picture plane and have considered some examples. Now we want to examine how it functions and some of the more important functions of line; namely, the functions of axial balance; movement; line as contour; and, the articulation of the third dimension or the illusion of depth.

---

32. Weismann, p. 76.

33. Leon C. Karel, Avenues to the Arts (Kirksville, Mo.: Simpson Publishing Co., 1966), p. 45. It may be the case that these observations could be tested empirically, but to the best of my knowledge no one has either done so nor issued the parameters for such a test in a controlled research environment.

34. Cleaver, p. 4.

AXIAL BALANCE

What are we saying when we talk about a work of art being balanced? When we say a work of art is balanced we essentially mean that "its elements and their qualities have been poised against each other in such a manner that they are equalized."[35] The parts or the visual units of an art object seem to fit together in some identifiable order,[36] and we speak of the exact correspondence of size and position of opposing parts of the configuration as its symmetry.[37]

Some interesting questions come into focus: does aesthetic unity or balance come about by accident or design? Is the order apparent or real? Is symmetry intended by the artist or assumed by the viewer? It is not the purpose of this paper to engage in an intention-extention dialogue, but it should be pointed out that the mere act of balancing forms on the canvas does not necessarily require great emotional intensity. "A degree of sensitivity to how forms 'seem' to hold on a canvas will suffice."[38] Or as Mondrian states:

> The complexity of even an apparently simple composition requires more than a mechanical placement of elements to arrive at a state of equilibrium, so that even though everyone may agree about the necessity for a balanced composition, the most that may be said about its achievement is that the artist arrives at it intuitively and the viewer must use his intuition in responding to it.[39]

---

35. Weismann, p. 84.
36. Nathan Knobler, The Visual Dialogue (New York: Holt, Rinehart and Winston, Inc., 1966), p. 110.
37. Weismann, loc. cit.
38. Leepa, p. 124.
39. Knobler, p. 118.

Balance in the visual arts is primarily a function of visual weights. The viewer possesses a need for a feeling of equilibrium and he organizes the elements in a visual composition to satisfy this need.[40] However, this feeling for balance and the feeling for force (which we shall discuss shortly), are two different but related feelings. "The feeling for balance is a feeling for the relative weight of masses on the canvas."[41] The analogy commonly used is that of a see-saw with a weight placed at both ends. A small weight on one side of the canvas placed at a distance from the center balances a larger mass close to the center in much the same way a small weight is made to balance a larger weight on a see-saw when the fulcrum is properly positioned beneath the bar. The feeling for force is an emotional reac tion to the relationship of these elements, each opposed to one another. It is, in a sense, the experiencing of a dynamic equilibrium of forms. This may become somewhat clearer when we look at Mondrian's distinction between 'static balance' and 'dynamic equilibrium'.

When we talk about the weight of a visual element in the graphic arts, we are really talking about apparent weights. ■ Looks to be much heavier than ■ . While ■ may indeed by really heavier than ■ (viz. the quantity of ink, being a real mass, is greater in one than the other; therefore, there is a real difference in weight),

---

40. Knobler, p. 117.
41. Leepa, pp. 122-3.

the real difference in weight does not account for the felt difference (a matter of degree) in weight that is experienced: difference in apparent weight corresponds to difference in real mass, but in varying degrees.

The apparent weight of an element in a composition can also vary as its colour is changed (a yellow square appears to be lighter in weight than a black square of equal size), or as its shape, texture, or size is varied.[42] It may also vary as an element's position on the surface of the picture plane is changed, as shown in the Figs. 3, 4, and 5. The dark square seems heaviest when located at the lower corner on the surface of the picture plane, and lighter (in apparent weight) when placed in the upper portion of the picture plane. In Fig. 4, weight seems to be neutralized, that is, stable or fixed.

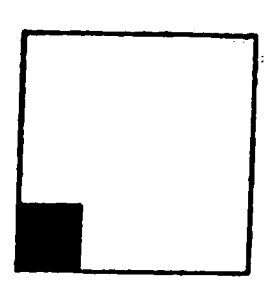


Fig. 3

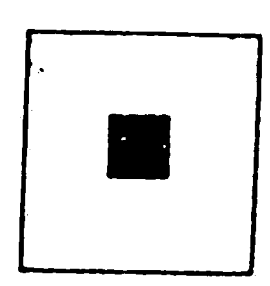


Fig. 4

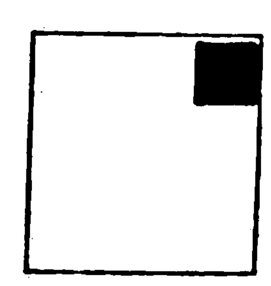


Fig. 5

---

42. Helson and Lansford studied colour preferences as recently as 1970. See their "Role of Spectral Energy of Source and Background Co-or in Pleasantness of Object Colors," Applied Optics 1970, Vol. 9, pp. 1513-1562.

The simplest method of creating balance is a repetitious design of similar or identical elements. In Fig. 6, a rectangle is divided into four similar areas: All forms are rectangles; all the rectangles are identical in size and shape, that is, their long and short axes

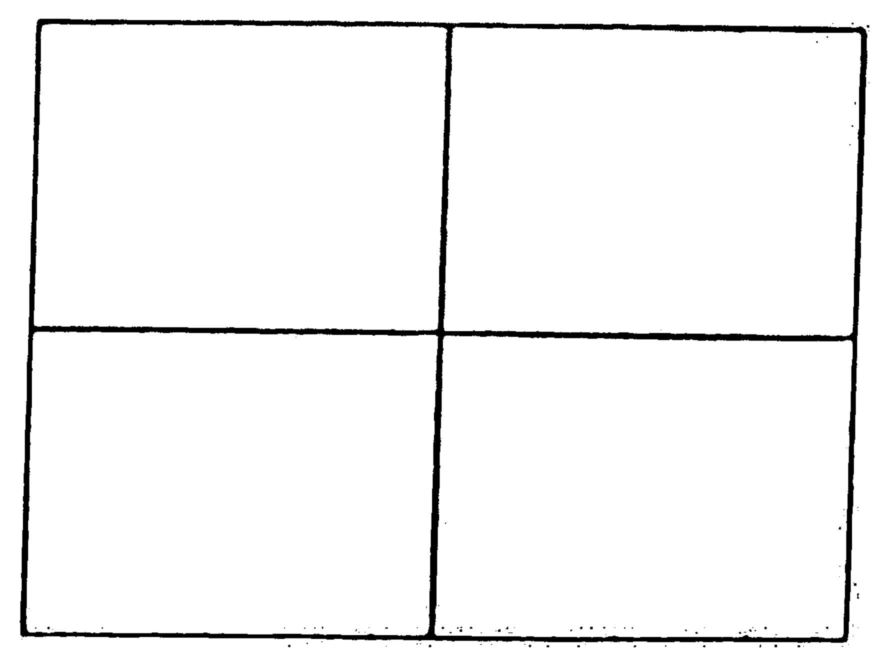


Fig. 6

are parallel. Balance cannot be denied; however, the overall effect is uninteresting, "a king of negation of space takes place..All parts are given equal value and space is so systematized that it becomes [uninteresting]."[43] To be interesting, a work of art must have balance, but balance alone is not enought, "it must have within its balance a complexity, a challenging difficulty, to involve the viewer in a search for meaning that he senses must be there in the work"[44] whether it is there or not. This 'complexity' or 'challenge' need not necessarily be restricted to the disposition of the elements qua elements within the framing-space of the picture plane. Consider

---

43. Lucy R. Lippard, Changing (New York: E.P. Dutton and Co., 1971), p. 164.
44. Knobler, p. 112.

Fig. 6, perhaps a title such as "The Last Call" or "Nine Rectangles" would provide a dimensional complexity and constitute grounds for a search for meaning, an aesthetic curiosity, while "Window" or "Four Rectangles" may not, In this case, the sensitive relations of form to title act in a homogeneous blend, provide the necessary stimulii for such a search, and the experiencing of this sensitive relationship is what we call 'emotional tension'.

However, emotional tension need not depend upon titles or the like, but can be initiated by the juxtaposition of the visual elements themselves. This is the difference between what Mondrian calls 'static balance' and 'dynamic equilibrium':

> The first maintains the individual unity of a particular form, single or in plurality. The second is the unification of forms or elements of forms through continuous opposition. The first is limitation, the second is extension. Inevitably dynamic equilibrium destroys static balance.[45]

Calculated precision and static equilibrium can be expressed by the clear linear definition of parts and the obvious axial balance as in Fig. 6, with its induced fields of equal optical quality and spatial strength. There is no sense of direction of forces, no sense of tension or directional energetic forces. It is a dead experience. The basis of every dynamic composition is said to be an inner contradiction generated by the tension between spatial forces.[46] We feel such forces at work in Bouleau's description of Picasso's technique which he relates as studying "an object as a surgeon dissects a cadaver":

---

45. Leepa, p. 110.
46. Kepes, p. 36.

> Each part of the dissected object is brought firmly onto the picture plane, and they are all juxtaposed and the surface is turbulent with a huddle of ridges that suggest a recession into space.[47]

Dynamic unity is successful only when the movement of each detail seems to fit logically into the movement of the whole,[48] and is often the result of the artist who combines the elements of his work into a unified whole with the imagination that adds variety to and within the basic unity.

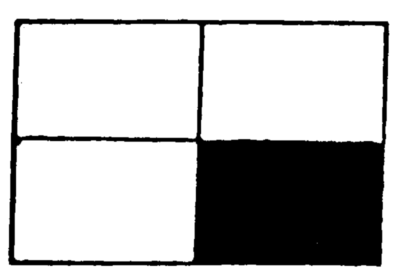


Fig. 7

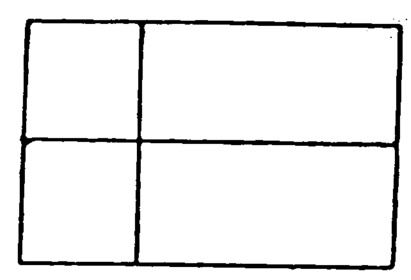


Fig. 8

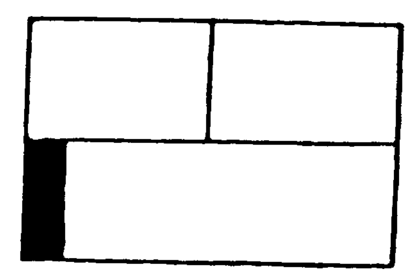


Fig. 9

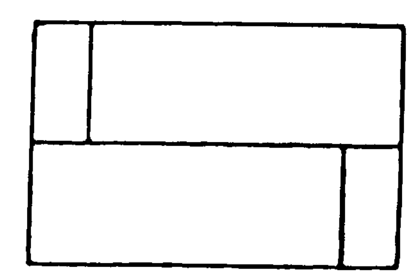


Fig. 10

Line, in Figs. 7, 8, 9, and 10, is employed in such a way that it creates spatial or energy fields of varying magnitudes, thus implying movement offering varying optical measures and qualities. Direction, weight, and intensity are integrated to produce a visual experience which is alive: "fields opened and advancing toward the spectator; another unit will create a field in a receding direction; another will activate a field tending upward on the surface; and yet another down.[49]

---

47. Charles Bouleau, The Painter's Secret Geometry (London: Thames and Hudson, 1963), p. 225.

48. What we mean when we say the detail seems to 'fit logically' is that an individual visual unit 'seems to belong there' by reason of the other elements in the composition. For example, a bold horizontal line stretched across Pollack's "Cathedral" just doesn't seem to fit; it seems out of place and not consistent with the other visual elements on the canvas. The same line superimposed on Mondrian's "Composition with Red 1936" seems to fit: it is something we might expect in such a context, and as such offers no great difficulty in accounting for it in our visual organization--it looks right.

49. Kepes, p. 36.

The visual elements thus employed are tied together by a common measure into an organic succession which braces the attention of the viewer in a continuous flow until all relationships are involved into a unity or balance.[50]

50. Kepes, p. 53.

THE ILLUSION OF MOVEMENT

Dynamic composition is effected by the virtue of lines (and the juxtaposition of lines) being able to suggest tension and movement on the surface of the picture plane. Notice, we say line suggests movement. Lines do not physically move about on the surface of the picture plane thereby creating tension and directional energetic forces. The evocation of feelings of tension and movement is solely through the combination of forms, colours, and elements reflecting materials and movements. The feeling of tension is real; movement is illusionary.

Line suggests motion in two ways: first, by representing things that we know are capable of motion; and second, by its form or by its relation to other lines and forms. When line is used to represent an object from the outside world which we know to be capable of motion, the illusion of movement is largely due to the representational object's conforming to a pre-given set of the spe-tator or to what has been referred to as einstellung, a "directed readiness" on the part of the observer to preserve or carry over the qualities or characteristics of the real object (as it exists in the real world) in the represented object.[51] Movement of this type is predicated on the learned associations that the observer carries with him into the experience. We shall be more concerned about movement of the second

51. Kling and Riggs (ed.), Woodworth and Schlosberg's Experimental Phychology (New York: Holt, Rinehart and Winston, Inc., 1971), p. 438. Also see Festinger, et. al, "Efference and the Conscious Experience of Perception," Journal of Experimental Phychology Monograph, No. 637, Whole, 1967.

variety and examine how felt movement is effected by the form of line itself and then by its relation to other lines or other visual elements within the same composition.

Before proceeding, however, it is necessary to distinguish between movement and felt movement. By movement we mean the actual modulation of position in real time and real space. Masses in the physical or real world move. Masses on the artist's canvas do not actually move, but give the appearance of movement by nature of their related placement on the surface of the picture plane. By 'appearance of movement' I do not mean that unless we look closely we might believe the masses on the canvas really did mo-e, but that they seem to exert a force felt bodily through their relation to other visual elements.[52]

Now it is one thing to give the appearance of movement and quite another to stimulate the eye so that we experience movement. Op art, for example, distorts the surface of the picture plane outside the conventions of depth stimulation, reconstructing it in such a way that it effects what is called a 'jazzing effect' which overloads the retinal or visual circuits in such a manner that the spectator actually experiences movement.[53] This experiencing of the sensation of movement "is due to direct stimulation of the retinal movement detectors with the constant tremor of the eyes."[54] (See Fig. 11).

---

52. Leepa, p. 115.
53. R.L. Gregory, The Intelligent Eye (New York: McGraw-Hill Book Company, 1970), p. 87.
54. Ibid., p. 88.

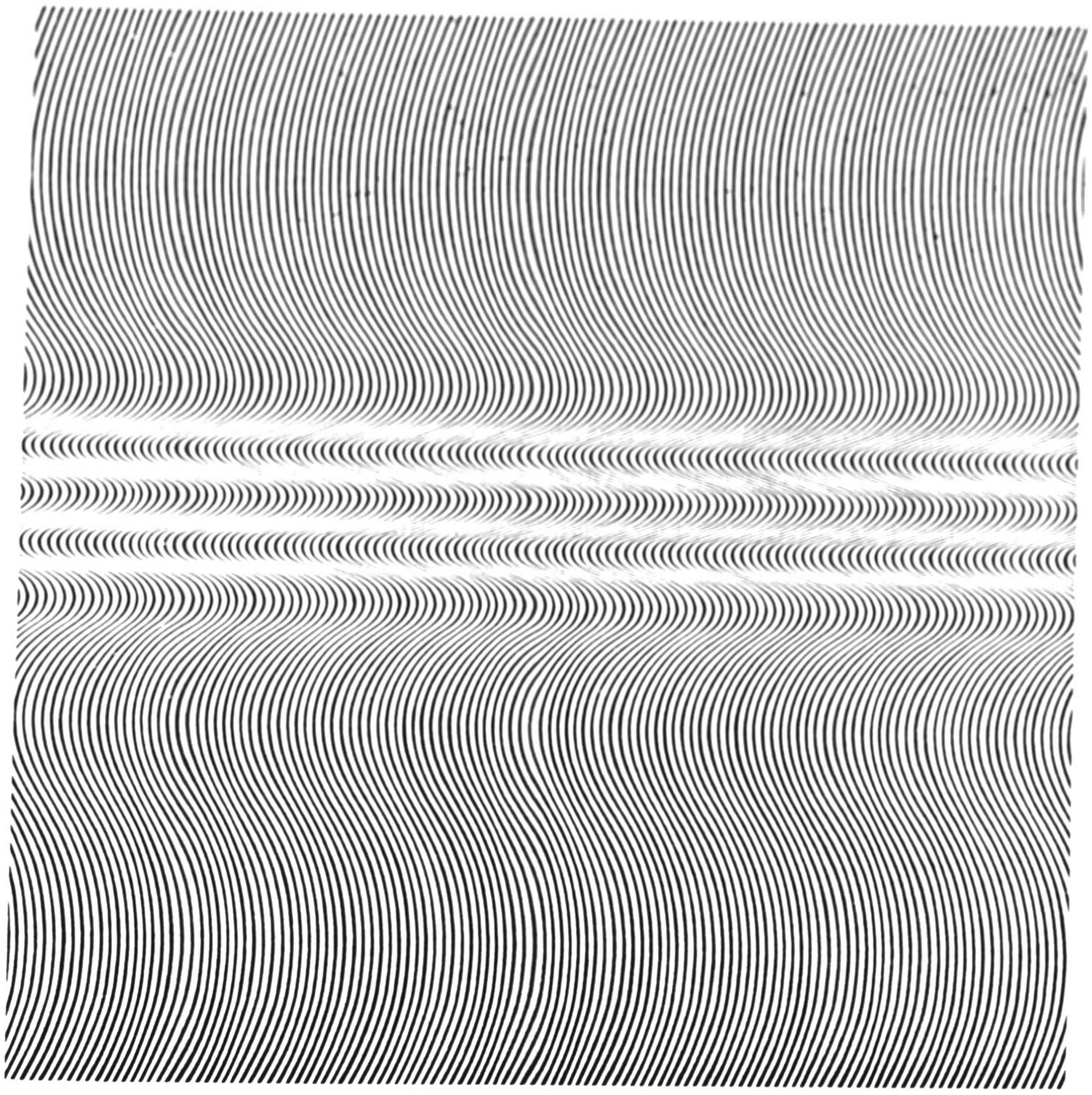


Fig. 11

"As soon as the eye establishes a flat plane as a constant, it is led back into schematic depth by devices in which frontal forms veer off into strong diagonals."[55] There is an actual optic dissonance as the vehicle of eye-rocking vibrations.

Lines give the appearance of movement by their form and by their relation to other forms. For example, curving lines tend to be seen

---

55. Knobler, p. 173.

as moving in the direction of their greatest thrust, and by modulating the thickness of the line the effect can be accentuated as in Fig. 12. We have the tendency to follow with our eyes the direction and extension of lines. This principle helps to explain the visual

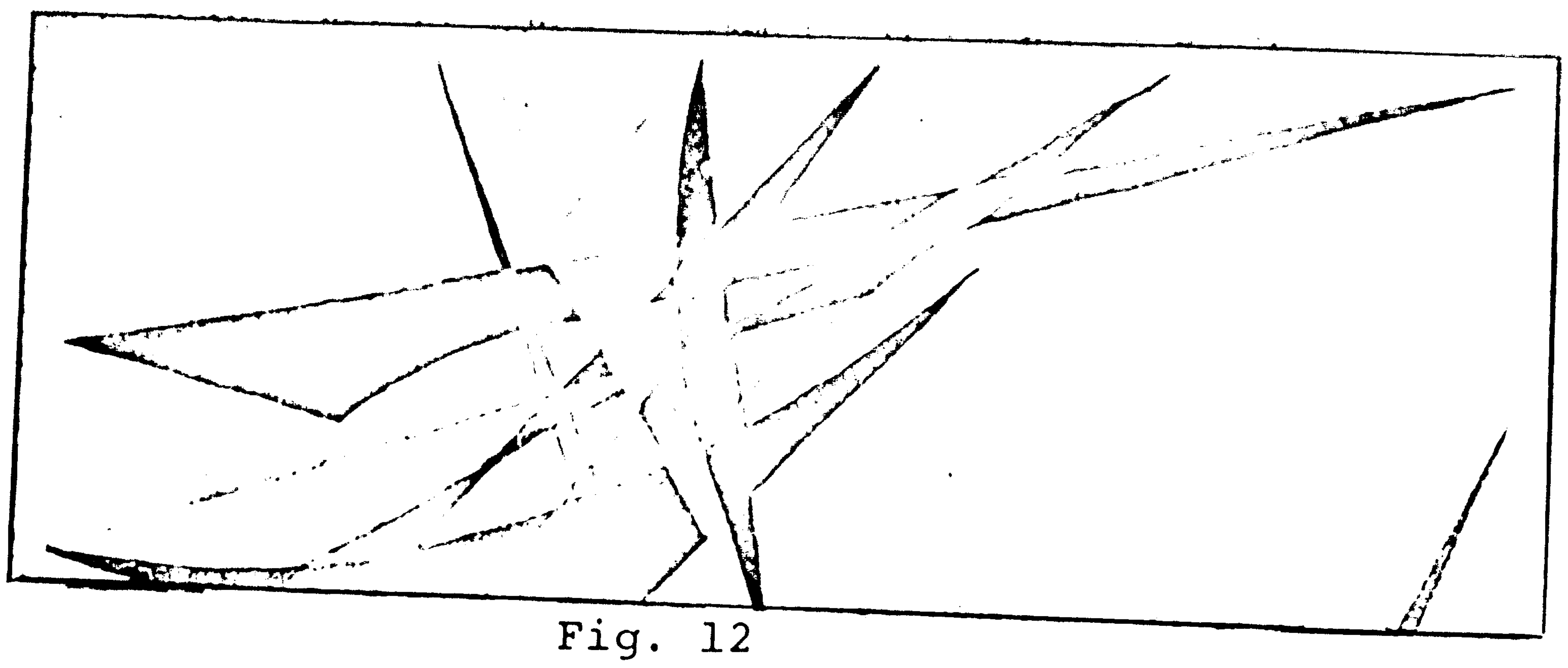


Fig. 12

illusion in Fig. 13, which is somewhat similar to the Müller-Lyer illusion. When arrows are placed near straight lines of equal length, the eye is given a directional clue as how to take the appearance of the two lines, in one case compressing the overall effect of length; in the other case, extending it. The effect is such that the figures with outward-directed arrows look larger than the corresponding figure with inward-directed arrows.[56] (In the Müller-Lyer illusion the effect is exactly the opposite).

---

56. This visual illusion and others is the subject of study in Robert Froman's Science, Art, and Visual Illusions (New York: Simon and Schuster, 1970).

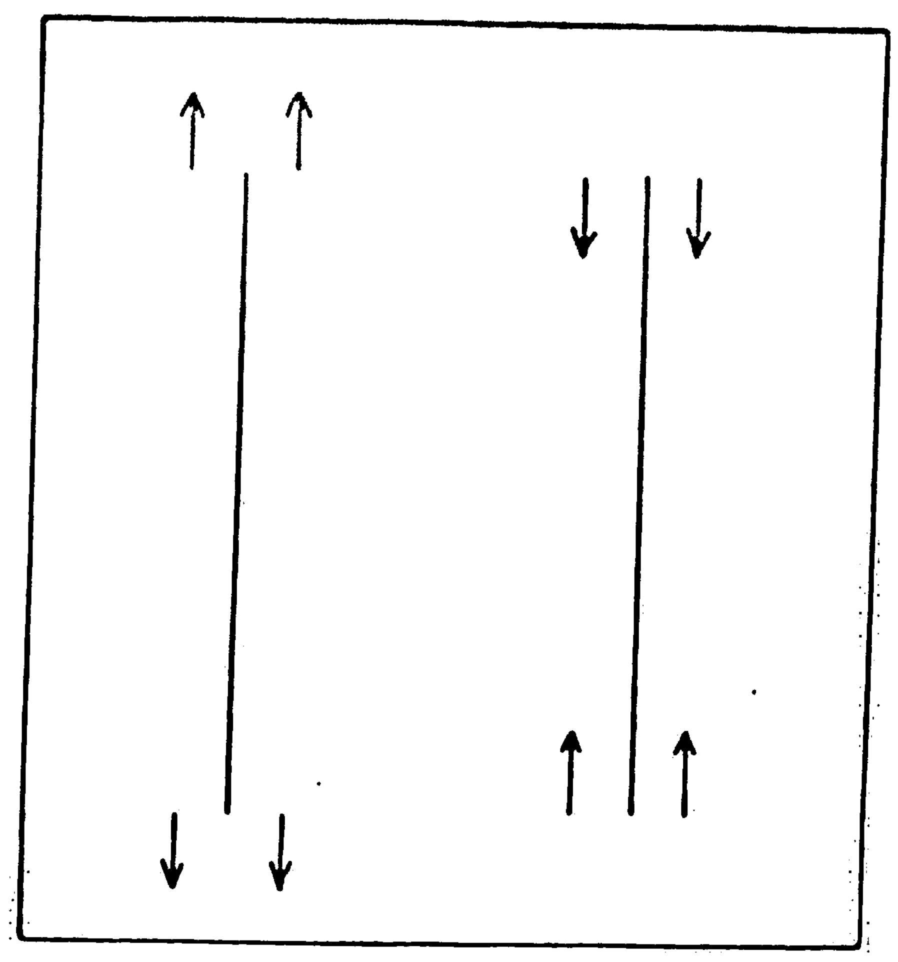


Fig. 13

The illusion of movement is further carried out because line itself is the result of movement and action: an extreme example of this would be the principle of 'living movement' in Japanese painting as described by Bowie:

> A distinguishing feature in Japanese painting is the strength of the brush strokes, technically called <u>fude no chikara</u> or <u>fude no ikioi</u>. When representing an object suggesting strength ... the moment the brush is applied the sentiment of strength must be invoked and felt throughout the artist's system and imparted through his arm and hand to the brush, and so transmitted to the object painted.[57]

---

57. Arnheim, p. 416.

Movement or felt tension is also brought about by the placement of forms in relation to one another as well as to the vertical and horizontal edge of the picture plane. "One mass pushes in one direction, another opposes it; this takes place in two-dimensional direction, i.e., on the surface."[58] The masses, as we have pointed out earlier, do not really move on the surface of the picture plane: they do not really "exert a force" either. It is in the perception of these masses that certain tensions are felt bodily and are influenced by the nature of the related placement of the masses on the canvas.[59] A visual element positioned at the right of the canvas will produce a longer distance to the left of the canvas than to the right. This 'surface distance' will help establish the movement of the form and picture surface toward the right. This effect is usually referred to as 'shifting'.[60] Fig. 8 (shown earlier), when compared to Fig. 6 (also shown earlier), illustrates this principle. Then the visual elements of Fig. 6 are 'shifted' as in Fig. 8, the entire surface of the picturepplane is involved, not only the lines, but, even more important, the spaces around the lines. While line helps direct the movement, the space between the lines and the edges of the picture

---

58. Leepa, p. 115. While what is said here refers to apparent motion on the surface of the picture plane, clearly exactly the same sort of thing is involved in apparent 'three-dimensional' movement. This will become obvious when we consider 'hyper-dimensional' movement as it is represented by the Necker Cube in another section.

59. Ibid.

60. Ibid., p. 119.

plane plays a dominant role. "Two straight lines close to each other (the line implied by the edge of the picture plane and the line parallel to it), creates a feeling of energy measured by the distance between the two lines."[61]

The principle of tension or movement is further illustrated by the figures below:

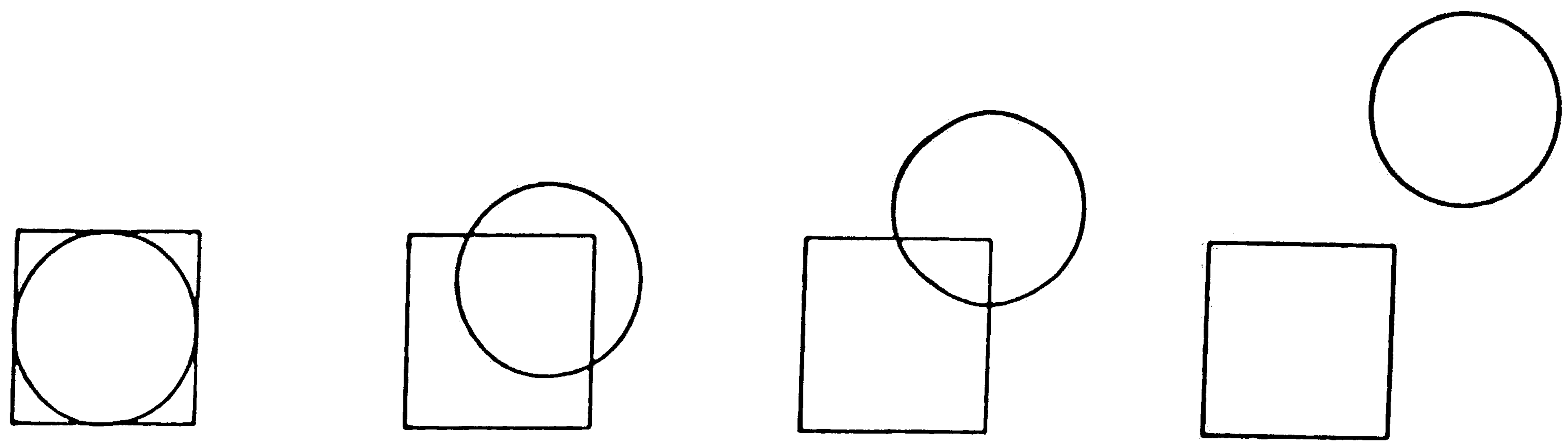


Fig. 14 Fig. 15 Fig. 16 Fig. 17

There seems to be little movement or tension implied by Fig. 14 and 17, but in Figs. 15 and 16, tension is noticeable. The forms show a tendency toward changing their locations in the direction of one of the two extreme solutions, that is, of either coinciding or tearing apart.[62]

This gives us a clue as tc what linear movement in the visual arts does. It guides the surface tension opposites and helps to group forms in rhythmic patterns, thus tying the picture together for the eye to grasp more easily.[63] The juxtaposed elements, the correspondence between lines and surfaces produce "subtle modulations which

---

61. Kepes, p. 182.
62. Arnheim, p. 239. (The illustrations are adapted from text).
63. Leepa, p. 122.

are brought to a crescendo by the space-building power of lines crossing."[64] It is this phenomenon of linear movement, the relative strength of visual elements and the operation of invisible forces that function between visibly located centers of force which Moholy-Nagy called "a celebration for the eye: a rythmical and emotional exultation:[65] and Weismann called the vital ingredient in the expressive power of a work of art:

> In responding to art as a whole, we are made conscious of the interworkings of all these forces. Whatever degree of expressive power the balanced work of art may possess is made real and meaningful to us by virtue of, and in terms of, the particular character of the pattern created by the interworkings of these forces.[66]

---

64. Moholy-Nagy, p. 128.
65. Ibid.
66. Weismann, p. 110.

LINE AS CONTOUR

Another function of line is line as contour. When we talk about contours, we talk about the outline or the shape of objects or areas, real or implied, produced by a deviation of some space-sensation from the mean of the surrounding field on which the attention is directed.[67] As Mach pointed out in 1865, "a contour occurs with a relatively abrupt change of gradient: mathematically, it is a change of a change, that is to say it is the second derivation of luminance, not the first (d^2L/ds^2; not dL/ds)."[68] The illumination of a position on the retina is felt in proportion to its deviation from the mean of the illumination of the adjacent positions.[69] The delineation of contours is a body-felt sensation as the result of the organic reciprocal action of the retinal elements on one another as described by Mach:

> Let $i=f(x,y)$ be the intensity of illumination of the retina with reference to a system of co-ordinates (XY); then the mean

---

67. Ernest Mach, "On Contours", Visual Perception: The Nineteenth Century (New York: John Wiley and Sons, Inc., 1964), p. 94.
68. Kling and Riggs, pp. 428-9
69. Mach, p. 95.

> value determining the intensity for a given position may be symbolically represented as approximately
>
> $$i + \frac{m}{2}\left(\frac{\partial^2 i}{\partial x^2} + \frac{\partial^2 i}{\partial y^2}\right)$$
>
> m is constant and the radii of all curves of the surface f(x,y) are taken as large in proportion to the distance at which the retinal positions are still perceptibly influenced. Now according as
>
> $$\left(\frac{\partial^2 i}{\partial x^2} + \frac{\partial^2 i}{\partial x^2}\right)$$
>
> is positive or negative, the position of the retina experiences a darker or brighter sensation respectively than it does under equal illumination of the adjacent positions with the intensity corresponding to itself.[70]

Perhaps a graphic illustration of how contour is produced by a change of gradient is best seen in Mach's band phenomenon (created with horizontal lines), as shown in Fig. 18. While this is not the only way in which line produces contour, it is an interesting one.

---

70. Mach, p. 96. It might be interesting to note that DeLaunay denied the reality of contours on the strength that he could not stop his chromatic circles from organizing themselves upon diameters and chords and from suggesting lines as well as depth. See Bouleau's <u>The Painter's Secret Geometry</u>, p. 226.

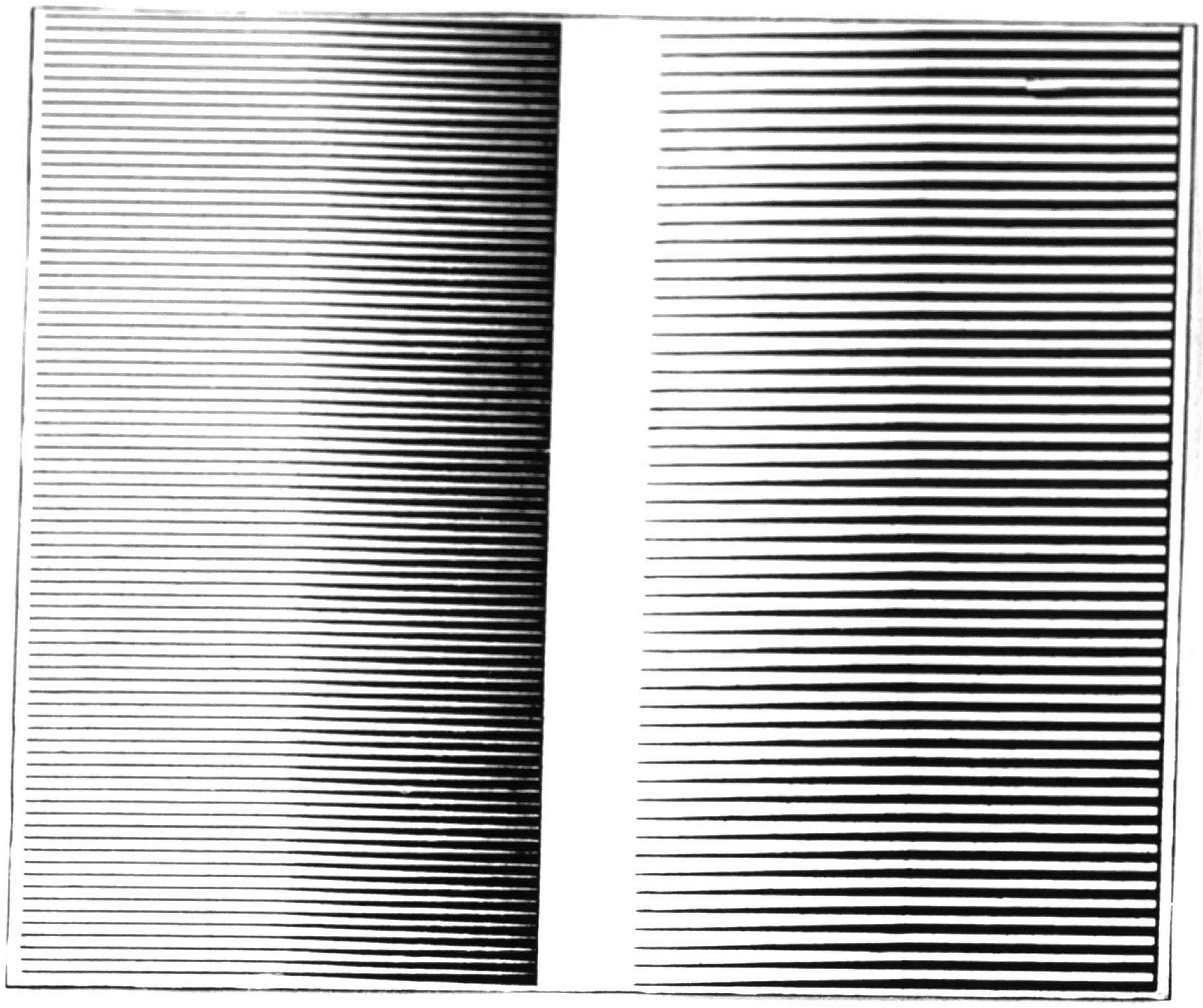


Fig. 18

In the illustration at the left the black lines are a constant thickness from the left side to the midpoint and then thicken gradually. When the illustration is viewed from a distance, a vertical white 'Mach band' appears down the middle. In the illustration at right the horizontal black lines are a constant thickness from the right side to the midpoint and then thin out. When viewed from a distance, the illustration appears to have a vertical black band down the middle.[71]

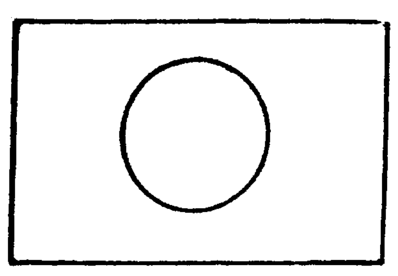


Fig. 19

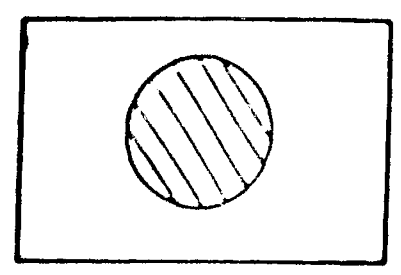


Fig. 20

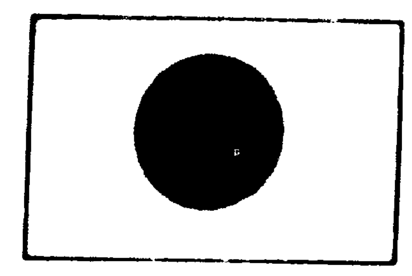


Fig. 21

Another way in which line functions as contour is shown by the figures above. In Fig. 19, there is a linear object which has interior and exterior contours. A gradual increase of elements within the linear object (as in Fig. 20), shows that in each addition to the number of internal units, an overall spatial unit can be maintained which the number of internal spatial units and contours increases. When a point of saturation is reached, a uniformity of surface is produced on a new level. In Fig. 21, line no longer exists, only exterior contour.

For the most part, outline figures produced by nothing but contour tend to appear in front of the ground plane.[72] In Fig. 21, the outline shape tends to be seen as a surface that lies on top of a throughgoing ground plane; it seems, as Arnheim suggests, to lie

---

71. The illustration and explanation is adapted from Floyd Ratliff's "Contour and Contrast", Scientific American, Vol. 226, No. 6 (June, 1972), pp. 90-101.

72. Arnheim, p. 215. We shall see exceptions to this when we mention convex and concave shapes in the section dealing with the illusion of space.

closer to the observ er. "This difference of location in depth is not brought about by any process originating in the [outline figure] itself; it is induced by remote control through the contours."[73]

Arnheim makes a distinction between 'contour' and what he calls the 'structural skeleton' of an object. He maintains that the shape of a visual object does not consist only of its outline, but has another more essential quality. He cites Delacoix's theory that "the first thing to grasp of any object in order to make a drawing of it is the contrast of its principle lines",[74] and these principle lines do not refer to any contours actually given in the object.[75] They form what Arnheim calls the 'structural skeleton' of a visual object.

For Arnheim, the 'structural skeleton' is a descriptive device, more exacting and more complete than any appeal to contour. He points out that while the structural differences may be caused by changes of the contours they [the structural differences of unlike triangles] cannot be described in terms of the contour, but rather in terms of the axes and angles of the individual triangles:

> The 'identity' of each triangle ... its character or nature ... depends on its structural skeleton, which consists primarily of the framework of axes and secondarily of characteristic correspondences of parts created by the axes.[76]

---

73. Arnheim, p. 215.
74. Ibid., p. 78
75. Ibid.
76. Ibid., p. 79.

He goes on to say that if we were given the task of duplicating a pre-given set of visual objects (i.e., a set of triangles), without the aid of a template we would be unable to complete the task accurately if we were to rely solely upon a description of the visible contours. The importance of the 'structural skeleton' is that it establishes the identity of a visual pattern by indicating the conditions that must be fulfilled if a given pattern is to resemble or represent another.[77]

Let us make the assumption that we are presented with three different triangles: an equilateral triangle, an isosceles triangle, and a scalene triangle. Our task is to duplicate these shapes using only a compass, a ruler, and pencil. How would we proceed? It is most likely that we would set out by measuring the legs or sides of each triangle, taking a careful note of the size and direction of the angles formed by the abutment of any two lines as we go along. In doing this Arnheim would say we are cataloguing the structural differences of each triangle; that is, plotting the 'structural skeleton'.

---

77. Arnheim, p. 80.

The 'structural skeleton' of an isosceles triangle, for example, might take the form of:

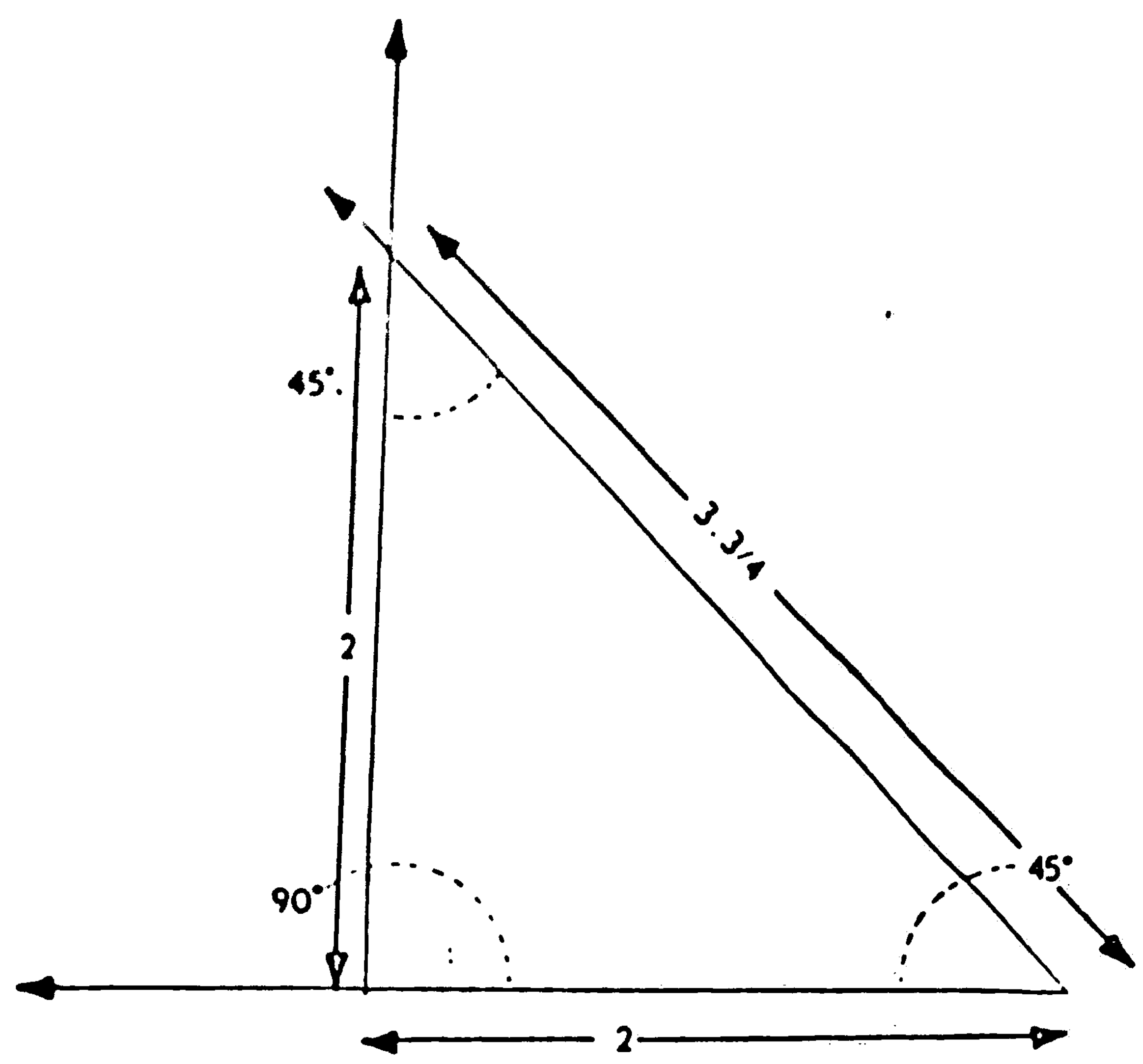


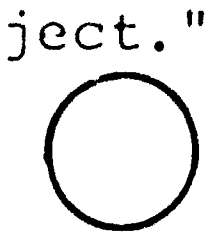
Fig. 22

Contour alone cannot account for the structural differences which distinguish one kind of triangle from another. In describing the individual triangles we are really giving a description of its 'structural skeleton' in accounting for the differences in angles and axes:

d_e= a closed figure bounded by three sides (all of which are equal in length) and having three angles (each angle being equal to 60°).

d_i= a closed figure bounded by three sides (only two of which are equal in length) and having three angles (only two of which are equal).

d_s= a closed figure bounded by three sides (none of which are equal in length) and having three angles (none of which are equal).

However, Arnheim cannot dismiss the fact that while visual objects cannot be fully described in terms of their contours, certain kinds of visual objects can be distinguished by contour. "That is a round object; that is a triangular object." Contours can be immediate 'clues' to the recognition of  not belonging to the same class as  . This kind of description, perhaps while mechanically incomplete, is nonetheless quite functional in immediately differentiating one object from another; sometimes contour is all that we have available.

Line functioning as contour can perhaps be more simply shown in Fig. 23. As we had mentioned earlier, when a line is placed upon the surface of the picture plane it divides the picture plane into two

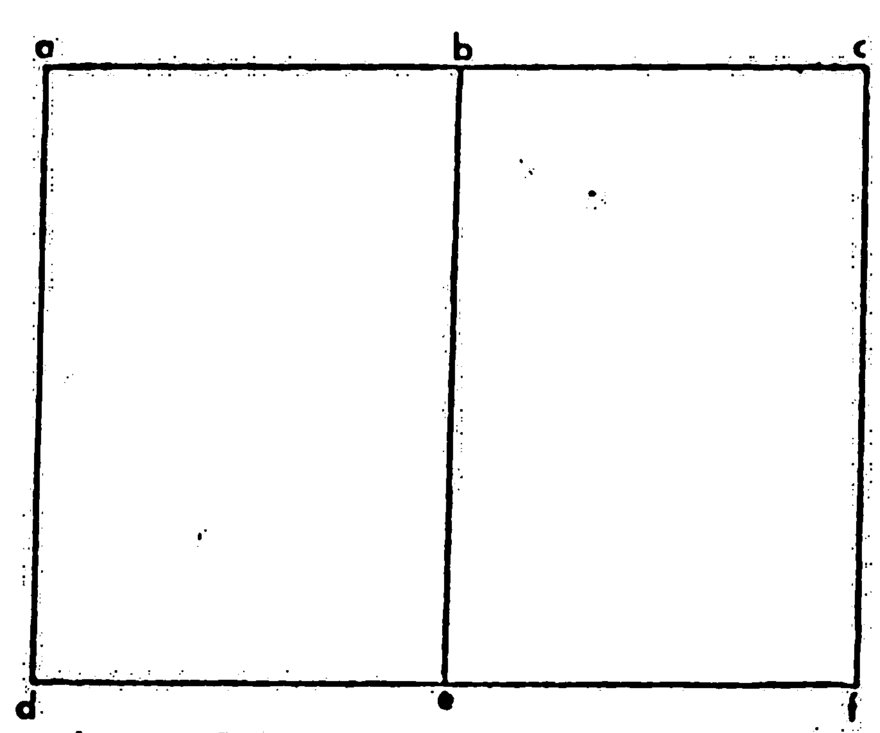


Fig. 23

separate planes. In Fig. 23, the introduction of line 'be' creates planes 'abed' and 'bdfe'. It functions as a commonly shared edge.

Its relationship to the picture surface is adjusted to the frame 'acfd' and functions symmetrically within the confines of 'acfd'. 'acfd' is a closed conteur, that is a plane bounded by four edges as a deliberate exclusion of the surrounding world. 'abed' and 'bcfe' are also closed contours differing from 'acfd' in that they share a common edge with another plane. 'abed' participates in 'bcfe' by virtue of 'be'.

THE ILLUSION OF THREE-DIMENSIONAL SPACE

By understanding how a line functions as an edge of a plane, we have a clue how the areas of a picture can be sensitively related to create a two-dimensional organic unity, each area of the surface interactively affecting one another at the same time. By creating planes on the surface of the picture plane, we are creating spatial units. In Fig. 24, and Fig. 25, we see two types of spatial units or spatial planes: one parallel to the surface, and one oblique to

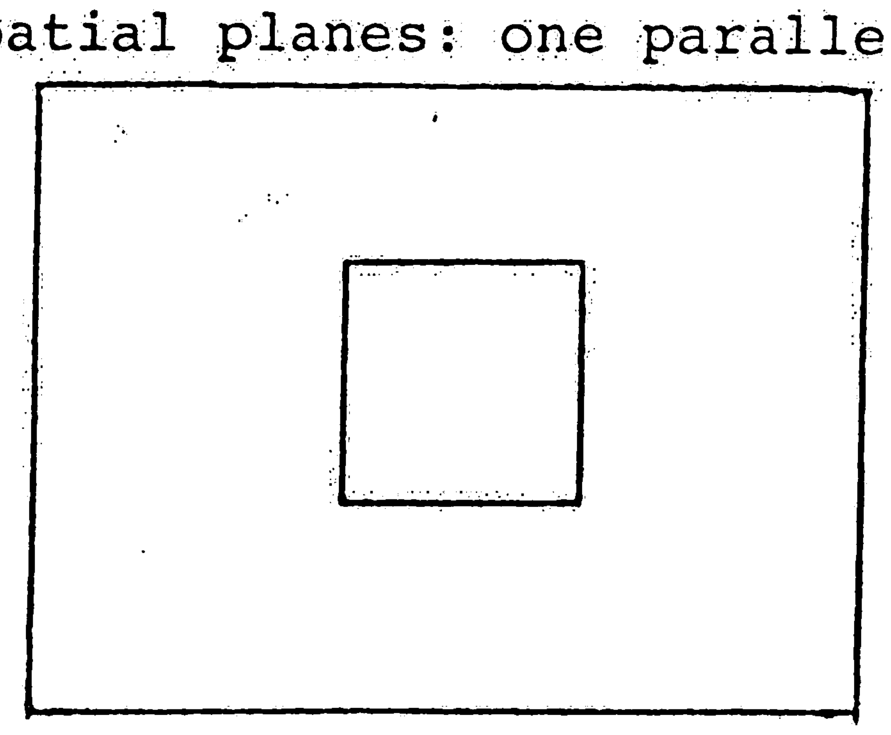


Fig. 24

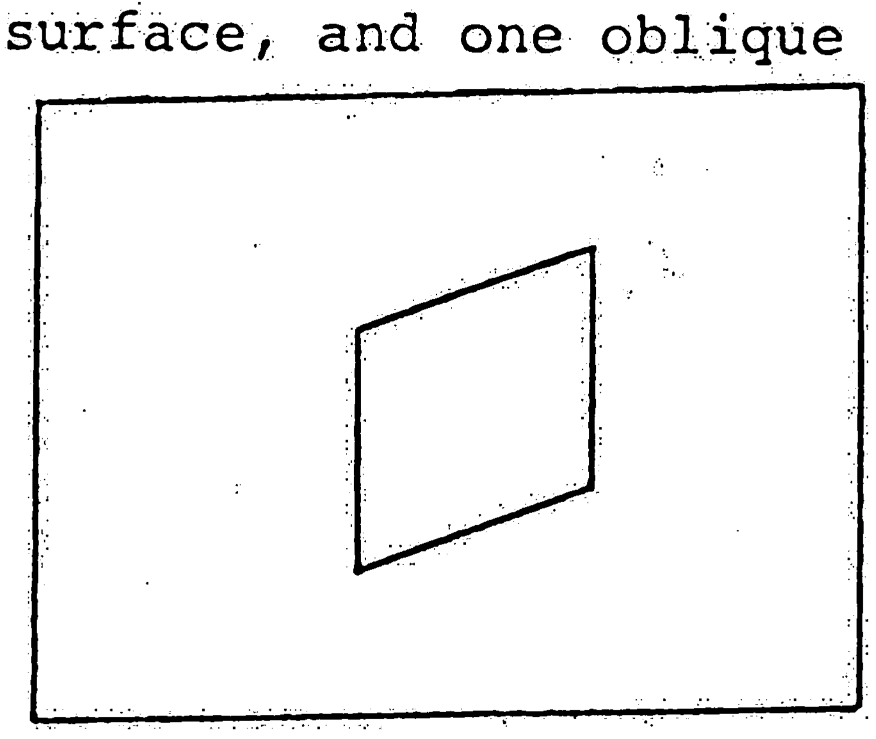


Fig. 25

the surface. Each plane, regardless of its position on the surface of the picture plane is considered as having an imaginary horizontal and vertical axis which serves two functions; first, as a notation in describing the plane; and second, as an orientation around which a plane may be made to turn.[78] It is by virtue of these imaginary axes that the illusion of three-dimensional space is created.

Space is defined as the relationship between the position of bodies. In the graphic arts, we find this space to be, for the most part, exclusively two-dimensional. The sidual elements or graphic dimensions actually exist only on the flat surface of the picutre plane, that is, they exist only on a two-dimensional plane. Their extensions do not in fact pierce or violate the plane (except in some forms of op art which shall be considered the exception rather than the rule); they do not take a position in back of or in front of the flat surface of the picture plane. Two-dimensional space in painting is real. Whatever depth or three-dimensional qualities may appear to be present in art is solely a matter of illusion.

Weismann offers an excellent study on the spatial qualities of the graphic arts, and he attributes the illusion of three-dimensional space to the visual tensions which are set up between the surface of the picture plane and whatever is marked or coloured upon it.[79] If we

---

78. Leepa, p. 98. (Also see J. J. Gibson's "The Perception of Visual Surfaces", American Journal of Psychology, Vol. 63, 1950, pp. 367-384.)

79. Weismann seems to be strongly influenced by Arnheim: as a matter of fact, much of what he writes can be found in Arnheim's Art and Visual Perception. However, I used Weismann as a reference primarily because in most instances he is slightly clearer than Arnheim himself and therefore what he writes is a bit more easily understood.

look at an illustration adapted from his text (my Fig. 26), a line is made on a plane. Depth is implied in so far as the line appears to lie above the plane. As Weismann carefully states, "the [line] is _on_ not _in_ the plane ... However, a considerable distance is im-

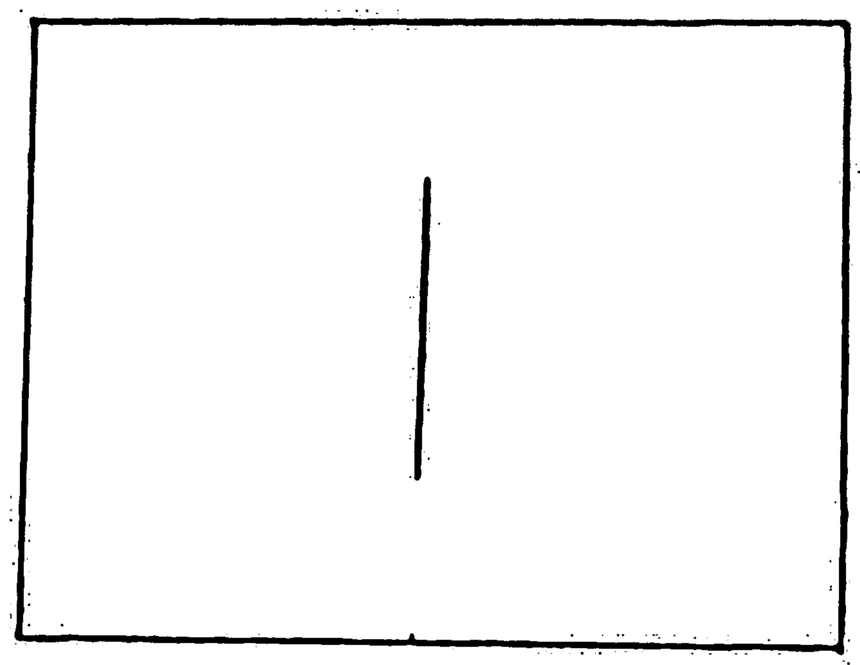


Fig. 26

plied between the level of the [line] and the level of the plane behind it."[80] He goes on to explain why we see the line lying above the plane:

> It is simpler to interpret what we see as a continuous plane lying under the [line] than it is to see the plane interrupted by ... an open incision. For were the latter the case, we would have to postulate the existence of another, darker plane lying behind the opening and showing through.[81]

---

80. Weismann, p. 155.
81. _Ibid._ Also see Wertheimer's "Principles of Perceptual Organization", _Readings in Perception_ (Princeton, N.J.: Van Nostrand, 1958); and Koffka's _Principles of Gestalt Psychology_ (New York: Harcourt, Brace, 1935).

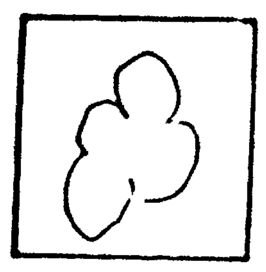


Fig. 27

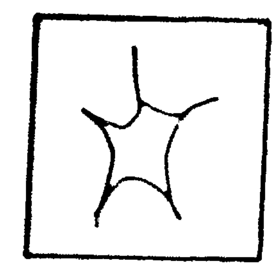


Fig. 28

With regard to flat convex or concave shapes, Weismann points out that flat convex shapes generally appear to expand and therefore appear closer to us; while flat concave shapes seem to contract and appear to be further away.[82] Unlike the line of Fig. 26, concave shapes oscillate in their apparent position on the surface of the picture plane: "One moment we interpret [the concave shape] as a hole, the next moment we see the plane as if it is continued uninterrupted below the concave shape."[83]

Another illustration of how line can be used to create the illusion of three-dimensional space is the consideration of two independent shapes (Fig. 29 and 30), and the phenomenon which occurs

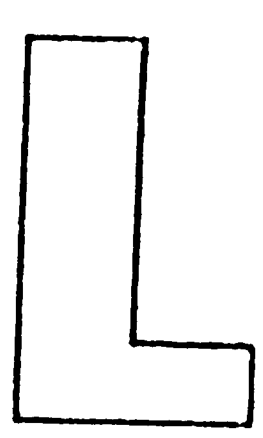


Fig. 29

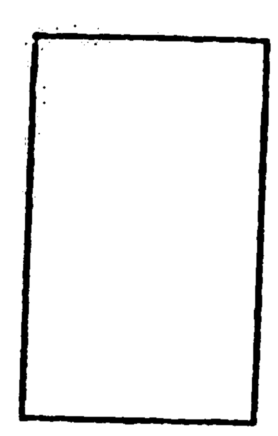


Fig. 30

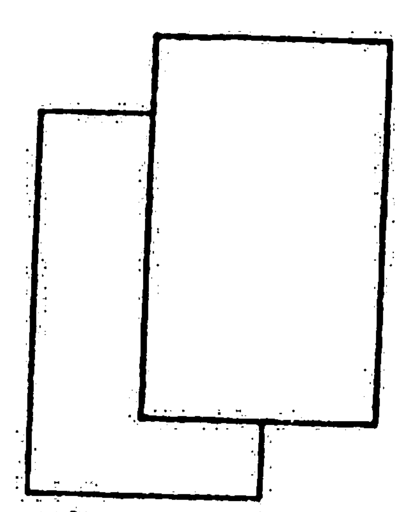


Fig. 31

---

82. Arnheim, p. 240; also, Weismann, p. 162.
83. Weismann, p. 162.

when these two shapes are abutted against one another. When the L-shape is placed against a corner of the rectangle, the shapes are still in fact flat but in this position we see the L-shape as a rectangle with part of its surface hidden behind the fully showing rectangle.[84] This is what Weismann and the earlier Gestaltists call the preference of our vision for simplicity: "our eyes preserve the quality of completeness so we see the rectangle as if it were in front of the L."[85]

The relative positions and the gradation of size of visual units on the surface of a picture plane are also the basis for the illusion of space. In Fig. 32, the rectangles (actually squares) lie on the

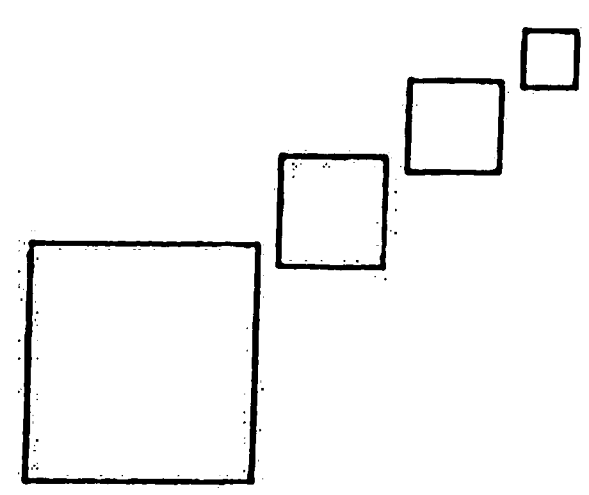


Fig. 32

same two-dimensional flat surface of the picture plane but because of their relative positions and planned gradation in size, they give the illusion of receeding back into space. The elements which lie on the lower parts of the picture plane appear closer to us than those which lie higher up. This appearance of spatiality is illu-

---

84. Weismann, p. 158.

85. Ibid. Also see Dinnerstein and Wertheimer's "Some Determinants of Phenomenal Overlapping," American Journal of Psychology; Vol. 70, 1957, pp. 21-37; also, Ratoosh's "On Interposition as a Cue for the Perception of Distance", Proceedings of the National Academy of Science, Vol. 35, 1949, pp. 257-259.

sionary as the elements lie equidistant from the spectator on a common flat surface.

Lines alone can create the illusion of three-dimensional space, and diagonal lines or directional lines tend to increase the illusion of deep space.[86] An example would be the 'vanishing point' in the graphic arts. The vanishing point is that imaginary (or at times real), position on the surface of the picture plane "where an ancillary line, parallel to the horizontals of the facade and passing through the center of projection" apparently pierces the surface of the picture plane.[87] All the horizontal lines of the facade are projected as straight lines which converge toward the imaginary point of an extremity of the picture plane:

> Since the visual angles subtended by the distances of the projections of all the other parallels to the ancillary line must, like the angles subtended by the distances between these parallel themselves, become smaller and smaller with increasing distance, these straight projected lines must necessarily converge toward the point image of the ancillary line.[88]

Pirenne goes on to say:

> If we call <u>distance of the picture</u> the length of the perpendicular to the plane of projection from the centre of projection, and <u>principle point</u> the point where this perpendicular intersects the plane,

---

86. Weismann, p. 164.
87. M. H. Pirenne, <u>Optics, Painting, and Photography</u> (Cambridge: Cambridge University Press, 1970), p. 139.
88. <u>Ibid</u>.

> then the distance of the vanishing point is equal to the distance of the parallels with the perpendicular to the plane of projection.[89]

As we had noted earlier, we have the tendency to follow with our eyes the direction and extension of lines. The impact of the feeling of distance and space created by converging lines is quite noticeable when we consider the geometric illusion below which is due to inappropriate depth-cue scaling.[90] The two cylinders are actually the same

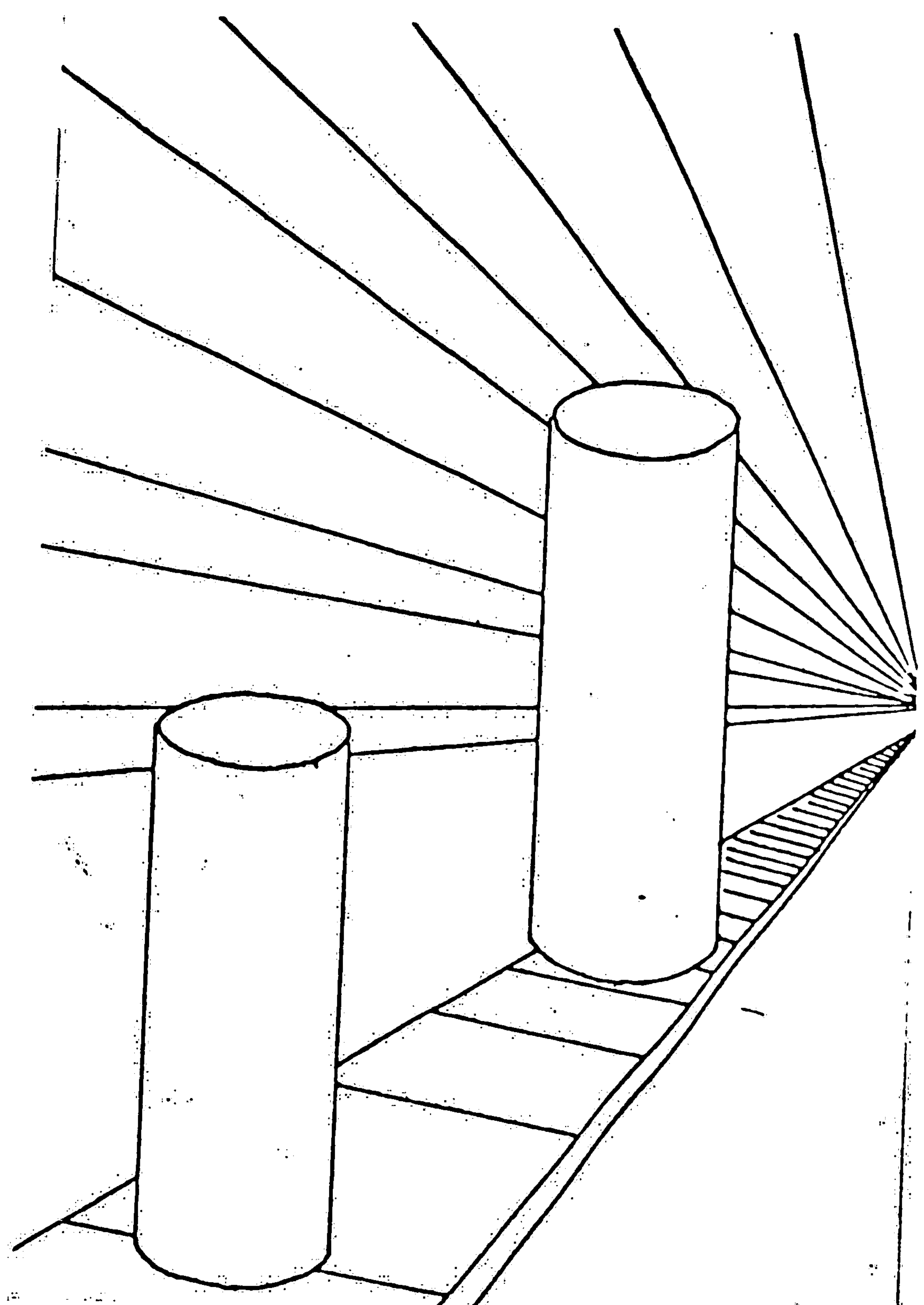


Fig. 33

---

89. Pirenne, p. 139.

90. For a discussion of errors in depth-due scaling see Richard Gregory's "Visual Illusions", Scientific American, Vol. 219, No. 5 (November, 1968), pp. 66-76. Also see Stavrianos' "The Relation of Shape Perception to Explicit Judgments of Inclination", Archives of Psychology, (1945), p. 296; Also, R. B. Freeman, Jr., "Effect of Size on Visual Slant", Journal of Experimental Psychology, Vol. 71, (1966), pp. 96-103.

size, but the cylinder located on the upper-right area of the picture plane appears to be larger. This 'appearance of being larger' is directly due to the fact that the drawing now seems to have not only the two dimensions of height and width, but with the introduction of converging lines it takes on a third dimension, depth. Thus lines not only function in articulating the third dimension, but can distort and change the relationship of the other visual elements on the surface of the picture plane and effectively alter their appearance. Line can induce optical illusions.

HYPER-DIMENSIONAL MOVEMENT

I would like to conclude my paper with a brief discussion of a special class of objects which involve the use of lines to create the phenomenon of 'hyper-dimensional' shift. Belonging to this class of visual objects would be figures such as the Necker Cube and Jastrow's duck-rabbit, to name two. The phenomenon is somewhat akin to what Attneave calls multistability in perception.[91] Characteristic of hyper-dimensional shift is either the apparent movement involving a component which at one time appears to move toward the observer and at another time appears to move away; or, the spontaneous shift or change in the appearance of a visual unit.

---

91. Fred Attneave, "Multistability In Perception", Scientific American, Vol. 225, No. 6 (December, 1971), pp. 62-71.

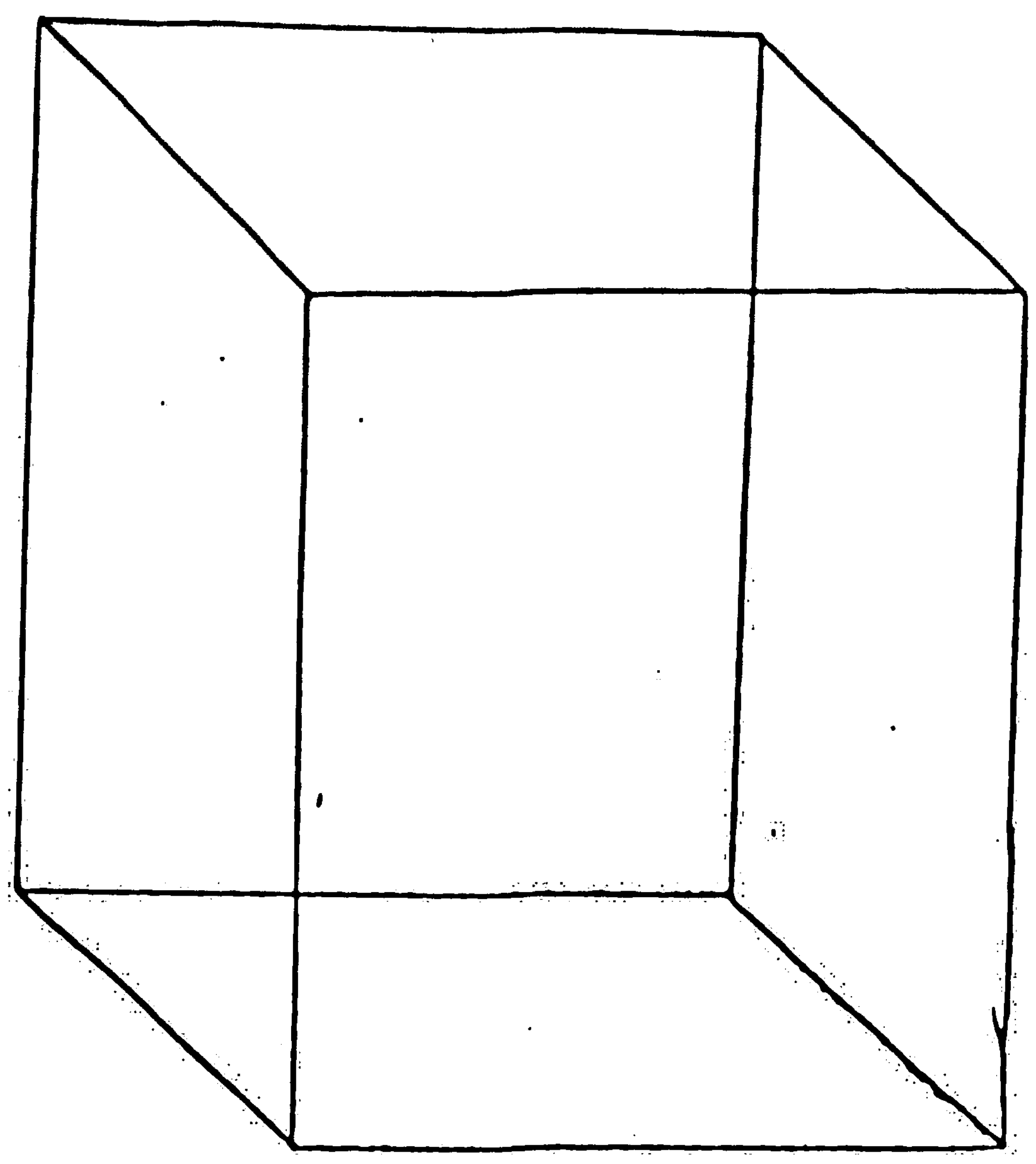


Fig. 34

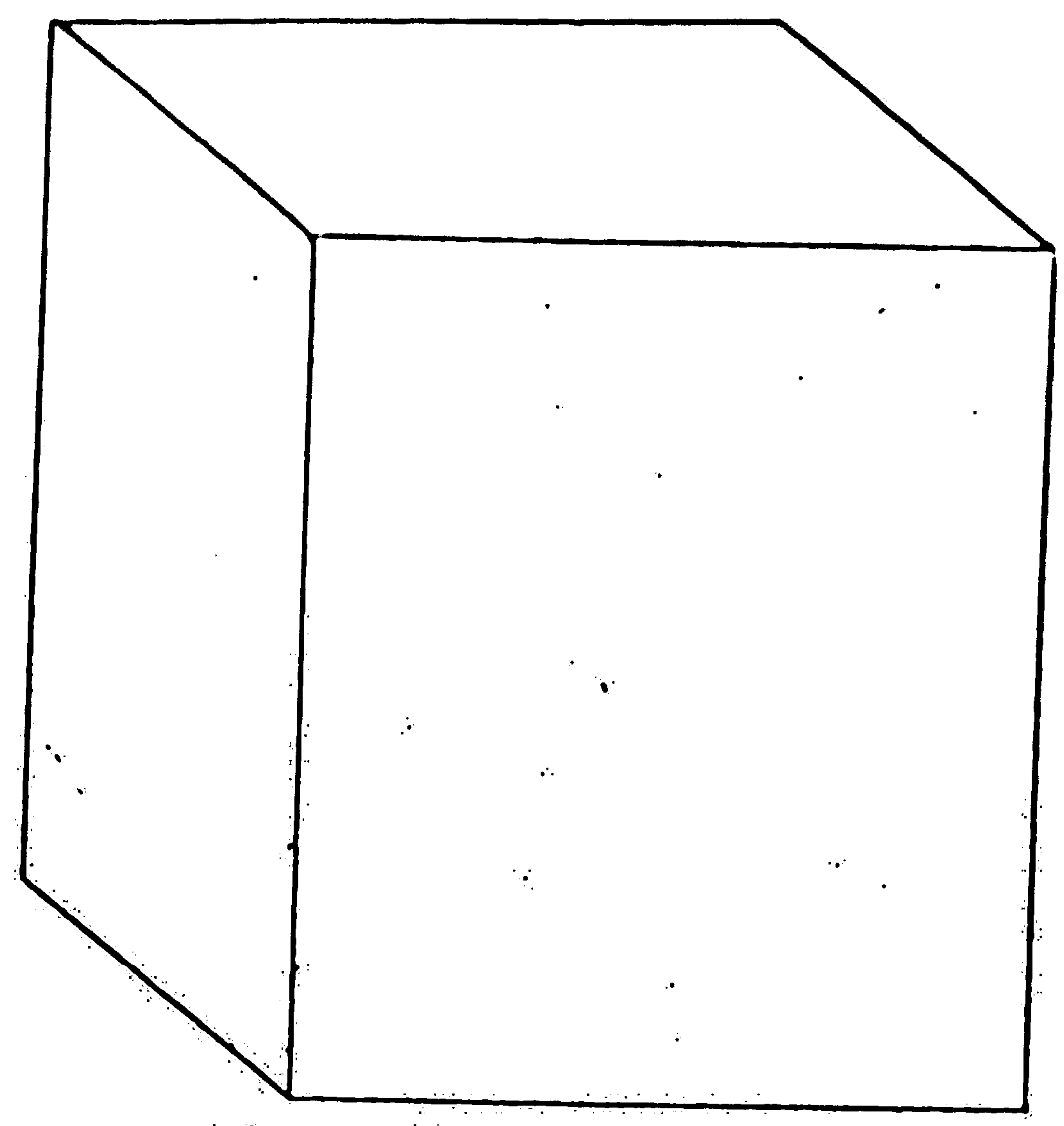


Fig. 35

What happens in instances of hyper-dimensional shift is more easily described than explained. When looking at Fig. 34, the observer first constructs an image in which one set of edges is taken as the outer surface of the figure. If he continues to look at the figure a new image is constructed in which a different set of edges is taken as the outer surface. The cube first appears to be projected away from the observer; then suddenly toward him. As long as the subject continues to look at the figure, he switches back and forth between these images every so often. As the length of time that he looks at the figure increases, change comes more easily, in fact, almost involuntarily.

How do we account for this phenomenon? Why do we experience an abrupt directional shift when looking at Fig. 34, and not when looking at Fig. 35. In Fig. 34, the object, as it exists on the surface of the picture plane, is the same object in all instances: existing as a continuing entity in real time and real space by virtue of the picture plane.[92] What is more, it is an inanimate object incapable of real motion (this is also the case in Fig. 35). However, we cannot deny that change or movement takes place. There are even instances when we might accurately report that we can feel the flip-flop of the back and front surfaces of Fig. 34. We witness the sudden transition as the figure reverses in depth.

The shift happens within us. That the change in our visual impression is related to the object can be demonstrated by the fact that shifts happen with some objects and not with others, but how it is related is a far more perplexing matter. One possible explanation involves what I would like to call 'preference for orientation' which

---

92. The visual object is a two-dimensional figure which, in the case of the Necker Cube, gives the illusion of being a three-dimensional object. The picture plane actually exists in space only, as we have seen, at the position in three-dimensional space where we come upon it.

is somewhat like the principle of Prägnanz, or minimum complexity.[93]

Fig. 34 is unlike Fig. 35 in at least one important aspect: The latter is a 'solid' figure in which the fix-point or visual orientation is already established for the viewer (his option of interpretation or organization is closed off or limited at best to one plausible construct); the former is void of any restrictive surfaces, leaving the task or organization up to the observer. How he will eventually organize the visual units of an ambiguous figure into a visual whole depends upon which of the visual units he selects as the base position for such organization; that is, what units will satisfy his preference for orientation.

Once a visual orientation has been established and a visual construct has been formed, the perceptual system searches out other possible constructs which might account for the data at hand. Upon discovering other possible constructs he selects that construct which seems most simple, rejecting the others.[94] In Fig. 35, there is at best one construct that best suits the given visual units.

---

93. See Attneave, pp. 67-68: "It seems likely that the perceptual machinery is a teleological system that is 'motived' to represent the outside world as economically as possible, within the constraints of the input received and the limitations of its encoding capabilities."

94. It is an established neurological fact that the eye constantly scans the visual plane even in instances when vision is directed to one object or one area. "During normal viewing of stationary objects the eyes alternate between fixations, where they are aimed at a fixed point in the visual field, and rapid movements called saccades. Each saccade leads to a new fixation on a different point in the visual field." See Norton and Stark's "Eye Movement and Visual Perception", Scientific American, Vol. 224, No. 6 (June, 1971), pp. 34-43 and, Pritchard's Stabilized Images of the Retina (San Francisco: W. H. Freeman and Co., 1961) and E. L. Thomas' "Movements of the Eyes", Scientific American, Vol. 219, No. 2 (August, 1968), pp. 88-95.

The construct is in the form of neural activity, and is quite unlike the retinal image of the object.[95] Fig. 34 is an ambiguous figure in the sense that we first effect a construct which accounts for the input received and then discover an entirely new construct which equally accounts for the visual data, and we cannot choose between the two. What is more, we don't have to. Either construct accounts quite adequately for the data provided; that is, the formats suggested by the two orders of fixation for the inter-connection of features into the overall internal representation are both equally acceptable. There is no reason to prefer the one over the other.

Attneave raises the question: Once the perceptual system locks into one aspect of the figure [after recognizing that there are other constructs equally suitable] why does it not remain in that state? He noted that an ambiguous figure alternates or shifts "more rapidly the longer it is looked at, presumably because the alternative neural structures build up some kind of fatigue", thereby giving way to fresher and more excitable constructs.[96] Pritchard reported the same

---

95. Norton and Stark, p. 35.

96. Attneave, p. 70. He goes on to draw an analogy between the perceptual system and a multivibrator circuit which spontaneously alternates between two states by virtue of a charge leaking from one coupling capacitor eventually starting a second capacitor, causing a positive feedback which cuts off condution in the first tube. The entire process is then repeated in reverse _ad infinitum_ until the system is disengaged. Also see Washburn and Gillette's "Motor Factors in Voluntary Control of Cube Perspective Fluctuations and Retinal Rivalry Fluctuations", _American Journal of Psychology_, Vol. 45 (1933), pp. 315-319; also, Washburn, Reagan, and Thurston's "The Comparative Controllability of the Fluctuations of Simple and Complex Ambiguous Perspective Figures", _American Journal of Psychology_, Vol. 46 (1934), pp. 636-638.

phenomenon when a stabilized image alternately faded and regenerated over prolonged periods of observation.[97]

Another consideration which helps to formulate a description of this phenomenon is Wittgenstein's distinction between the 'continuous seeing' of an object and the 'dawning of an aspect'.[98] He uses as his model Jastrow's duck-rabbit, represented below in Fig. 36, an ambiguous figure that can be taken at one time as a duck and another

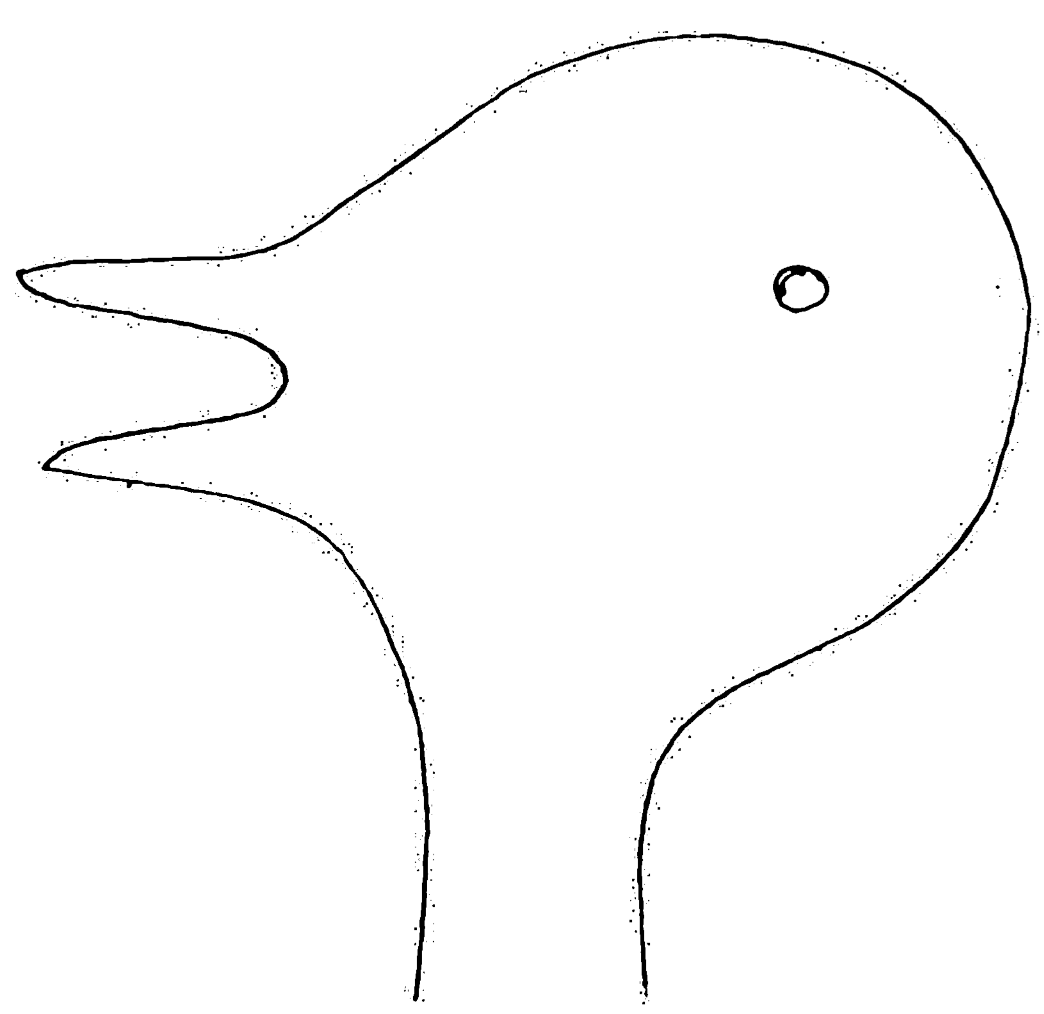


Fig. 36

---

97. Pritchard, p. 2.

98. Ludwig Wittgenstein, Philosophical Investigations (New York: MacMillan Company, 1965), p. 194: his analysis of the two uses of 'see'.

time as a rabbit. The distinction takes the form of: "I see that it has not changed; yet I see it differently. I call this experience 'noticing an aspect'."[99] The confusion that Wittgenstein is trying to avoid is one which involves a misuse of language in reporting such phenomena as shifts in visual images. We tend to describe the alteration like a perception, as if the object actually changed before our eyes. "Now I am seeing this," he says, has the form of a report of a new perception while it is actually an expression of a change of aspect. It is not the object which has changed, but rather our visual impression. We recognize a new way to organize what is before us in a way we didn't see it before. Seeing, in this sense then, he says, is not a part of perception but a particular way of organization. However, he might conclude, the fly is not fully shown the way out of the fly-bottle. It may very well be the case that we will have to look to the neuro-scientists to free the cascading beastie.[100]

---

99. Wittgenstein, p. 193.
100. Ibid. "Its causes are of interest to psychologists."

BIBLIOGRAPHY:

Arnheim, Rudolf. Art and Visual Perception: A Psychology of the Creative Eye. Berkeley, California: University of California Press, 1957.

Attneave, Fred. "Multistability in Perception", Scientific American, Vol. 225, No. 6: 62-71, December, 1971.

Basaldella, Mirko. "Visual Considerations", Education of Vision. New York: George Braziller, 1965.

Beam, Philip. The Language of Art. New York: The Ronald Press Company, 1958.

Bouleau, Charles. The Painter's Secret Geometry. London: Thames and Hudson, 1963.

Buermeyer, Laurence. The Aesthetic Experience. Merion: The Barnes Corporation, 1924.

Capers, Roberta, and Maddox, Jerrold. Images and Imagination. New York: The Ronald Press Company, 1965.

Cleaver, Dale G. Art: An Introduction. New York: Harcourt, Brace and World, Inc., 1966.

Dinnerstein, D. and Wertheimer, M. "Some Determinants of Phenomenal Overlapping", American Journal of Psychology, Vol. 70: 21-37, 1957.

Elton, William (ed.). Aesthetics and Language. Oxford: Basil Blackwell, 1959.

Festinger, L., et. al. "Efference and the Conscious Experience of Perception", Journal of Experimental Psychology Monograph, Vol. 637, 1967.

Freeman, R. B., Jr. "Effect of Size on Visual Slant", Journal of Experimental Psychology, Vol. 71: 96-103, 1966.

Gibson, J. J. "The Perception of Visual Surfaces," American Journal of Psychology, Vol. 63: 367-384, 1950.

Gilson, Etienne. Forms and Substances in the Arts. New York: Charles Scribner's Sons, 1966.

Gregory, R. L. The Intelligent Eye. New York: McGraw-Hill Book Company, 1970.

BIBLIOGRAPHY (cont.):

"Visual Illusions", Scientific American, Vol. 219, No. 5: 66-76, November, 1968.

Hastie, Reid, and Schmidt, Christian. Encounter With Art. New York: McGraw-Hill Company, 1969.

Helson, H. and Lansford, T. "The Role of Spectral Energy of Source and Background Color in Pleasantness of Object Colors", Applied Optics, Vol. 9: 1513-1562, 1970.

Ittelson, W. H., and Kilpatrick. Experiments in Perception. San Francisco: W. H. Freeman and Company, 1951.

Ivins, William, Jr. Art and Geometry: A Study in Space Intuitions. New York: Dover Publications, Inc., 1964.

Karel, Leon C. Avenues to the Arts. Kirksville, Mo.: Simpson Publishing Co., 1966.

Kepes, Gyorgy (ed.). Education of Vision. New York: George Braziller, 1965.

Language of Vision. Chicago: Paul Theobald and Company, 1951.

Kling, J. W., and Riggs, Lorrin A. Woodworth and Schlosberg's Experimental Psychology. New York: Holt, Rinehart and Winston, Inc., 1971.

Knobler, Nathan. The Visual Dialogue. New York: Holt, Rinehart and Winston, Inc., 1966.

Koffka, K. Principles of Gestalt Psychology. New York: Harcourt, Brace and World, Inc., 1935.

Leepa, Allen. The Challenge of Modern Art. New York: A.S. Barnes and Company, Inc., 1961.

Lippard, Lucy R. (ed.). Changing. New York: E. P. Dutton and Company, Inc., 1971.

Lowry, Bates. The Visual Experience: An Introduction to Art. New York: Harry N. Abrams, Inc., 1964.

BIBLIOGRAPHY (cont.):

Mach, Ernest. "On Contours", Visual Perception: The Nineteenth Century. New York: John Wiley and Sons, Inc., 1964.

Moholy-Nagy, L. Vision in Motion. Chicago: Paul Theobald and Company, 1947.

Munro, Thomas. Scientific Methods in Aesthetics. New York: W. W. Norton and Company, Inc., 1928.

Norton, David, and Stark, L. "Eye Movements and Visual Perception", Scientific American, Vol. 224, No. 6: 34-43, June, 1971.

Pirenne, M. H. Optics, Painting, and Photography. Cambridge: Cambridge University Press, 1970.

Pritchard, Roy M. Stabilized Images of the Retina. San Francisco: W. H. Freeman and Company, 1961.

Ratliff, Floyd. "Contours and Contrast", Scientific American, Vol. 226, No. 6: 90-101, June, 1972.

Ratoosh, P. "On Interposition as a Cue for the Perception of Distance", Proceedings of the National Academy of Science, Vol. 35: 257-259, 1949.

Schillinger, Joseph. The Mathematical Basis of the Arts. New York: Philosophical Library, 1966.

Stavriano, B. K. "The Relation of Shape Perception to Explicit Judgments of Inclination", Archives of Psychology: 296, 1945.

Taylor, Joshua C. Learning to Look. Chicago: University of Chicago Press, 1957.

Thomas, E. Llewellyn. "Movements of the Eye", Scientific American, Vol. 219, No. 2: 88-95, August, 1968.

Washburn, M.F., and Gillette, A. "Motor Factors in Voluntary Control of Cube Perspective Fluctuations and Retinal Rivalry Fluctuations", American Journal of Psychology, Vol. 45: 315-319, 1933.

BIBLIOGRAPHY (cont.):

Washburn, M. F., Reagan, C. and Thurston, E. "The Comparative Controllability of the Fluctuations of Simple and Complex Ambiguous Perspective Figures", American Journal of Psychology, Vol. 46: 636-638, 1934.

Weismann, Donald L. The Visual Arts As Human Experience. Englewood Cliff, N.J.: Prentice-Hall, Inc., 1970.

Wertheimer, M. "Principles of Perceptual Organization", Readings In Perception, Beardslee and Wertheimer (ed.). Princeton, N.J.: Van Nostrand, 1958.

Wittgenstein, Ludwig. Philosophical Investigations. New York: The MacMillan Company, 1965.

Vita

David Jerome Swann (June 13, 1942 -)
received his B.S. in Sociology from John Carroll University, Cleveland, Ohio, in June, 1964; and did graduate work both at John Carroll University and Lehigh University, Bethlehem, Pennsylvania.

Besides being actively involved as an officer and member of the Board of Directors of Swann Oil Inc., an international petrochemical marketing company, Swann has shown his sculpture in many art exhibits and salons in the area and is doing extensive research in Indian art and Asian culture.