SHAPE

Text abridged and adapted from *Art and Visual Perception* by Rudolph Arnheim (1974)

Vision as active exploration

The world of images does not simply imprint itself on our eyes. In looking at an object, we reach out for it. With an invisible finger we move through the space around us, go out to the distant places where things are found, touch them, catch them, scan their surfaces, trace their orders, and explore their texture. Perceiving shapes is an **active occupation**.

If vision is an active activity, what does it involve? Perceiving all the innumerable elements of information? Or some of them? If an observer carefully examines an object, she finds her eyes well equipped to see small detail. And yet, visual perception does not operate with the mechanical faithfulness of a camera, which records everything impartially. The camera not only records the whole set of tiny bits of shape and color constituting the eyes and mouth of the person posing for the photograph, but also the corner of the telephone appearing accidentally behind her head, which observers may not notice. So what do we see when we see?

Seeing means perceiving some outstanding features of objects —the blueness of the sky, the curve of a swan's neck, the rectangularity of the book, the brightness of a piece of metal, or the straightness of a ruler. A few simple lines and dots are readily accepted as "a face," not only by Westerners, who may be suspected of having agreed among one another on such "sign language," but also by babies, aborigines, and animals.

A few outstanding features not only determine the identity of a perceived object, but also make it appear as a complete, integrated pattern. This applies not only to our image of the object as a whole, but also to any particular part on which our attention is focused. But it does not mean that the sense of sight neglects detail. On the contrary, even young children notice slight changes in the appearance of the things they know.

The experimental findings demanded a complete change in the theory of perception. It seemed no longer possible to think of vision as proceeding from the particular to the general. Instead, it became evident that overall structural features are the primary data of perception, so that perceiving the roundness of a head (which is not round at all) is not a late product of intellectual abstraction, but a direct and more elementary experience than the recording of individual detail. The young child sees "doggishness" before he is able to distinguish one dog from another. This psychological discovery is of decisive importance for the understanding of artistic form.

Vision deals with the basic material of experience by creating a corresponding pattern of general forms, which are applicable not only to the individual case at hand but to an indeterminate number of other similar cases as well. Vision is a creative activity of the human mind. Perceiving accomplishes at the sensory level what in reasoning is known as understanding. Every person's eyesight anticipates in a modest way the justly admired capacity of the artist to produce patterns that validly interpret experience by means of organized form. Eyesight is insight.

What is Shape?

The **physical shape** of an object is determined by its boundaries. Other spatial aspects are not generally considered properties of physical shape. So it does not matter whether the object is placed right-side-up or upside-down, or whether other objects are present nearby.

Perceptual shape, by contrast, may change considerably when its spatial orientation or its environment changes. Perceptual shape is the outcome of an interplay between the physical object, the medium of light acting as the transmitter of information, and the conditions prevailing in the nervous system of the viewer. The shape of an object we see does not, however, depend only on what we see at a given moment. Strictly speaking, the image is determined by the totality of visual experiences we have had with that object, or with that kind of object, during our lifetime.

Correspondingly, if someone makes an image of something she has experienced, she can choose how much of the shape she wishes to include. The Western style of painting, created by the Renaissance, restricted shape to what can be seen from a fixed point of observation. The Egyptians, the Native Americans, and the cubists ignore this restriction. Children draw the baby in the mother's belly. One may omit the boundaries of an object and yet draw a recognizable picture of it (Fig. 1). When a person who has been asked what a winding staircase looks like describes with her finger a rising spiral, she is not giving the outline but the characteristic main axis, actually nonexistent in the object. Thus, **the shape of an object is depicted by the spatial features that are considered essential**.

Fig. 1: No boundaries but a recognizable image.

The influence of the past

Every visual experience happens in a context of space and time. Just as the appearance of objects is influenced by that of neighboring objects in space, so it is also influenced by sights that preceded in time. The interaction between the shape of the present object and that of things seen in the past is not automatic and universal, but depends on whether a relation is perceived between them.

Fig. 2: Spatial context and temporal context.

For example, Fig. 2*d*, taken by itself, looks like a triangle attached to a vertical line. But in the company of Fig. 2*a*, *b*, and *c*, it will probably be seen as a corner of a square about to disappear behind a wall. This effect is brought about by **spatial context**, as in Fig. 2, or even more compelling by **temporal context**, e.g. if *a, b, c, d* follow one another as phases of an animated film. The effect comes about because a sufficiently strong structural resemblance ties the figures together. Similarly, Fig. 3 may change its shape abruptly when we are told that it represents a giraffe passing behind a window. Here the **verbal description** brings about a visual memory trace that resembles the drawing sufficiently to establish contact with it.

Fig. 3: Verbal description changes image.

The influence of memory is increased when a strong personal need makes the observer want to see objects of given perceptual properties. A man waiting at a street corner for his girl

friend will see her in almost every approaching woman, and this tyranny of the memory trace will get stronger as the minutes pass on the clock.

Seeing shape

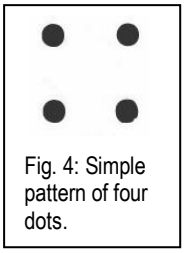

Fig. 4: Simple pattern of four dots.

How does the sense of sight take hold of shape? Most of the time it grasps shape immediately. It seizes an overall pattern. But how is this pattern determined? When we look at a simple outline figure, there seems to be no problem, not much of a choice. And yet, why do we tend to see the four dots of Fig. 4 as a square like Fig. 5*a*, but hardly as a leaning diamond or a profile face (Fig. 5*b* and *c*), even though the latter shapes contain the four points as well?

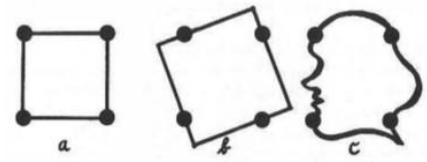

Fig. 5: Possible shapes with four dots.

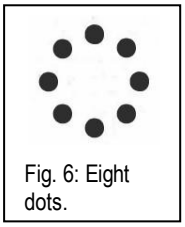

Fig. 6: Eight dots.

If four more dots are added to Fig. 4, the square disappears from the now octagonal or even circular pattern (Fig. 6). White circles or —for some observers— squares appear in the centers of the crosses shown in Fig. 7, even thought there is no trace of a circular or square-shaped contour. Why circles and squares rather than any other shape?

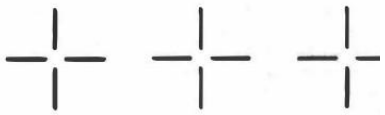

Fig. 7: Crosses with shapes.

Phenomena of this kind find their explanation in what **gestalt psychologists** describe as the basic law of visual perception, **the law of simplicity**: *Any stimulus pattern tends to be seen in such a way that the resulting structure is as simple as the given conditions permit.*

Simplicity

What do we mean by simplicity? It may be described as the **subjective** experience and judgment of an observer who feels no difficulty in understanding what is presented to her. But we must also determine the **objective** simplicity of visual objects by analyzing their formal properties. Objective and subjective simplicity do not always run parallel.

How can simplicity be determined by analysis of the shapes constituting a pattern? A temptingly elementary and exact approach would be that of merely counting the number of elements: how many lines or colors does this picture consist of? Such a criterion, however, is misleading.

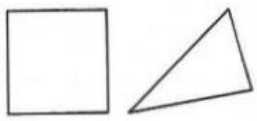

Fig. 8: Regular and irregular shapes.

For example, the regular square, with its four edges and four angles, is simpler than the irregular triangle (Fig. 8). In the square all four edges are equal in length and lie at the same distance from the center. Only two directions are used, the vertical and the horizontal, and all angles are the same. The whole pattern is highly symmetrical around four axes. The triangle has fewer elements, but they vary in size and location, and there is no symmetry.

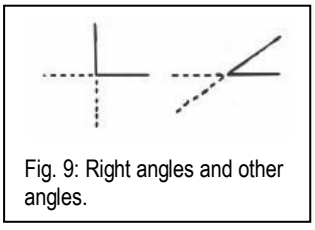

Fig. 9: Right angles and other angles.

A straight line is simple because it uses one unchangeable direction. Parallel lines are simpler than lines meeting at an angle because their relation is defined by one constant distance. A right angle is simpler than other angles because it produces a subdivision of space based on the repetition of one and the same angle (Fig. 9).

These examples suggest that we may arrive at a good approximate **definition of simplicity** by counting not the elements, but the **structural features**. Such features, as far as shape is concerned, can be described by distance and angle. If we increase the number of equally spaced radii drawn in circle from ten to twenty, the number of elements has increased, but the number of structural features is unchanged; for whatever the number of radii, one distance and one angle are sufficient to describe the build of the whole.

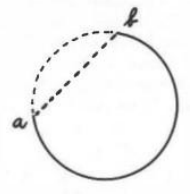

Fig. 10: Simplest connection between *a* and *b*.

Structural features must be determined by the total pattern. Fewer features in a limited area will often make for more features in the whole, which is another way of saying that what makes a part simpler may make the whole more complex. In Fig. 10, the straight line is the simplest connection between points *a* and *b* as long as we overlook the fact that a curve will make for a simpler total pattern.

So far, simplicity has been discussed in an **absolute** sense. In this sense, a folk song is simpler than a symphony and a child's drawing is simpler than a painting by Tiepolo. But we must also consider **relative simplicity**, which applies to every complexity level. When someone wishes to make a statement or needs to fulfill a function she must concern herself with two questions: What is the simplest structure that will serve the purpose (**parsimony**, or economy), and what is the simplest way of organizing this structure (**orderliness**)?

The *principle of parsimony* is valid aesthetically in that the artist must not go beyond what is needed for her purpose. She follows the example of nature. To say too much is as bad as to say too little, and to make one's point too complicated is as bad as to make it too simply.

The great works of art are complex, but we also praise them for "having simplicity," by which we mean that they organize a wealth of meaning and form in an overall structure that clearly defines the place and function of every detail in the whole. This way or organizing a needed structure in the simplest possible way may be called its *orderliness*.

In a mature work of art all things seem to resemble one another. Sky, sea, ground, trees, and human figures begin to look as though they were made of the same substance, which falsifies the nature of nothing but recreates everything by subjecting it to the unifying power of the great artist. Every great artist gives birth to a new universe, in which familiar things look as they have never before looked to anyone. This new appearance, rather than being distortion or betrayal, reinterprets the ancient truth in a fresh, enlightening way. The unity of the artist's conception leads to a simplicity that, far from being incompatible with complexity, shows its virtue only in mastering the abundance of human experience rather than escaping to the poverty of abstinence.

Subtle complexity can be obtained by combining geometrically simple shapes; and the combinations, in turn, may be held together by **simplifying orderliness**. Fig. 11 shows the compositional scheme of a relief by Ben Nicholson. Its elements are as simple as can be found anywhere in a work of art. The composition consists of one regular and complete circle plus a number of rectangular figures, which lie parallel to one another and to the frame.

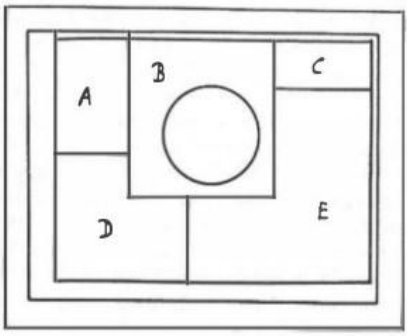

Fig. 11: Compositional scheme of Ben Nicholson's *1936 (White Relief)*.

Yet even without the differences in depth that in the original relief (Fig. 12) play the various planes against one another, the total effect is not elementary. Most of the form units do not interfere with one another,

Fig. 12: Ben Nicholson: *1936 (White Relief)* (1936).

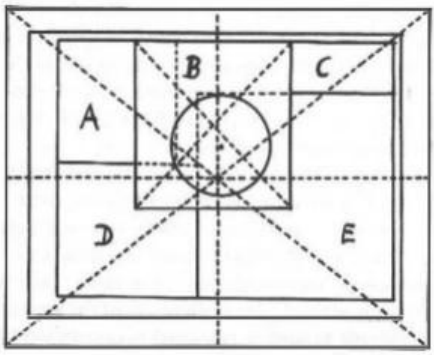

Fig. 13: Linear scheme of Ben Nicholson's *1936 (White Relief)*.

but rectangle B overlaps D and E (Fig. 13). The three outermost rectangles, which frame the composition, are roughly but not exactly of the same proportion, and their centers, though close, do not coincide. The close approximation of proportion and location produces considerable tension by making the observer perceive subtle distinctions. This holds true for the entire composition. Two of the inner units, A and C, are clearly rectangular; D, when completed, is perceived as a square (since it is a little broader than high, which compensates for the familiar overestimation of the vertical); B and the completed E look marginally rectangular, but their proportions flirt with squareness.

The center of the whole pattern does not coincide with any point in the composition, nor does the central horizontal touch any corner. The central vertical axis comes close enough to the center of B to create an **element of simplicity** in the relation between that rectangle and the total area of the work. The same is true for the circle, and yet both B and the circle deviate enough from the central vertical to look clearly asymmetrical in relation to each other. The circle lies neither in the center of B nor in the center of the whole pattern; and the overlapping corners of B have no simple relation to the structures of the rectangles D and E, into which they intrude.

Why does the whole pattern hold together nevertheless? Some of the simplifying factors have already been mentioned. In addition, the prolongation of the bottom edge of C would touch the circle; and if A were enlarged to a square, the corner of that square would also touch the circle. These coincidences help to keep the circle in place. And, of course, there is the overall balance of proportions, distances, and directions, less easily analyzed but equally important for the unity of the whole.

Every painting or sculpture carries meaning. Whether representational of "abstract," it is "about something"; it is a statement about the nature of our existence. Similarly, a useful object, such as a building or a teapot, shows its function to the eyes. The simplicity of such objects, therefore, involves not only their visual appearance in and by itself, but also the relation between the image seen and the statement it is intended to convey. In language, a sentence whose intricate verbal structure exactly corresponds to the intricate structure of the thought to be expressed has a welcome simplicity; whereas any discrepancy between form and meaning interferes with simplicity. Short words in short sentences do not necessarily make for a simple statement.

In the arts, a shaped mass of clay or an arrangement of lines may be meant to represent a human figure. An abstract painting may be called *Victory Boogie-Woogie*. The meaning or content can be relatively simple (*Reclining Nude*), or quite complex (*Soft Construction with Boiled Beans*). The character of the meaning and its relation to the visible form intended to

express it help to determine the degree of simplicity of the whole work. If a percept that is quite simple in itself is employed to express something complex, the result is not simple.

The discrepancy between complex meaning and simple form may produce something quite complicated. **Simplicity** requires a correspondence in structure between meaning and tangible pattern. Gestalt psychologists call such structural correspondence "isomorphism." It is a requirement for design in the applied arts as well.

Simplification demonstrated

According to the basic law of visual perception, **the law of simplicity**, we have already mentioned, any stimulus pattern tends to be seen in such a way that **the resulting structure is as simple as the given conditions permit**. In other words, the perceptual forces constituting a visual field will organize themselves in the simplest, most regular, and most symmetrical pattern available under the circumstances.

This tendency will be less apparent when the stimulus is so strong that it imposes the shape. When the stimulus is weak, the organizing power of perception can impose itself more fully. Leonardo da Vinci observes that when the figure of a man is seen from afar, "he will seem a very small **round dark body**. He will appear round because distance diminishes the various parts so much as to leave nothing visible except the greater mass."

Why does the reduction make the viewer see a **round shape**? The answer is that distance weakens the stimulus to such an extent that perception is left free to impose on it **the simplest possible shape** —namely, **the circle**. Such weakening of the stimulus also occurs under other conditions, for example, when the perceived pattern is dimly illuminated or exposed for only a split second. Distance in time has much the same effect as distance in space; when the actual stimulus has disappeared, the remaining memory trace weakens.

Leveling and sharpening

Figures containing slight ambiguities, such as Fig. 14*a* and *d*, where the two wings of *a* are almost but not quite symmetrical, and the small rectangle in *d* is slightly off-center, are shown for a split second to a group of people. This keeps the stimulus weak enough to leave observers with a margin of freedom. Under these conditions, two principal types of reaction follow.

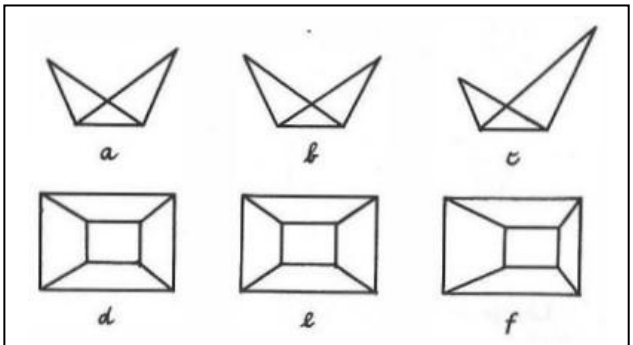

Fig. 14: Original images and perceived images.

In making drawings of what they have seen, some people perfect the symmetry of the model (*b, e*) and thus increase its simplicity; they reduce the number of structural features. Others exaggerate the asymmetry (*c, f*). They also simplify the model, but in the opposite way. Instead of reducing the number of structural features, they modify the given ones more clearly from one another. By eliminating the ambiguities, they certainly make the task of the viewer simpler.

Both tendencies, the one toward "leveling" and the one toward "sharpening," are application of the tendency to make perceptual structure as clear-cut as possible. **Leveling** is characterized by such devices as unification, enhancement of symmetry, reduction of structural features, repetition, dropping of non-fitting detail, and elimination of obliqueness. **Sharpening** enhances differences, and stresses obliqueness. Leveling and sharpening frequently occur in the same drawing, just as in a person's memory large things may be recalled as larger, small ones as

smaller, than they actually were, but at the same time the total situation may survive in a simpler, more orderly form.

In art we can remember the difference between classicistic and expressionistic styles. **Classicism** tends toward simplicity, symmetry, normality, and the reduction of tension. **Expressionism** heightens the irregular, the asymmetrical, the unusual, and the complex, and wants to increase the tension. The two types of style epitomize two tendencies whose interplay constitutes the structure of any work of visual art and indeed of any visual pattern.

A whole maintains itself

It appears that the things we see behave as wholes. On the one hand, what is seen in a particular area of the visual field depends strongly on its place and function in the total context. On the other hand, the structure of the whole may be modified by local changes. This interplay between whole and part is not automatic and universal. A part may or may not be influenced noticeably by a change in the total structure; and a change in shape or color may have little effect on the whole when the change lies off the structural track. All these are aspects of the fact that any visual field behaves as a gestalt.

For example, some observations show that when brain injuries cause blind areas in the visual field, incomplete figures are seen as complete, provided their shape is sufficiently simple and enough of it appears in the sighted area. An extensive injury may black out either the right or left half of the visual field completely. If the patient is made to fixate the center of a circle for one tenth of a second, even though only half of it actually stimulates the visual centers of her brain, she reports seeing a complete circle. On being shown a smaller portion of the circle she will report seeing "a kind of bow." The patient is not merely guessing by inference from past experience, but actually sees either the complete or the incomplete figure.

Subdivision

Even though well-organized figures maintain their integrity and complete themselves when mutilated or distorted, we should not assume that such figures are always perceived as undivided, compact masses. To be sure, a black disk is seen as one unbroken thing rather than as two halves. This is so because undivided unity is the simplest way of perceiving the disk. But what about Fig. 15? Although on paper it is a continuous mass, an observer has great difficulty seeing it that way. At first glance, the figure may look awkward, strained, and not in its final shape. As soon as it appears as a combination of rectangle and triangle, tension ceases, and the figure settles down and looks comfortable and definitive. It has assumed the simplest possible structure compatible with the given stimulus.

Fig. 15: Whole versus parts.

The rule is readily derived from Fig. 16. When the square (*a*) is divided into two halves, the whole pattern prevails over its parts because the symmetry of the square is simpler than the shapes of the two rectangles. Even so, we can manage at the same time to single out the two halves without much effort. If now we divide the rectangle (*b*) in the same manner, the figure breaks apart quite readily because the simplicity of the two squares imposes itself against the less compact shape of the whole.

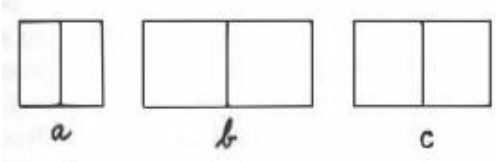

Fig. 16: Simpler patterns prevail.

If, on the other hand, we wish to obtain a particularly coherent rectangle, we may apply our subdivision to the **rectangle of the golden section** (*c*), in which the longer, horizontal side is

related to the shorter, vertical side as the sum of both is to the longer. Traditionally and psychologically, this proportion of has been considered particularly satisfying because its combination of unity and dynamic variety. Whole and parts are nicely adjusted in strength so that the whole prevails without being threatened by a split, but at the same time the parts retain some self-sufficiency.

If subdivision depends on the simplicity of the whole as compared to that of the parts, we can study the relation between the two factors by leaving the shapes of the parts constant while varying their configuration. In Fig. 17 we move from the maximum coherence of the cross shape to the virtual disappearance of any integrated pattern at all. We also notice in the two central examples a distinct visual tension: greater simplicity and a corresponding relaxation of tension would be obtained if the two bars came apart, either in the depth dimension —and in fact the two bars seem to lie in slightly different planes— or side by side. This tension is absent in the two outer figures, in which the two components either fit in a tightly symmetrical whole or are removed from interfering with each other.

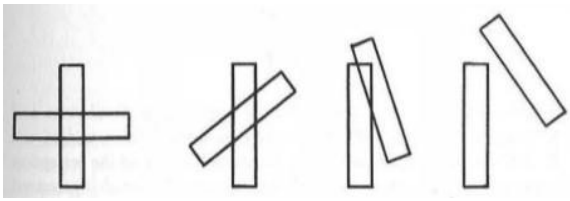

Fig. 17: Constant elements and variations in configuration.

Why the eyes often tell the truth

Subdivision of shape is of the greatest biological value because it is a principal condition for discerning objects. But to see shapes is not enough. If visual shapes are to be useful, they must correspond to the objects out there in the physical world. What is it that enables us to see a car as one thing and the person in it as another, rather than paradoxically unifying part of the car and part of the person into one misleading monster? Sometimes our eyes fool us. In military camouflage the unity of objects is broken up into parts that fuse with the environment, a technique used also by nature for the protection of animals.

Why, then, do our eyes serve us well most of the time? It is more than a lucky coincidence. For one thing, the human-made part of the world is fitted to human needs. Only the secret doors in old castles, and similar things, blend with the walls. The letter boxes in London are painted a bright red to make them stand out from their surroundings. However, not only the human mind but physical nature as well must obey the law of simplicity. The outer shape of natural things is as simple as conditions permit; and this simplicity of shape favors visual segregation. The redness and roundness of apples, as distinct from the different colors and shapes of leaves and branches, exist not as a convenience to pickers, but as external manifestations of the fact that apples grow differently and separately from leaves and branches. Separate internal processes and different materials create, as a by-product, segregated appearance.

Fig. 18: Constantin Brancusi: *The Kiss* (1907).

Subdivision in the arts

In the work of painters, sculptors, or architects, the subdivision of visual shape is particularly necessary and apparent. Here again it may facilitate practical orientation. Principally, however, subdivision conveys visual statements for their own sake. In his sculpture *The Kiss* (Fig. 18), Constantin Brancusi has fitted the two

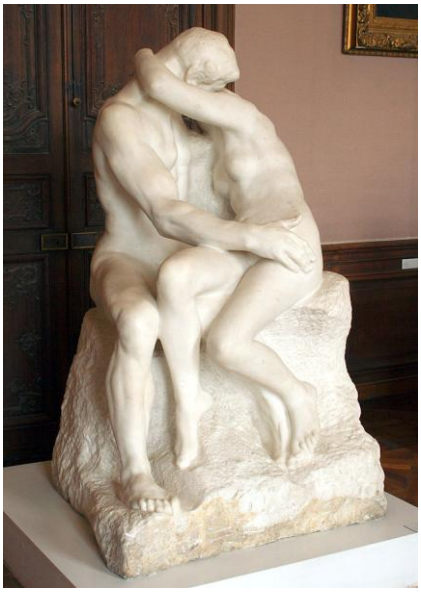

Fig. 19: Auguste Rodin: *The Kiss* (1882).

embracing figures into a regularly shaped square block so tightly that the unity of the whole dominates the subdivision, the two human beings. The obvious symbolism of this conception contrasts strikingly with, for instance, August Rodin's well-known representation of the same subject (Fig. 19), in which the futile struggle for union is conveyed by the indomitable independence of the two figures. Here the parts are made to jeopardize the unity of the whole.

For the artist's purposes, subdivision tends to be much more complex than it is in the schematic figures used to demonstrate basic principles in this chapter. In the arts, subdivision is rarely limited to one level, but proceeds at hierarchic levels, subordinated to one another. A primary segregation established the main features of any work. The larger parts are again subdivided into smaller ones, and it is the task of the artist to adapt the degree and kind of the segregations and connections to her intended meaning.

What is a part?

In a purely quantitative sense, any section of a whole can be called a part. Sectioning may be imposed on an object from the outside, but to partition by mere amount or number is to ignore structure. No other procedure is available, of course, when structure is absent. Any section of the blue sky is as good as any other. But the subdivision of a sculpture is not arbitrary, even though as a physical object it may be dismantled into any kind of section for shipping purposes.

The parts of most simple shapes are easily determined. A square is seen as consisting of four straight lines with divisions at the corners. But when shapes are less clear-cut and more complex, the structural components are not so obvious. Mistakes in the comprehension of an artistic structure are easily made when a viewer judges by relations within narrow limits rather than taking into account the overall structure. The local situation suggests one conception, the total context prescribes another. In restricted local terms the horizontal base of Fig. 20 slides as an undivided whole into the right wing of the curve, although the total structure breaks the same line into two sections, belonging to different sub-wholes.

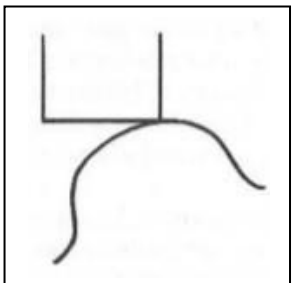

Fig. 20: Whole and parts.

It is necessary therefore to distinguish between "genuine parts" —that is, sections representing a segregated sub-whole within the total context—, and mere portions or pieces —that is, sections segregated only in relation to a limited local context or to no inherent breaks in the figure at all. The statement "the whole is greater than the sum of its parts" refers to genuine parts. The statement is, however, misleading because it suggests that in a particular context the parts remain what they are, but are joined by a mysterious additional quality, which makes the difference. Instead, the appearance of any part depends on the structure of the whole, and the whole, in turn, is influenced by the nature of its parts.

No portion of a work of art is ever quite self-sufficient. The broken-off heads of statues often look disappointingly empty (see Fig. 21). But if they had carried too much expression of their own, they would have destroyed the unity of the whole work. This is why dancers, who speak

Fig. 21: *The Winged Victory of Samothrace* (200BCE).

through their bodies, often wear blank facial expressions; and it is why Picasso, after experimenting with sketches of rather complex hands and figures for his mural *Guernica* (Fig. 22), made them much simpler in the final work.

Fig. 22: Pablo Picasso: *Guernica* (1937).

The same is true for completeness. A truly self-contained sub-whole is very hard to accommodate. Good fragments are neither surprisingly complete nor uncomfortably incomplete; they have the particular charm of revealing unexpected merits of parts while at the same time pointing to a lost entity beyond themselves.

Similarity and difference

Once it is understood that relations between parts depend on the structure of the whole, we may safely and profitably isolate and describe some of these relations. The properties that tie visual items together can be reduced to one rule, **the rule of homogeneity or similarity**.

Similarity and subdivision are opposite poles. Whereas subdivision is one of the prerequisites of sight, similarity can make things invisible. Homogeneity is the limiting case, in which, as some modern painters have demonstrated, vision approaches or attains the absence of structure. Similarity acts as a structural principle only in conjunction with separation, namely, as a force of attraction among segregated things.

Grouping by similarity occurs in time as well as in space. To demonstrate similarity independently of other factors, one must select patterns in which the influence of the total structure is weak, or at least does not directly affect the particular rule of grouping to be demonstrated. Any aspect of percepts —shape, brightness, color, spatial location, movement, etc.— can cause grouping by similarity.

A general principle to be kept in mind is that although all things are different in some respects and similar in others, comparisons make sense only when they proceed from a common base. Comparisons, connections, and separations will not be made between unrelated things, but only when the organization as a whole suggests a sufficient basis. Similarity is a prerequisite for the noticing of differences.

In Fig. 23, shape, spatial orientation, and brightness are kept constant. These similarities put all the squares together and at the same time forcefully point to their difference in size. The size difference, in turn, results in a subdivision, by which the two large squares, as against the four small ones, are connected at a secondary level. This is an example of *grouping by similarity of size*.

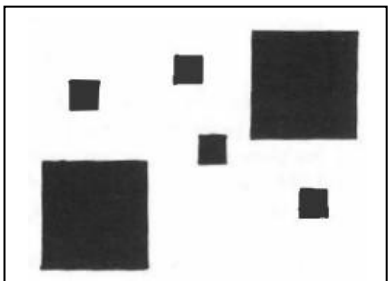

Fig. 23: Grouping by similarity of size.

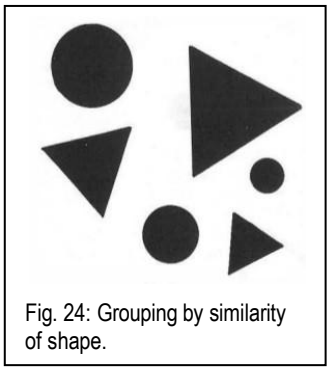

Fig. 24: Grouping by similarity of shape.

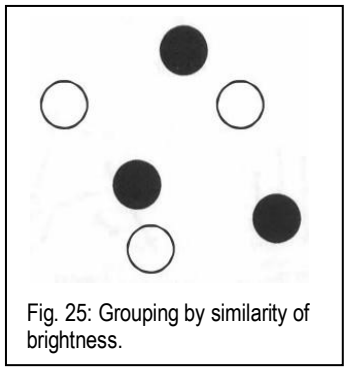

Fig. 25: Grouping by similarity of brightness.

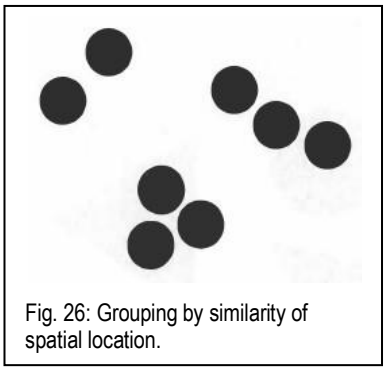

Fig. 26: Grouping by similarity of spatial location.

Groupings and separations are produced by other perceptual features in Figs. 24 to 27. Grouping by difference of *shape* is seen in Fig. 24. Difference of brightness collects the black disks as against the white ones in Fig. 25. We observe that similarities of size, shape, or color will unite items distant in space from one another. But spatial location by itself is also a grouping factor; Fig. 26 illustrates "proximity" or "nearness," i.e. grouping by the similarity and difference of *spatial location* produces visual clusters. Finally Fig. 27 shows the effect of *spatial orientation.*

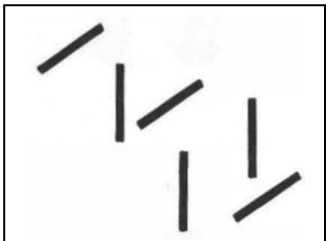

Fig. 27: Grouping by similarity of spatial orientation.

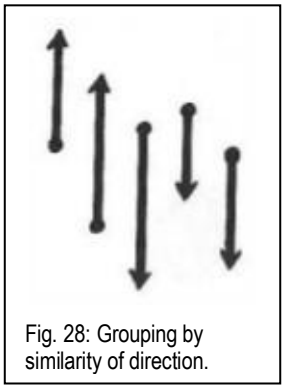

Fig. 28: Grouping by similarity of direction.

Movement introduces the additional factors of *direction* and *speed*. If in a group of five dancers three move in one direction, two in another, they will segregate, much more strikingly than the immobile Fig. 28 can show. The same holds true for differences in speed (Fig. 29). If in a film an excited man pushes his way through a crowd, he attracts attention; in a still photograph he might not stand out at all.

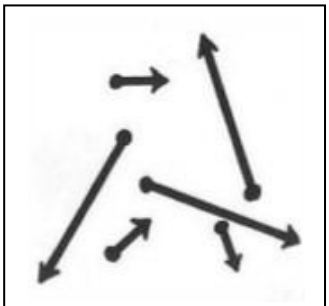

Fig. 29: Grouping by similarity of speed.

Admittedly, the effects of grouping and separation in our examples are not particularly strong. This is so because in order to show what similarity and difference can do by themselves, patterns were avoided as much as possible. Actually, the similarity factors are most effective when they support patterns. The approach "from below" (bottom-up) is quite limited, and must be supplemented by the approach "from above" (top-down). These terms are used to describe the difference between starting the analysis of a pattern with its components and proceeding to their combinations —the method used with the rules of grouping— and beginning with the overall structure of the whole and descending from there to more and more subordinated parts.

Grouping from below and subdivision from above are reciprocal concepts. An important difference between the two procedures is that in starting from below we can apply the principle of simplicity only to the similarity obtained between unit and unit, whereas when we apply it from above, the same principle accounts for overall organization as well. The sixteenth-century painter Giuseppe Arcimboldo represented Summer, Winter, Fire, Water, etc. symbolically by profile portraits. Each figure is composed of objects, e.g., Summer of fruits, Fire of burning logs, candles, lamp, etc. When the viewer proceeds from the components of one of these paintings, he recognizes the objects and appreciates how artfully they are fitted together. But she will never arrive in this way at the profile figure, constituted by the structure as a whole.

One step beyond the mere similarity of separate units is the grouping principle of *consistent shape*. This principle relies on the intrinsic similarity of the elements constituting a line, surface, or volume. Why do we see the right leg of the woman in Picasso's painting (Fig. 30) as a continuous shape, despite the interruption by the left leg? Even though we know what a woman is expected to look like, the two shapes representing the leg would not unite into one if the contour lines were not related by similarity of direction and location.

Fig. 30: Pablo Picasso: *Standing Female Nude* (1908).

Fig. 31: Straight lines and irregular lines.

The more consistent shape of the unit, the more readily will it detach itself from its environment. Fig. 31 shows that the straight line is more easily identifiable than the irregular ones. When there is a choice between several possible continuations of lines (Fig. 32), the spontaneous preference is for the one that carries on the intrinsic structure most consistently. Fig. 32*a* will be seen more easily as a combination of the two parts indicated in *b* than of the two indicated in *c*, because *b* provides the simpler structure.

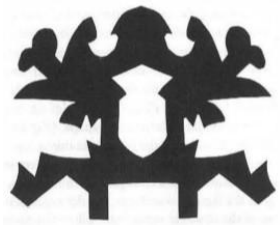

Fig. 33: Symmetry.

Fig. 32: Intrinsic structure.

By going beyond the relations between parts, one arrives at similarities definable only in reference to the whole pattern. Similarity of location can be extended to apply not only to units lying together, but also to similar position within the whole. Symmetry is such a similarity (Fig. 33).

The limiting case of similarity of location is contiguity. When there are no intervals between units, a compact visual object results. Object formation is accomplished through the rule of simplicity, of which the rules of similarity are a particular application. A visual object is the more unitary the more strictly similar its elements are in such factors as color, brightness, etc.

Examples from art

All works of art have to be looked at "from above" (top-down approach), that is, with a primary grasp of the total organization. At the same time, however, relations among the parts often play an important compositional role. Similarity and dissimilarity shape the principal theme, for example, of Pieter Bruegel's famous *The Parable of the Blind Leading the Blind* (Fig. 34), illustrating the biblical saying that "if the blind lead the blind, both shall fall into the ditch."

A group of six coordinated figures is tied together by the **principle of consistent shape** (Fig. 35). The heads form a descending curve, connecting the six figures into a row of bodies, which slopes downward and finally falls rapidly. The painting represents successive stages of one process: unconcerned walking, hesitation, alarm, stumbling, and falling. The similarity of the figures is not one of strict repetition but of gradual change, and the eye of the observer is made to follow the course of the action. The principle of the motion picture is applied here to a sequence of simultaneous phases in space. In other words, a group of dispersed items is held together by similarity.

Fig. 34: Pieter Bruegel, the Elder: *The Parable of the Blind Men* (1568).

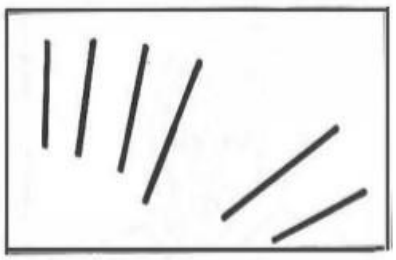

Fig. 35: Pieter Bruegel, the Elder: *The Parable of the Blind Men* (1568). Principle of consistent shape.

In Grünewald's Crucifixion of the Isenheim altar (Fig. 36), the figures of John the Baptist and John the Evangelist, placed at opposite sides of the panel, are both dressed in bright red; white is reserved for the coat of the Virgin, the lamb, the Bible, the loincloth of Christ, and the inscription on the top of the cross. In this way, the various symbols of spiritual values —virginity, sacrifice, revelation, chastity, and kingship— which are distributed over the entire panel, are not only united compositionally but also interpreted to the eye as having a common meaning. In contrast, the symbol of the flesh is suggested in the pink dress of Mary Magdalene, the sinner, who in this way is associated with the naked limbs of the men. There is also in this picture an unrealistic but symbolically significant scale of sizes, leading from the gigantic figure of Christ down to the undersized Mary Magdalene.

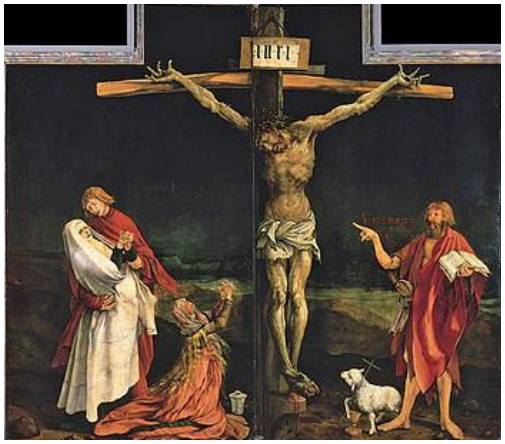

Fig. 36: Matthias Grünewald: *Crucifixion of the Isenheim Altar* (1515). Similarity of color.

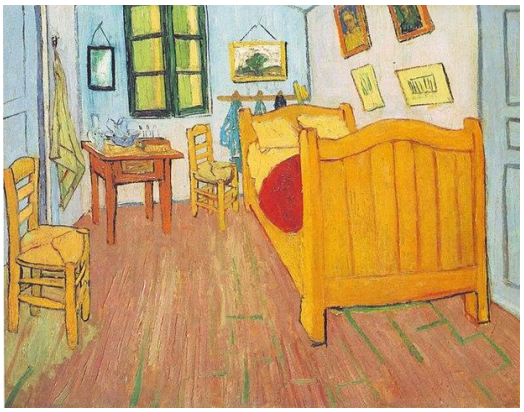

Fig. 37: Vincent Van Gogh: *The Bedroom in Arles* (1889).

Perceptual comparison requires, as we saw earlier, some kind of similarity as a base. Just as the size differences in Fig. 23 showed up clearly because shape and spatial orientation were kept constant, so the size difference between the two chairs in Van Gogh's painting *The Bedroom in Arles* (Figs. 37 and 38) is emphasized by the same means. The difference in size, which helps create depth, is underlined by the striking similarity of color, shape, and spatial orientation.

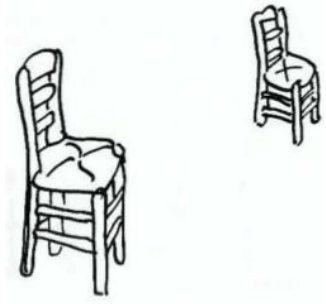

Fig. 38: Vincent Van Gogh: *The Bedroom in Arles* (1889). Similarity of color, shape, and spatial orientation. Difference in size.

The structural skeleton

Although the visual shape of an object is largely determined by its outer boundaries, the boundaries cannot be said to *be* the shape. In Fig. 35 it was possible to present the basic compositional theme of Bruegel's painting by means of straight lines, which in no way resembled the actual outlines of the figures. Thus, in speaking of **"shape"** we refer to two quite different properties of visual objects: (1) **the actual boundaries** produced by the artist: the lines, masses, volumes, and (2) **the structural skeleton** created in perception by these material shapes, but rarely coinciding with them.

All through a piece of work, the artist must bear in mind the structural skeleton she is shaping while at the same time paying attention to the quite different contours, surfaces, volumes, she is actually making. By necessity, human work proceeds in sequence; what will be seen as a whole in the final work is created piece by piece. The guiding image in the artist's mind is not so much a faithful preview of what the completed painting or sculpture will look like, but mainly the structural skeleton, the configuration of visual forces that determines the character of the visual object.

A similar discrepancy between physical action and physical shape on the one hand, and the image obtained on the other hand, exists in what the viewer does when she looks at an object. There is little relation between the tracks and directions of eye movements and the perceptual structure of the final image that emerges from the scanning. The structural skeleton is not revealed either by the movements of the viewer's eyes or those of the artist's hands.

We can come to two conclusions. **First, the same structural skeleton can be embodied by a great variety of shapes**. In Fig. 39, we can see three of the innumerable versions of the human figure produced by artists of different cultures. One is surprisingly ready to recognize the human body in the elementary stick figure or the most elaborate picture —if only the basis axes and correspondences are respected.

Fig. 39: Human figures by different cultures.

Fig. 40: Duck-rabbit illusion.

Second, if a given visual pattern can have two different structural skeletons, it may be perceived as two totally different objects. Ludwig Wittgenstein's discussion of the famous duck-rabbit (Fig. 40), a drawing that can be seen as the head of a duck looking to the left or as that of a rabbit looking to the right, shows what puzzles one must face if one assumes that the actual outlines on paper contain everything there is to the percept. This particular drawing allows for two contradictory, but equally applicable structural skeletons, pointing in opposite directions. Wittgenstein, an acute observer, realized that this was not a matter of two different interpretations applied to one percept, but of two percepts.