ART AND VISUAL PERCEPTION

a psychology of the creative eye

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I BALANCE

The Hidden Structure of a Square

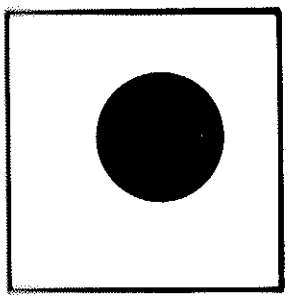

Figure 1

Cut a disk out of dark cardboard and put it on a white square in the position indicated by Figure 1.

The location of the disk could be determined and described by means of measurement. A yardstick would tell in inches the distances from the edges of the square. Thus it could be inferred that the disk lies off center.

But this result would come as no surprise. We do not have to measure—we can see that the disk lies off center. How is this "seeing" done? Which faculty of the mind provides such information? It is not the intellect, because the result is not obtained by means of abstract concepts. It is not emotion, for although the sight of the eccentric disk may produce discomfort in some persons and a pleasurable stir in others, this can happen only after they have spotted its location. Emotion is a consequence, rather than an instrument, of discovery.

We constantly make statements that describe things in relation to their environment. "My right hand is larger than the left." "This flagpole is not straight." "That piano is out of tune." "This cocoa is sweeter than the brand we had before." An object is seen immediately as having a certain size, that is, as lying somewhere on the scale between a grain of salt and a mountain. On the scale of brightness values, our white square lies high, our black disk

low. Similarly, every object is seen as having a location. The book you are reading appears at a certain spot, which is defined by the room about you and the objects in it—among them notably you yourself. The square appears somewhere on the book page, and the disk is off center in the square. No object is perceived as unique or isolated. Seeing something means assigning it a place in the whole: a location in space, a score on the yardstick of size or brightness or distance.

In other words, every act of seeing is a visual judgment. Judgments are sometimes thought to be a monopoly of the intellect. But visual judgments are not contributions of the intellect, added after the seeing is done. They are immediate and indispensable ingredients of the act of seeing itself. Seeing that the disk lies off center is an intrinsic part of seeing it at all.

The observations of the eye are not only geographical. In looking at the disk we may find that it does not merely occupy a certain place but exhibits restlessness. This restlessness may be experienced as a tendency of the disk to get away from where it is placed or, more specifically, as a pull in a particular direction—for example, toward the center. Although bound to its place and incapable of actual motion, the disk may nevertheless show an inner tension in its relation to the surrounding square. Again, this tension is not a supplementary contribution of intellect or fancy. It is as much part and parcel of the percept itself as size, location, or blackness. Since the tension has a magnitude and a direction, it may be described as a psychological "force."

If the disk is seen as striving toward the center of the square, it is being attracted by something not actually contained in the picture. The center point is not revealed to the eye by any marking in Figure 1; it is as invisible as the North Pole or the Equator, and yet it is more than an idea. It is clearly a part of the perceived pattern, an invisible focus of power, established at a considerable distance by the outline of the square. We may say it is "induced" (as one electric current can be induced by another).

There are, then, more things in the field of vision than those that strike the retinas of the eyes. Examples of "induced structure" are not infrequent. For example, in a picture done in central perspective the vanishing point may be established by the convergent lines even though no actual object can be seen at their meeting point. In a melody there may be "heard" by mere induction the regular beat, from which a syncopated tone deviates, as our disk deviates from the center. Again it must be emphasized that such an induction is not an intellectual operation. It is not an interpolation based on previously acquired knowledge but an integral element of what is immediately perceived.

A visual figure such as the square is empty and not empty at the same time. The center is part of a complex hidden structure, which can be explored by means of the disk, somewhat as iron filings will reveal the lines of force in a magnetic field. If the disk is put in various places within the square, it may be found that at some points it looks solidly at rest; at others it exhibits a pull in some definite direction, or its situation may be unclear and wavering.

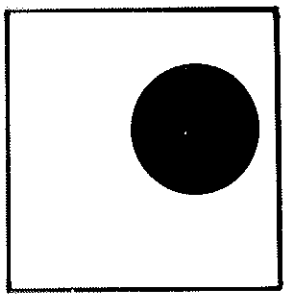

Figure 2

The disk is most stably settled when its center coincides with the center of the square. In Figure 2 it may be seen as drawn toward the contour to the right. With changing distance this effect will weaken or even turn into its opposite. For example, we can find a distance at which the disk looks "too close," possessed by the urge to withdraw from the boundary. Then the empty interval between the boundary and the disk will appear compressed, as though more "breathing" space was needed.

Investigation reveals that the disk is influenced also by the diagonals of the square as well as by the cross formed by the central vertical and horizontal axes (Figure 3). The center is established by the crossing of these four main structural lines. Other points on the lines are less powerful than the center, but the effect of attraction can be established for them also.

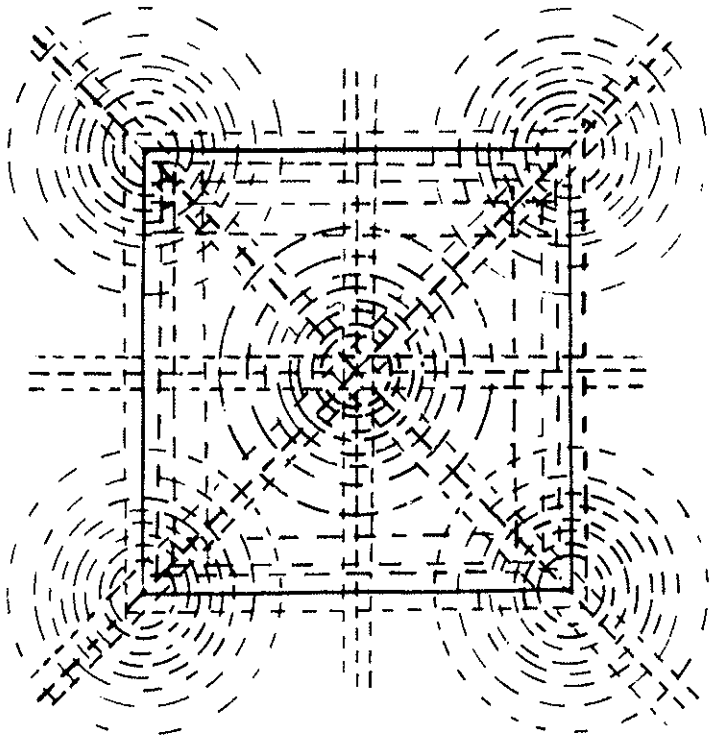

Figure 3

Wherever the disk is located, it will be affected by the forces of all the hidden structural factors. The relative strength and distance of these factors will determine their effect in the total configuration of forces. In the center all the forces balance each other, and therefore the central position makes for rest. Another comparatively restful position can be found, for example, by moving the disk along a diagonal. The point of balance seems to lie somewhat nearer to the corner of the square than to the center, which may mean that the center is stronger than the corner and that this preponderance has to be compensated by greater distance, as though they were two magnets of unequal power. In general, any location that coincides with one of the features of the "structural map" (Figure 3) will introduce an element of stability, which of course may be counteracted by other factors.

If influence from a particular direction predominates, a pull in that direction will result. When the disk is put exactly in the middle between center and corner, most observers see it striving toward the center.

An unpleasant effect is produced by locations at which pulls are so equivocal and ambiguous that the eye cannot decide whether the disk is pressing in any particular direction. Such wavering makes the visual statement unclear and interferes with the observer's perceptual judgment. In ambiguous situations the visual pattern ceases to determine what is seen, and subjective factors in the observer become more effective, such as his focus of attention or preference for a particular direction.

When conditions are such that the eye cannot keep checking on the actual location of the disk, the forces that are discussed here may, perhaps, produce genuine displacement instead of mere directed tension. If Figure 1 is seen for only a split second, will the disk be seen closer to the center than on leisurely inspection? According to Wertheimer, an angle somewhat larger or smaller than ninety degrees will be seen as a right angle when exposed briefly. A related phenomenon may be observed when the hand of a clock leaves a position of prominence, such as the twelve-o'clock mark. Interrupting its smooth rotation, the hand seems to cling to the position for a moment and then to liberate itself from it with a leap. All these phenomena are examples of the tendency to reach and maintain structurally simple configurations—a subject for later discussion.

Are the pulls in the disk active or passive? That is, does it move "under its own steam" or is it merely yielding to attractions exerted by the square? The difference is crucial for the expression conveyed by the pattern. Only exact experimentation will tell whether particular conditions make consistently for activity or passivity. Another question can be answered with more confidence. It always seems to be the disk that is being influenced by the square and not the square by the disk. This brings to mind experiments by Duncker in which luminous line patterns were put in slow motion relative to each other in a dark room. Regardless of what happened physically, the enclosed figure was seen as moving, whereas the enclosing one remained almost or completely still. The effect was found to be particularly strong when the observer explicitly fixated the disk rather than the square. Similarly in our figures, the surrounding square furnishes a stable basis, in reference to which visual action takes place. When seen in broad daylight the square is not isolated, as Duncker's figures were in the dark room, but anchored to the environment. The square acquires additional stability from the page on which it is printed. It constitutes an enclosure, within which there is greater freedom from surrounding space. The frame of a painting creates such an enclosure. It is a fence that to some extent protects the play of forces in the picture from the fettering influence of the environment.

The roving disk has revealed that a visual pattern consists of more than the elements recorded by the retinas of the eyes. To the retinas, brightness differences of black and white have created a pattern, which can be fully described in terms of size, shape, distance, and direction. Investigation re-

vealed, in addition to this visible pattern, a hidden structural map, the main features of which were indicated in Figure 3. This map represents a frame of reference, which helps to determine the balance value of any pictorial element just as the musical scale helps to determine the pitch value of each tone in a composition.

In still another and even more important way we had to go beyond the "stimulus pattern" recorded by the retinas. It became evident that the figure, plus its hidden structure, is not just a lattice of lines. As indicated in Figure 3, the visual pattern is really a field of forces. In this dynamic landscape, lines are actually ridges, from which the level of energy slopes off in both directions. These ridges are centers of attractive and repulsive forces, whose influence covers the entire area of their surroundings. What was called the internal structure of the square—and, incidentally, there is an external structure as well, outside the figure—is created secondarily by the meeting of the forces that emanate from the visible figure, namely, the edges of the square.

No place is free from this influence. It is true that "restful" spots were found in the square, but their repose does not indicate the absence of active forces. "Dead center" is not dead; no pull in any one direction is felt, because at the middle point pulls from all directions balance each other. To the sensitive eye, the balance of the middle point is alive with tension. Think of a rope that is motionless while two men of equal strength are pulling it in opposite directions. It is still, but it is loaded with energy.

Throughout this book it must be kept in mind that every visual pattern is dynamic. Just as a living organism cannot be described by its anatomy, so the essence of a visual experience cannot be expressed by inches of size and distance, degrees of angle, or wave lengths of hue. These static measurements define only the "stimulus," that is, the message sent to the eye by the physical world. But the life of a percept—its expression and meaning—derives entirely from the activity of the kind of forces that have been described. Any line drawn on a sheet of paper, or the simplest form modeled from a piece of clay, is like a rock thrown into a pond. It upsets repose, it mobilizes space. Seeing is the perception of action.

What Is Meant by Perceptual Forces?

The reader may have noticed with apprehension the use of the term "forces." Are these forces merely figures of speech, or are they real? And if they are real, where do they exist?

They are assumed to be real in both realms of existence—that is, as psychological and as physical forces. Psychologically, the pulls in the disk exist in the experience of any person who looks at it. Since these pulls have a point of attack, a direction, and an intensity, they meet the conditions established by physicists for physical forces. For this reason, psychologists have adopted the same term.

In what sense can it be said that these forces exist, not only in experience, but also in the physical world? Surely they are not contained in the objects at which we are looking, such as the white paper on which the square is

drawn or the dark cardboard disk. Molecular and gravitational forces are active in these objects, holding their microparticles together and preventing them from flying away. But there are no known physical forces that would tend to push an eccentrically placed paper disk in the direction of the center of a paper square. Nor will lines drawn in ink exert any magnetic power on the surrounding paper surface. Where, then, are these forces?

Remember how the observer obtains knowledge of the square and the disk. Light rays, emanating from the sun or some other source, hit the object and are partly absorbed and partly reflected by it. Some of the reflected rays reach the lens of the eye and are projected on its sensitive background, the retina. Do the forces in question arise among the stimulations that light produces in the millions of small receptor organs situated in the retina? The possibility cannot be entirely excluded. But the receptor organs of the retina are essentially self-contained. In particular, the "cones," which are largely responsible for pattern vision, have little anatomical connection with each other, many of them having private pathways to the optic nerve.

In the brain center of vision itself, which is located in the back of the head, conditions seem to exist, however, that would allow for this very kind of process. According to gestalt psychologists, the cerebral area contains a field of electrochemical forces. These interact freely, unconstrained by the kind of compartmental division that is found among the retinal receptors. Stimulation at one point of the field is likely to spread to adjoining areas. As an example of a phenomenon that seems to presuppose such interaction, Wertheimer's experiments on illusory movement may be cited. If two light spots appear successively in a dark room for a split second, the observer often does not report two separate and independent experiences. Instead of seeing one light and then, at some distance, another, the observer sees only one light, which moves from one position to another. This illusory movement is so compelling that it cannot be distinguished from the actual displacement of one light dot. Wertheimer concluded that this effect was the result of "a kind of physiological short-circuit" in the brain center of vision, by which energy shifted from the place of the first stimulation to that of the second. In other words, he suggested that local brain stimulations acted upon each other dynamically. Subsequent research confirmed the validity of this hypothesis and provided more information about the exact nature and behavior of cortical forces. Although all these findings were indirect, in that they inferred knowledge of physiological happenings from psychological observations, more recent investigations by Köhler have opened the way for the direct study of the brain processes themselves.

The forces that are experienced when looking at visual objects can be considered the psychological counterpart or equivalent of physiological forces active in the brain center of vision. Although these processes occur physiologically in the brain, they are experienced psychologically as though they were properties of the perceived objects themselves. In fact, by mere inspection they can be no more distinguished from the effects of physical processes taking place in the objects than a dream or hallucination can be

distinguished from the perception of "actual" events. Only by comparing various experiences can man arrive at telling the difference between events that are merely produced by the activity of the nervous system and others that occur in the external objects themselves.

There is no point, however, in calling these forces "illusions." They are no more illusory than colors, which are attributed to the objects themselves although they are actually nothing but the reactions of the nervous system to light of particular wave lengths. Psychologically, our visual forces are as real as anything else we perceive or feel or think. The term "illusion" is useful only when a difference arising between the physical and the psychological world makes us commit a mistake in dealing with physical things—for example, walking into a mirror or giving a slant to a wall which is supposed to be vertical. No such danger exists for the artist, because in the arts what looks right is right. The artist does not use his eyes for the purpose of handling paints. He handles paints for the purpose of creating a visible image, since the image, and not the paint, is the work of art. If a wall looks vertical in the picture, it is vertical; and if walkable space is seen in a mirror, there is no reason why images of men should not walk right into it, as has happened in some movies. Thus, the forces that pull our disk would be "illusory" only to a man who decided to use their energy for running an engine. Perceptually and artistically they are quite real.

Two Disks in a Square

In order to get a bit closer to the complexity of the work of art, a second disk is now introduced into the square. What is the result? First of all, some of the effects of the relationship between disk and square also appear with regard to the two disks. When they lie close together, they attract each other and may look almost like one indivisible thing. Also a distance between them can be found at which they repel each other because they are too close together. The distances at which these effects occur will depend on the size of the disks and the square as well as on the locations of the disks in the square.

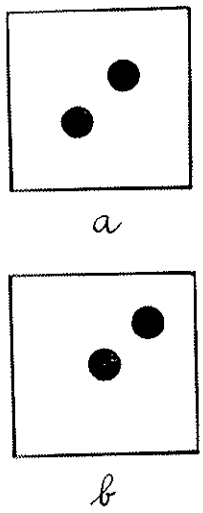

Figure 4

The locations of the disks may balance each other. Either of the two locations in Figure 4*a* may look unbalanced by itself. Together they make for a symmetrically located pair that is at rest. However, the same pair may look intolerably unbalanced when moved to another place (Figure 4*b*). The earlier analysis of the structural map helps to explain why this is true. The two disks form a pair because of their closeness, their similarity of size and shape, and also because they are the only "content" of the square. As members of a pair they tend to be symmetrical—that is, equal value and function in the whole are attributed to them. This perceptual judgment, however, is in conflict with another that derives from the location of the pair. The lower disk lies in the prominent and stable position of the center. The upper is at a less stable location. Thus location creates a distinction between the two that is in conflict with their symmetrical pairness. This conflict is insoluble. The spectator finds himself shifting between two in-

compatible conceptions. The example shows that a visual pattern cannot be considered without regard to the structure of its spatial surroundings, and also that ambiguity can result from a contradiction between form pattern and location pattern.

Psychological and Physical Balance

In discussing the perceptual effect of location, we become inevitably concerned with the factor of balance or equilibrium. Especially in a work of art all elements must be distributed in such a way that a state of balance results. What is balance, and why is it indispensable?

To the physicist, balance is the state of a body in which the forces that act upon it compensate each other. In the simplest example this is achieved by two forces of equal strength that pull in opposite directions. The definition is applicable to visual balance. Exactly like a physical body, every finite visual pattern has a fulcrum or center of gravity. And just as the fulcrum of even the most irregularly shaped flat object can be determined by locating the point at which it will balance on the tip of a finger, so the center of a pattern can be determined by trial and error. According to Denman W. Ross, the simplest way of doing this is by moving a frame around the pattern until the two balance; then the center of the frame coincides with the center of the pattern. Except for the most regular shapes, no method of rational calculation is available that could replace the eye's intuitive sense of balance. From our previous speculation it would follow that the eye experiences balance when the physiological forces in the cortical field are distributed in such a way that they compensate each other.

The center of gravity of a painting roughly coincides with the center of the frame. (Slight deviations from the geometric center occur mainly for two reasons: The difference of "weight" between the top and the bottom of a visual object tends to push the perceptual center upward; the interaction between the pictorial pattern and the structural map of the plane may cause the displacement of the center of the framed space.)

In a frameless work of art—for example, a piece of sculpture—the figure determines its own fulcrum, except for the influence of such environmental factors as a niche in which the statue may be placed or the base on which it rests.

When the two pans of a scale are in balance, they will be seen swinging up and down until they settle in a position of rest. No further action of physical force can be observed by the eye. Our observations of the disk in the square have demonstrated that this does not hold true for perceptual balance. In a work of art, the forces that have been balanced remain visible. This is the reason why motionless media, such as painting and sculpture, can represent life, which is action.

There are other differences between physical and perceptual equilibrium. The photograph of a dancer may look unbalanced although her body was in a comfortable position at the time the photograph was made. A model may find it impossible to hold a pose that shows perfect poise on canvas.

Sculpture may need an internal armature to hold it upright, although it may be well balanced visually. A duck sleeps peacefully standing on one oblique leg. The reason for these discrepancies is that the visual balance values of such factors as size, color, and direction often do not correspond to equal physical factors. A clown's costume—red on the left side and blue on the right—may be asymmetrical to the eye as a color scheme, although the two halves of the costume—and indeed of the clown—are equal in physical weight. Also, in a painting, a physically unrelated object—such as a curtain in the background—may counterbalance the asymmetrical position of a human figure.

An amusing example is found in a fifteenth-century painting that represents St. Michael weighing souls (Figure 5). By the mere strength of prayer, one frail little nude figure outweighs four big devils plus two millstones. The difficulty is that prayer carries only spiritual weight and provides no visual pull. As a remedy, the painter has used the large dark patch on the angel's dress just below the scale that holds the saintly soul. By visual attraction, which is nonexistent physically, the patch creates the weight that adapts the appearance of the scene to its meaning.

Why Balance?

Why is pictorial balance indispensable? It must be remembered that visually, just as physically, balance is the state of distribution in which everything has come to a standstill. In a balanced composition all such factors as shape, direction, and location are mutually determined by each other in such a way that no change seems possible, and the whole assumes the character of "necessity" in all its parts. An unbalanced composition looks accidental, transitory, and therefore invalid. Its elements show a tendency to change place or shape in order to bring about a state better fitted to the total structure. Under such conditions the artistic statement becomes incomprehensible. The pattern is ambiguous and allows no decision as to which of the possible configurations is meant. We get the impression that the process of creation has been suddenly and accidentally frozen somewhere in its course. Since change is needed, the stillness of the work becomes a handicap. Timelessness gives way to the frustrating sensation of arrested time.

This phenomenon is related to my earlier assertion that every act of perception is a perceptual judgment. A blimp floating in an empty universe would be neither large nor small, neither high nor low, neither fast nor slow, and it would be neither at rest nor moving in any direction. Any visual quality must be defined by its environment in space or time. A balanced pattern does just this.

Naturally, the artist always wants to express some kind of inequality. For example, in one of El Greco's paintings of the Annunciation the angel is much larger than the Virgin. But this symbolic disproportion is compelling only because it is fixated by counterbalancing factors. Otherwise the unequal size of the two figures would lack finality and, therefore, meaning. It is only seemingly paradoxical to assert that disequilibrium can be ex-

Figure 5

pressed only by equilibrium, just as discord can be shown only by harmony, or separateness by unity.

The following examples are adapted from a test designed by Maitland Graves to try the artistic sensitivity of students. Compare *a* and *b* in Figure 6. The left figure is well balanced. There is plenty of life in this combination of squares and rectangles of various sizes, proportions, and directions, but they all hold each other in such a way that every element stays in its place, everything is necessary, nothing can be changed. Compare the clearly established internal vertical of *a* with its pathetically wavering opposite number in *b*. In *b*, proportions are based on small differences, which leave the eye uncertain whether it deals with equality or inequality, square or rectangle. We cannot tell what the pattern is trying to say.

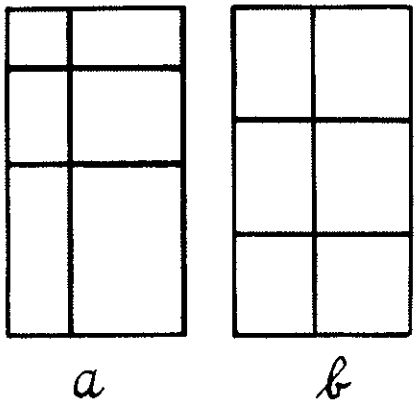

Figure 6

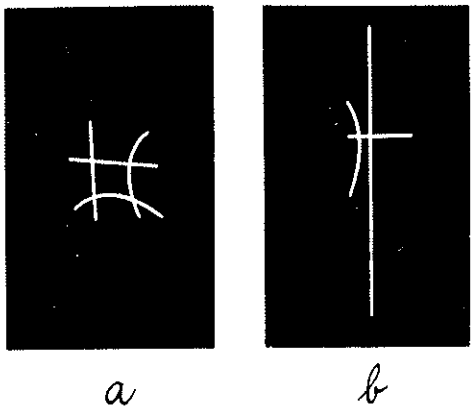

Figure 7

Somewhat more complex, but no less irritating in its ambiguity is Figure 7*a*. Relations are neither clearly rectangular nor clearly oblique. The four lines are not sufficiently different in length to assure the eye that they are unequal. The pattern, which drifts in space without anchor, approaches, on the one hand, the symmetry of a crosslike figure of vertical-horizontal orientation and, on the other, the shape of a kind of kite with a diagonal symmetry axis. Both interpretations, however, are equally inconclusive. They have none of the reassuring clarity of Figure 7*b*.

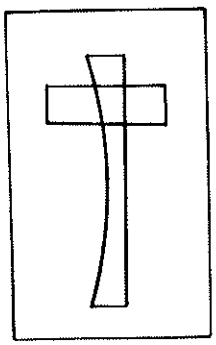

Figure 8

Disequilibrium does not always render the whole configuration fluid. In Figure 8 the symmetry of the Latin cross is so firmly established that the unfitting curve looks like an injury. Here, then, a balanced pattern is present to such an extent that it is capable of segregating the rest as an intrusive element. Under such conditions disequilibrium makes for local interference with the unity of the whole.

Weight

At this point it may be useful more systematically to describe the two factors that determine balance: weight and direction.

Weight depends on location. A pictorial element lying in or close to the center of the composition or on the central vertical axis pulls less compositional weight than one lying off the main tracks indicated in the structural

map (Figure 3). For example, the centrally located figure of Christ or the Virgin may be quite large or weighted by color or some other factor without overthrowing the balance of the composition. Van Pelt has pointed out that in a symmetrical arrangement of three arches the central one should be larger. It would look too weak if it had merely the size of the other two. (Compositional weight must not be confused with "importance." A centrally located object assumes more importance than a lateral one.)

An object in the upper part of the composition is heavier than one in the lower; and location at the right side makes for more weight than location on the left. Also, the lever principle of physics has been applied to pictorial composition. According to this principle, the weight of a pictorial element increases proportionally to its distance from the center of balance. Although this is probably true, it must be kept in mind that pictorial weighing does not occur in empty space, as physical weighing does, and that usually the other powerful factors of location will strongly interfere with the lever effect.

There seems to be a lever effect in the depth dimension—that is, the farther away from the observer objects are located in pictorial space, the more weight they carry. Puffer has observed that "vistas," which lead the glance to distant space, have great counterbalancing power. This may be a special case of a more general distance effect. The factor is hard to evaluate, because a distant object appears relatively large for reasons of perspective. By appearing larger, it may pull more weight than a picture area of its size would do otherwise. In Manet's *Déjeuner sur l'herbe,* the figure of a girl picking flowers at a distance has considerable weight in relation to a group of three large figures in the foreground. How much of this derives from the fact that being far away she looks perspectively larger than the space she occupies?

Weight depends also on size. Other factors being equal, the larger object will be the heavier. As to color, red is heavier than blue, and bright colors are heavier than dark ones. A black area must be larger than a white one in order to counterbalance it. This is due in part to the irradiation effect, which makes a bright surface look relatively larger.

"Intrinsic interest" has been found by Puffer to be a factor of compositional weight. An area of a painting may hold the attention of the observer either because of the subject matter—for example, the spot around the Christ child in an Adoration—or by its formal complexity, intricacy, or other peculiarity. (Compare the multicolored bouquet of flowers in Manet's *Olympia.*) The very tininess of an object may cause a fascination capable of compensating the light weight that would otherwise go with small size. Also, recent experiments have suggested that perception may be influenced by the observer's wishes and fears. It would be interesting to find out whether pictorial balance is changed by the introduction of a highly desirable object or a frightening one.

Isolation makes for weight. The sun or moon in an empty sky will be heavier than an object of similar appearance surrounded by other things. On the stage, isolation is known as a means of emphasis. Star actors often

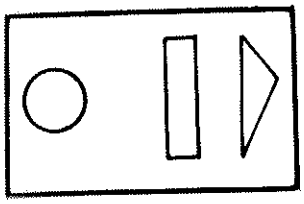

Figure 9

insist on not being approached too closely by others during important scenes.

Shape and direction seem to influence weight. Regular shape, as it is found in simple geometric forms, is probably heavier than irregular shape. Also compactness—that is, the degree to which mass is concentrated around its center—seems to produce weight. Figure 9, taken from the Graves test, shows a relatively small circle counterweighing a larger rectangle and triangle. Vertically directed forms seem to be heavier than oblique ones. Most of these "rules" need to be verified by exact experiment.

What about the influence of knowledge? In a picture, no knowledge on the part of the observer will make a bundle of cotton look heavier than a lump of lead of similar appearance. The problem has come up in architecture. According to Mock and Richards, "We know from repeated experiences how strong wood or stone is for we frequently handled them in other contexts, and when we look at a piece of wood or masonry construction we are immediately satisfied that it is able to do the job it has to do. But reinforced concrete construction is different; so is a building of steel and glass. We cannot see the steel bars inside the concrete and reassure ourselves that it can safely span several times the distance of the stone lintel it so much resembles, nor can we see the steel columns behind a cantilevered store window, so that a building may appear to stand unsafely on a base of glass. It should be realized, however, that the expectation that we shall be able to understand at a glance why a building stands up is a survival of the handicraft age that had disappeared even in the days of William Morris."

This kind of reasoning is common nowadays, but seems open to doubt. Two things must be distinguished. On the one hand there is the technical understanding of the craftsman, who deals with such factors as methods of construction and strength of material. Most of these data cannot be obtained by looking at the finished building, and there is no artistic reason why they should. Quite another matter is the visual comprehensibility of the building. The beholder must be able to understand such things as the distribution of *visual* weight and the relations between load and carrier. Technical information or misinformation is likely to influence visual evaluation very little. What perhaps does count is certain stylistic conventions—for example, as to the width of the span. Such conventions oppose change everywhere in the arts. Some of the resistance to the visual statics of modern architecture may be owing to this conservatism. But the main point is that the purely visual discrepancy between a large mass and a thin supporting pole is in no way touched by the assurance of the architect that the thing will not collapse physically. Wherever the architect abandons the appearance of the solid cube or wall, which are remnants of the older construction method, and reveals the skeleton of slender girders, style catches up with technology and the eye ceases to have trouble.

Direction

Direction, as well as weight, determines balance. Like weight, direction is influenced by location. The weight of any compositional element, whether

it is a part of the hidden structural map or a visible object, will attract things in the neighborhood and thus impose direction upon them. I have already shown the centripetal pull in the disk caused by the center of the square. In Figure 10 the horse is seen to be drawn backward through the attraction of the figure of the rider, whereas in Figure 11 it is pulled forward by the other horse. In Toulouse-Lautrec's drawing, from which this sketch was made, the two factors balance each other. Weight by attraction was demonstrated also in Figure 5.

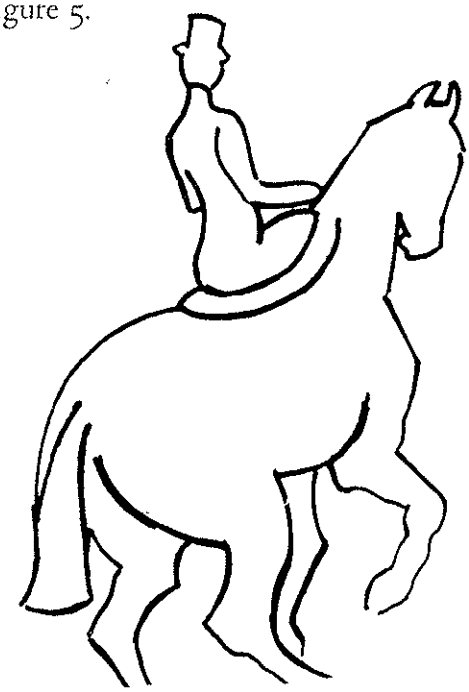

Figure 10

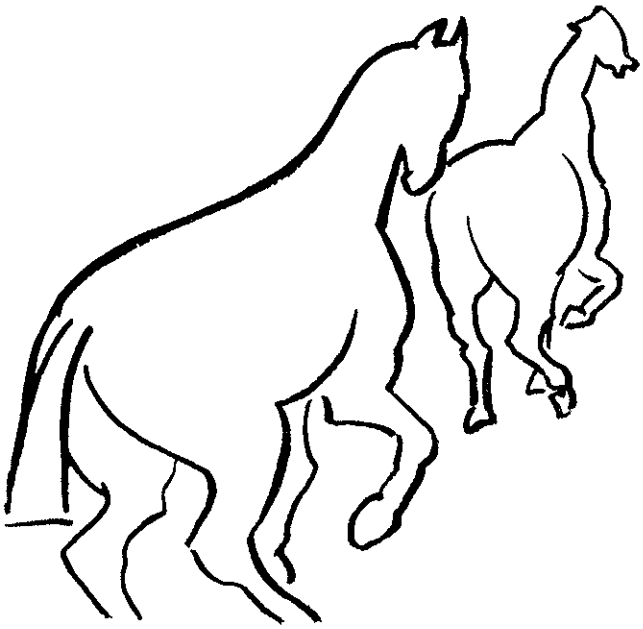

Figure 11

Figure 12

Elongated forms whose spatial position deviates from the vertical or horizontal only by a small angle show a pull toward that structurally strong direction. A similar striving toward the diagonal may also exist.

The shape of pictorial objects creates axes, and these axes create directed forces. This is true not only for such well-defined objects as a human figure, which in an upright position may show a vertically directed force, but also for any detail—as, for example, the line of the mouth—or any grouping of objects—say, a row of men forming a large rectangle. Compositional triangles forge groups of figures into upward-moving pyramids—for example, in the El Greco *Pietà* (Figure 12).

The axes produced by shape allow for movement in two opposite directions. An ellipse (Figure 13) is directed upward as well as downward. Preference for one of the two directions is caused by various factors. A shape may be seen as directed to the right rather than to the left because of the general tendency to read visual patterns from left to right. If one point of the shape is "anchored," for example, by coinciding with the fulcrum, the force will be seen as issuing from there. If one side of the shape is anchored to the frame and the other ends in free space—as, for example, the triangle of Figure 12—the force will move toward the free end. Similarly, the shape of an arm will move toward the hand and that of the branch of a tree toward its tip.

Subject matter also creates directed forces. It will define a human figure as walking forward or falling backward. In Rembrandt's *Portrait of a Young Girl* at the Chicago Art Institute the eyes of the girl are turned to the left, thus providing the almost symmetrical shape of the front-face figure with a strong lateral force. Spatial directions created by the glance of actors are known as "visual lines" on the stage.

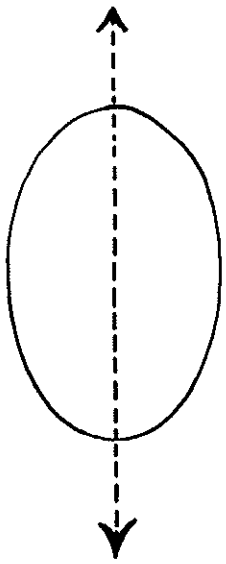

Figure 13

In any particular work of art many of the above factors act with and against each other to create the balance of the whole. Weight through color may be counteracted by weight through location. The direction of shape may be balanced by movement toward a center of attraction. The complexity of these relations contributes greatly to the liveliness of a work of art.

When actual motion is used, as in the dance, the theater, or the movies, direction is indicated by the movement. Balance may be obtained between events that occur at the same time—as when two dancers walk symmetrically toward each other—or in succession. Film cutters often have a scene of movement toward the right followed, or preceded, by one of movement toward the left. The elementary need for such balancing compensation was shown clearly by experiments in which, after the apex of an obtuse angle had been fixated for some time, straight lines of the same location and orientation appeared bent in the opposite direction. Also, when observers inspected a straight line that was moderately tilted from the vertical or the horizontal, the objective vertical or horizontal later appeared bent in the opposite direction.

Speech creates visual weight at the place from which it issues. For example, in a duet between a dancer who speaks poetry and another who is

silent the asymmetry may be compensated by more active movement of the silent dancer.

Patterns of Balance

Balance is often centered in one or more nodal elements or focuses that carry the main weight. For example, a pair of human figures may furnish the twin centers of the work. Each figure in turn will be organized within itself around secondary balance centers, which may be located in the face, the lap, the hands, depending on the composition. The same will be true for the rest of the picture. In this way a chief theme is created, which represents the top of a hierarchic order. From the two figures and their over-all balance in the whole work the eye descends toward lower levels of organization reaching smaller and smaller units. What may be called the steepness of the hierarchic order differs with the style of the work. Some are dominated by a powerful theme surrounded by a subservient "background." On the other hand—for example, in certain works by Klee, Matisse, Braque, the cubists, or the impressionists—the balance of the whole may be maintained by a large number of minor centers, all of similar strength. In its extreme consequence, this latter method leads to an even distribution of substance, better suited to interpret the over-all character of a mood or mode of existence than to describe life as depending upon the effects of central powers or events. In paintings of this kind the influence of the structural map is weak. The result is a homogeneity that may well be termed "atonal," in that the relation to the underlying structural "key" is given up and replaced by a network of connections between the elements of the composition itself.

Top and Bottom

It has often been remarked that the lower part of a visual pattern demands more weight. A distinction must be made here between adding just enough weight to the bottom part to make the whole look balanced and giving the bottom overweight so that it looks heavier than the top. Langfeld says: "If one is asked to bisect a perpendicular line without measuring it, one almost invariably places the mark too high. If a line is actually bisected, it is with difficulty that one can convince oneself that the upper half is not longer than the lower half." When this occurs, an increase of the lower length will act simply as a compensation. It will make both halves look equal. But Horatio Greenough speaks of a different matter: "That buildings, in rising from the earth, be broad and simple at their bases, that they grow lighter not only in fact but in expression as they ascend, is a principle established. The laws of gravitation are at the root of this axiom. The spire obeys it. The obelisk is its simplest expression." Here the pattern is made to look heavier at the bottom.

Gravitation is probably at the root of this asymmetry in the vertical dimension, but how its effect on vision comes about is not known. Man's experience in handling physical objects teaches him that bottom heaviness assures stability. It is possible that this knowledge affects the observer when

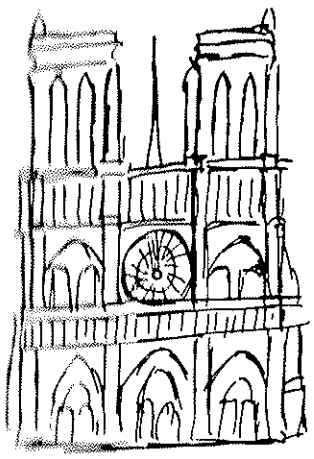

Figure 14

visual balance is evaluated. It is equally possible that, independent of experience, a physiological feature of the brain makes for this asymmetry; or there may be a combination of both factors. The strictly spherical building at the New York World's Fair in 1939 aroused the unpleasant impression of wanting to rise from the ground but being tied to it. Whereas a securely balanced building points freely upward, the contradiction between the symmetrical sphere and asymmetrical space made for frustrated locomotion in this particular structure. The use of a completely symmetrical form in an asymmetrical context is a delicate undertaking. As an example of how the task can be solved, the position of the rose window in the façade of Notre Dame in Paris (Figure 14) may be studied. Relatively small enough to avoid any danger of drifting, it "personifies" the balance of vertical and horizontal elements obtained around it. Since the vertical is stronger, the window finds its place of rest somewhat above the center of the square-shaped surface that represents the main mass of the façade.

The compensation, which keeps the lower part of a pattern from looking too light or too small, is needed everywhere, except for the structurally strongest shapes, which resist the distortion of angles. For example, a picture frame can be strictly rectangular because any rectangle maintains its regular shape; but in a less regular shape, allowance must be made for compensation.

It cannot be maintained, however, that general artistic practice makes patterns look heavier at the bottom—that is, lowers the center of gravity. True, in the landscape that man, the land animal, sees around himself the lower part of the visual field is crowded with buildings, fields, trees, and events whereas the sky is relatively empty. A corresponding effect is sought in the arts wherever the realistic representation of solid material bodies is intended. By lowering the center of gravity the painter or sculptor adapts his work to the asymmetry of physical space. This practice, however, is not universal. It goes with certain styles only. For instance, modern art—because of its trend toward abstraction—has little use for this uneven distribution of masses. Suspended in space and reposing in itself, the picture demonstrates its emancipation from material reality by shirking earthly weight. This tendency can be found even in certain works of modern sculpture and architecture.

The experience of flying through the air and the upsetting of visual conventions in photographs taken from the air have contributed to this development. The motion-picture camera refuses to keep its line of sight parallel with the ground, thus presenting views in which the gravitational axis is freely displaced and the lower part of the picture not necessarily more crowded than the upper. The modern dance has run into an interesting inner conflict by stressing the weight of the human body—which the classical ballet had tried to deny—and at the same time following the general trend in moving from realistic pantomime to abstraction.

Some modern abstractionists have maintained that their works can be turned around freely because they balance in all spatial orientations. Since

this rules out compensation for the asymmetry of space, the claim sounds suspicious. In a recent experiment twenty observers were asked to judge which way some abstract paintings were "right side up." They were correct significantly often, non-art students doing as well as art students.

Right and Left

A knotty problem is posed by the asymmetry of right and left. I shall discuss it here only as far as it concerns the psychology of visual balance. The art historian Wölfflin called attention to the fact that pictures change appearance and lose meaning when turned into their mirror images. He realized that this happens because pictures are "read" from the left to the right, and naturally the sequence changes when the picture is inverted. Wölfflin noted that the direction of the diagonal that runs from bottom left to top right is seen as ascending, the other as descending. Any pictorial object looks heavier at the right side of the picture. For example, when the figure of Sixtus in Raphael's *Sistine Madonna* is moved to the right by inversion of the painting, he becomes so heavy that the whole composition seems to topple (Figure 15). Gaffron carried the investigation further, notably in a book in which she attempted to show by detailed analysis that Rembrandt's etchings reveal their true meaning only when the observer looks at them the way the artist drew them on the plate and not in the inverted prints, to which we are accustomed. According to Gaffron, the observer experiences a picture as if he was facing its left side. He is subjectively identified with the left, and whatever appears in that part of the picture assumes greatest importance. This agrees with Dean's observations on the so-called stage areas of the theater. He says that as the curtain rises at the beginning of an act, the audience can be seen to look to its left first. The left side of the stage is considered the strong one. In a group of two or three actors, the one to the left dominates the scene.

It will be evident that when the observer experiences facing the left side, a second and asymmetrically located center is created in the picture at that

Figure 15

side. Just like the center of the frame, this subjective center carries importance and can be expected to influence the composition accordingly. A contrapuntal relationship between the two competing centers will result.

Like the area around the center of the frame, the area of the subjective center to the left is able to carry more weight, which seems to be the reason why the heavy figure of Sixtus (Figure 15) at the left does not upset the balance. As soon as it is moved to the right, it profits from the "lever effect" in relation to both centers. It therefore becomes heavy—it looks conspicuous. There is, then, a curious difference between being important and "central," at the left, and being heavy and conspicuous, at the right. In Grünewald's crucifixion of the Isenheim altar the group of Mary and the Evangelist to the left assumes greatest importance next to Christ, who holds the center, whereas John the Baptist to the right is the conspicuous herald, who calls attention to the scene at which he is pointing. If an actor comes on the stage from the right, he is noticed immediately, but the focus of the action lies at the left if it does not occupy the center. In the traditional English pantomime, the Fairy Queen, with whom the audience is supposed to identify, always appears from the left whereas the Demon King enters on the prompt side, that is, on the audience's right.

At the end of his observations on the right-left phenomenon Wölfflin reminds his readers that he has described but not explained it, and he adds: "Apparently it has deep roots, roots that reach down to the nethermost foundations of our sensuous nature." At present the most common explanation runs along empiricist lines. The reading of pictures from left to right is a habit taken over from the reading of books. The neuropsychiatrist Stanley Cobb, speaking of handedness, says: "Many fanciful ideas have been put forward, from the theory that the left hemisphere has a better blood supply than the right to the heliocentric theory that the right hand dominates because man originated north of the equator and, looking at the sun, was impressed with the fact that great things move towards the right! Thus right became the symbol of rectitude and dexterity and things on the left were sinister. It is an interesting observation that about 70 per cent of human foetuses lie in the uterus in the 'left occiput posterior' position, i.e., facing to the right. No one has ever found out whether or not these become the right handed majority of babies. Probably the dominance of right handedness is due to chance in heredity."

Gaffron relates the phenomenon to the dominance of the left brain cortex, which contains the higher brain centers for speech, writing, and reading in a right-handed person. If this dominance applies equally to the left visual center, it means that "there exists a difference in our awareness of visual data in favor of those which are perceived within the right visual field." Vision to the right would be more articulate, hence the conspicuousness of objects appearing in that area. The attention for what goes on at the left would make up for that asymmetry, and the eye would move spontaneously from the place of first attention to the area of most articulate vision. This is the state of the hypothesis at the present time.

Balance and the Human Mind

Thus far I have described balance as a means of eliminating ambiguity and disunity, that is, as an indispensable device for making an artistic statement comprehensible. This is not the usual way of dealing with the subject. The more common assertion is that the artist strives for balance because it is desirable for its own sake. Why is it desirable? "Because it is pleasing and satisfying." This is the hedonistic theory, which defines human motivation as the striving for pleasure and the avoidance of unpleasant feelings. It should be evident by now that this venerable theory is correct but useless It explains everything and nothing. What we need to know is why a particular activity or situation is pleasing.

It has been asserted that the artist strives for balance because the maintenance of bodily equilibrium is one of man's most elementary needs. When looking at an unbalanced pattern, the observer is said to experience a feeling of unbalance in his own body by some kind of spontaneous analogy. Hence the need for balanced composition.

This assertion is based on theory rather than on observation. There is no concrete evidence to show that such muscular reactions to visual experiences are frequent, strong, or decisive. The tendency to explain visual (or auditory) reactions by kinesthetic ones is not limited to the psychology of balance. It will be discussed critically later. I have already offered an alternative theory to the effect that the visual reaction of an observer may be considered the psychological counterpart of the striving for balance assumed to exist in the physiological forces of the cortical brain field.

Neither theory, however, can be sufficient. Both refer to specific tendencies of the body, and therefore cannot do justice to the deep spiritual function fulfilled by art. We must expect the need for balance to correspond to a universal human experience of much greater range. The phenomenon of balance must be seen in a wider context.

The psychology of motivation has recently profited from a way of thinking that has led workers in different fields of knowledge to similar conclusions. In physics the principle of entropy, also known as the second law of thermodynamics, asserts that in any isolated system each state represents an irreversible decrease of active energy. The universe tends toward a state of equilibrium, in which all existing asymmetries of distribution will be eliminated. Thus all physical activity can be defined as a striving for balance. In psychology the gestalt theorists have come to the conclusion that every psychological field tends toward the simplest, most balanced, most regular organization available. Freud has interpreted his "pleasure principle" as the belief that the course of psychical events is stimulated by an unpleasant tension and takes a direction that will lead to a reduction of tension. Finally, the physicist L. L. Whyte has been so impressed by the universality of the idea that he has formulated a "unitary principle," underlying all natural activity, according to which "asymmetry decreases in isolable systems."

In line with this trend of thinking, psychologists have defined motivation

as "the disequilibrium of the organism which leads to action for the restoration of stability." The establishment of this principle unquestionably represents a decisive step forward. At the same time its one-sided application leads to an intolerably static conception of motivation. The organism appears as something like a stagnant pool, stimulated to activity only when a pebble disturbs the balanced peace of its surface, limiting its activity to the reëstablishment of that peace. Freud came closest to accepting this view in its radical consequences. He described man's basic instincts as an expression of the conservative nature of living matter, as an inherent tendency to go back to a former state. He spoke of the basic importance of the "death instinct," a striving for return to inorganic existence. According to Freud's economy principle, man constantly tries to expend as little energy as possible. Man is lazy by nature.

In opposition to this view, it can be pointed out that a human being, not handicapped by physical or mental ailment, finds his fulfillment not in inactivity but in doing, moving, changing, growing, going ahead, producing, creating, exploring. There is no justification for the strange notion that life consists of attempts to put an end to itself as rapidly as possible. In fact the chief characteristic of the organism may well be that it represents an anomaly of nature because it wages an uphill fight against the universal law of entropy by constantly drawing new energy from its environment.

Such a view does not deny the importance of balance. Balance remains the final goal of any wish to be fulfilled, any task to be accomplished, any problem to be solved. But the racing is not done only for the winning's sake.

In human life, balance can be achieved only partly and temporarily. Even so, as a person is engaged in striving and activity, he constantly tries to organize the competing forces that make up his life situation in such a way that the best possible equilibrium results. Needs and duties, which often pull in opposite directions, have to be reconciled, and within the group of people of which he is a part there will be a constant maneuver of rearrangement to keep the friction of divergent interests at a minimum.

Balance Conveys Meaning

The above discussion concerns art in two ways. First of all, compositional balance reflects a tendency that is probably the mainspring of all activity in the universe. Art accomplishes what can never be realized by the overlapping strivings that make up human life. But at the same time the work of art is far from being merely an image of balance. If we define art—and this is my second point—as the striving for, and achievement of, balance, harmony, order, unity, we arrive at the same perverting one-sidedness as the psychologists did when they formulated the static conception of human motivation. Just as the emphasis of living is on directed activity and not on empty repose, so the emphasis of the work of art is not on balance, harmony, unity, but on a pattern of directed forces that are being balanced, ordered, unified.

A work of art is a statement about the nature of reality. From an infinite number of possible configurations of forces, it picks and presents one. In

any such configuration the whole determines place, character, and magnitude of each force, and in turn a unified structure results from the togetherness of all the forces of which it consists. This means that each pattern of existence is presented in its valid form. The work of art is the necessary and final solution of the problem of how to organize a reality pattern of given characteristics.

If, instead, the layman is told that art deals with the presentation of balance or harmony, he ought to conclude, with surprise, that apparently the celebrated craft of the artist is concerned with nothing better than the modest satisfaction experienced by a housemaid who arranges knickknacks on the mantelpiece in a symmetrical order. And when a lecturer endeavors to explain the *raison d'être* of a painting by showing in detail how the colors, masses, and directions balance each other, the layman should be expected to assume that, for reasons of their own, artists have expanded the game of the housemaid into a tricky trade.

Much of what is being said about art these days leaves the bystander in the position of a person to whom the functioning of an unknown machine is explained without any intimation of the use of the machine. Only when he is told that the work of art has a content—and that all the organizing of color and shape occurs exclusively for the purpose of conveying that content—only then will he understand why those balanced forms might regard him.

The notion that art is concerned with perfecting formal relationships, such as balance, misleads and alienates the public. It has equally devastating effects upon the practice of art. An artist who approaches his work with the sole intention of achieving balance and harmony without considering what he is trying to balance will get lost in the arbitrary playing with form that has wasted so much talent during the past few decades. Regardless of whether the work is representational or abstract, only the content can determine which pattern is to be chosen and subjected to the business of pictorial organization or composition. Therefore the function of balance can be shown only by pointing out the meaning it helps to make visible. According to Leonardo, in a good work of painting "the distribution or arrangement of the figures is devised in agreement with the conditions you desire the action to represent." Focusing upon the content need not be conscious or be formulated intellectually. It is a question of the attitude, which may be entirely beyond the awareness of the artist himself.

Madame Cézanne in a Yellow Chair

After so much theory, here is a concrete example of the approach I advocate. I have deliberately chosen a painting that at first glance looks simple—beautiful but perhaps artless—the kind of work on which many a museumgoer does not spend much time. My analysis will have to be detailed to bring out some of the richness of this masterpiece.

Cézanne's portrait of his wife in a yellow chair (Figure 16) was painted in 1888–1890. What strikes the observer first is the combination of external

tranquillity and strong potential activity. The reposing figure is charged with energy, which presses in the direction of the woman's glance. The figure is stable and rooted, but at the same time it is as light as though suspended in space. It rises, yet it rests in itself. This subtle blend of serenity and vigor, of firmness and disembodied freedom, may be described as the particular configuration of forces that represents the theme of the work. How is the effect achieved?

The picture has an upright format, the proportion being approximately 5:4. This stretches the whole in the direction of the vertical and reinforces the upright character of the figure, the chair, the head. The chair is somewhat slimmer than the frame, and the figure slimmer than the chair. Thus there is a scale of increasing slimness, which leads forward from the background over the chair to the foreground figure. At the same time the shoulders and arms form an oval around the middle point of the picture, a centric core of stability that counteracts the pattern of rectangles and is repeated in small scale by the head.

A dark band divides the background into two rectangles (Figure 17). Both are more elongated than the whole frame, the lower rectangle being 3:2 and the upper, 2:1. This means that these rectangles are stressing the horizontal more vigorously than the frame stresses the vertical. Although the rectangles furnish a counterpoint to the vertical, they also enhance the upward movement of the whole by the fact that vertically the lower rectangle is taller than the upper. According to Denman Ross, the eye moves in the direction of diminishing intervals—that is, upward in this picture.

A scale of increasing slimness, which leads from the background toward the observer was noted above. This crescendo effect is enhanced by a number of other features. The three main elements of the picture overlap each other spatially: a scale of three planes leads from the background over the chair to the figure. This three-dimensional scale is supported by a two-dimensional one—a series of steps—that rises from the small fraction of the dark band at the extreme left over the corner of the chair to the head. Similarly, a scale of increasing brightness leads from the dark band to the light face and hands, which represent the two focuses of the composition. The bright red of the coat also makes the figure advance. All these factors combine to a powerful, stepwise forward movement.

The three main planes overlap in the direction from far left to near right. This lateral movement toward the right is counteracted by the location of the chair, which lies mainly in the left half of the picture and thus establishes a retarding submovement toward the left. But the dominant right movement is enhanced by the asymmetrical position of the figure in relation to the chair, since the figure lies mainly in the right half of the chair. The trend toward the right is further strengthened by the unequal division of the figure, the larger part of which is on the left. (The nose divides the face in a proportion of about 5:2.) Again the eye moves in the direction of diminishing intervals—that is, from left to right. The wedge-shaped collar also sweeps toward the right.

Figure 16

Figure and chair are tilted at about the same angle relative to the frame. It will be remembered that in themselves all directions are ambiguous; so this tilt may be toward top left, or bottom right, or both. The composition as a whole, however, helps to define the direction of the movement. Both the top of the figure and the center of the bottom of the chair lie on the central vertical of the picture. This establishes for the chair an anchoring point or pivot at the bottom, around which it tilts toward the left; the head of the woman, doubly stabilized by its position on the medial vertical and in the center of the upper background rectangle, is the basis around which the body of the figure tilts forward toward the right. Thus the two focuses of the composition are set against each other. The head—where we localize the mind—reposes firmly; the hands—the instruments of labor—are thrust slightly forward in potential activity. But an ingenious counterpoint complicates the situation. The head, although at rest, contains activity in the watchful eyes and the dynamic asymmetry of the quarter profile. The hands, although moved forward, lie folded in restful symmetry.

The forward tilt of the figure is counterbalanced by the fact that, like the chair, it is solidly founded at the bottom of the picture whereas the top

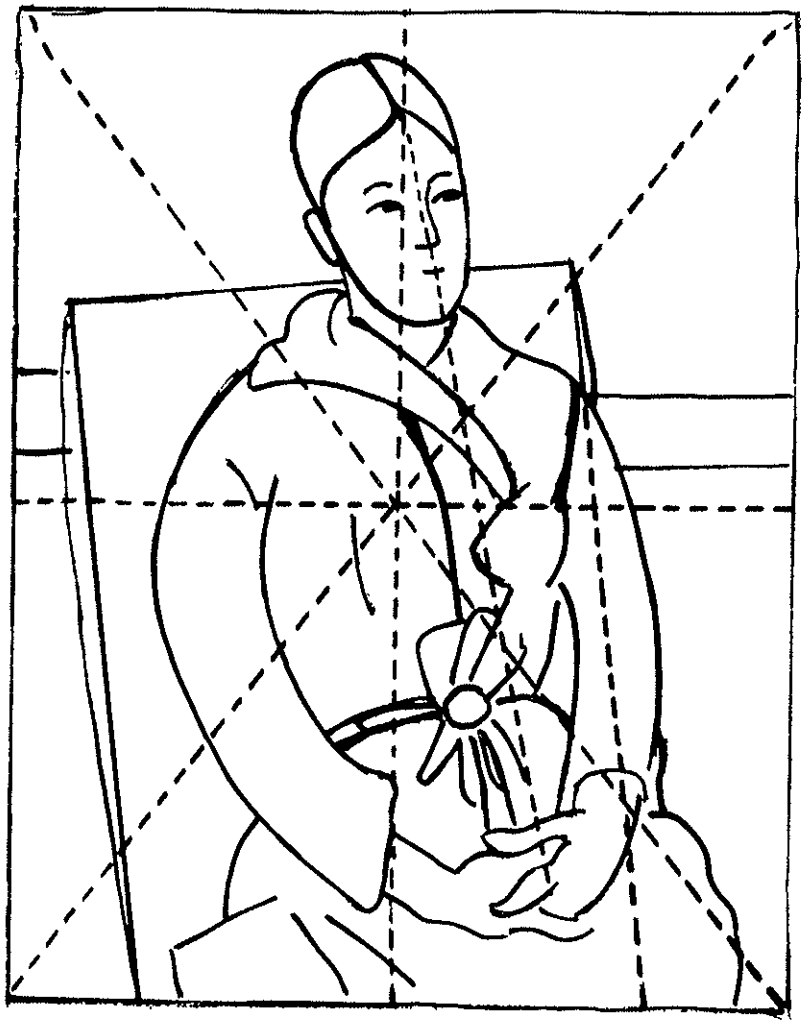

Figure 17

ends in free space. But the free rising of the head is checked not only by central location but also by its nearness to the upper border of the frame. It rises so much that it is caught by a new harbor. Just as the musical scale rises from the base of the key tone only to return to a new base at the distance of the octave, so the figure rises in the frame from the bottom base only to find new repose at the top base at the upper edge of the frame. Like the so-called "leading" tone of the scale, the head in its high location is not only as far away as possible from the bottom base of departure but at the same time captured by the new top base, which it approaches. (There is, then, a similarity between the structure of the musical scale and the framed composition. They both show a combination of two structural principles: the gradual increase of intensity by the rising from bottom to top; and the symmetry of bottom and top, by which the act of ascension from the base finally transforms itself into an upward fall toward a new base, so that withdrawal from a state of rest turns out to be the mirror image of the return to a state of rest.)

If this analysis is correct, it will not only exhibit the wealth of dynamic relationships that a work of art contains but also demonstrate that these relationships establish the particular balance of rest and activity that was earlier described as the theme or content of the picture. Only by realizing how these relationships interpret the content can we understand and appreciate their artistic excellence.

Two general remarks should be added. It will be seen that the subject matter of the picture is an integral part of the conception. Only because shapes are recognized as head, body, hands, chair, do they play their particular compositional role. The fact that the head harbors the mind is at least as important as its shape, color, or location. As an abstract pattern, the formal elements of the picture would have to be quite different to convey a similar meaning. And the observer's knowledge of what a seated, middle-aged woman signifies contributes strongly to the deeper meaning of the work.

Then too, it will have been noticed that the composition rests on a kind of counterpoint—that is, on many counterbalancing elements. But these antagonistic forces are not contradictory or conflicting. They do not create ambiguity. Ambiguity confuses the artistic statement because it leaves the observer on the edge between two or more assertions that do not add up to a whole. As a rule, pictorial counterpoint is hierarchic—that is, it sets a dominant force against a subservient one. Each relationship is unbalanced in itself; together they all balance each other in the structure of the whole work.