III FORM

"Form is the visible shape of content," wrote the painter Ben Shahn, and this is as good a formula as any to describe the distinction between shape and form I am observing in these chapters. Under the heading "Shape" I discussed some of the principles by which visual material, received by the eyes, organizes itself so it can be grasped by the human mind. Only for the sake of extrinsic analysis, however, can shape be separated from what it stands for. Whenever we perceive shape, consciously or unconsciously we take it to represent something, and thereby to be the form of a content.

Most practically, shape serves, first of all, to inform us about the nature of things through their external appearance. What we see of the shape, color, and external behavior of a rabbit tells us much about the nature of a rabbit, and the difference in appearance between a teacup and a knife indicates which object is suited to containing a liquid and which to cutting a cake. Furthermore, while the rabbit, the cup, and the knife tell us about their individual selves, each of them teaches us automatically about whole categories of things —rabbits in general, cups, and knives—and, by extension, about animals, containers, cutting tools. Thus, a shape is never perceived as the form of just one particular thing, but always as that of a kind of thing. Shape is a concept in two different ways: first, because we see every shape as a *kind* of shape (compare what was said about perceptual concepts on p. 44); second, because each kind of shape is seen as the form of whole kinds of objects. To use an example of Wittgenstein's: the line drawing of a triangle can be seen as a triangular hole, a solid, a geometrical figure; as standing on its base or hanging by its top corner; as a mountain, a wedge, an arrow, a pointer, etc.

Not all objects concentrate on telling by their shape about their own physical nature. A painted landscape has little reference to a flat piece of canvas covered with traces of pigment. A figure carved in stone reports about

living creatures, creatures that differ so much from inert pieces of marble. Such objects are made for vision only. But they, too, serve as form for whole categories of things: the painted view of the Grand Canyon reports about landscapes, the bust of Lincoln speaks of thoughtful men.

In addition, form always goes beyond the practical function of things by finding in their shape the visual qualities of roundness or sharpness, strength or frailty, harmony or discord. It thereby reads them symbolically as images of the human condition. In fact, these purely visual qualities of appearance are the most powerful of all. It is they that reach us most directly and deeply. All this will come up repeatedly in this book. But one further point needs to be made before we proceed to details. All shape, I implied, is semantic; that is, merely by being seen it makes statements about kinds of subjects. In doing so, however, it does not simply present replicas of its subjects. Not all the shapes recognized as rabbits are identical, and Dürer's picture of a rabbit is not strictly identical with any rabbit anybody has ever seen.

This fundamental condition of all imagery would not have had to be pointed out to a peasant living in the Maya's Classic age—at least, not as far as pictorial and sculptural likenesses are concerned, because the woven and ceramic images of his time differed all too obviously from the subjects they represented. The fact is less evident in our own tradition, based on centuries of more or less realistic art. Dürer's rabbit looks in fact so strikingly like a real animal that it takes enlightened inspection to discover the fundamental difference. "He was a very skillful artist," says Goethe of a painter friend of his, "and he was among the few who know how to transform artifice entirely into nature and nature entirely into art. They are exactly the ones whose misunderstood merits keep giving rise to the doctrine of false naturalness."

The doctrine to which Goethe referred long ago held, and still holds, that art aims at a deceitful illusion, and that any deviation from this mechanical ideal needs to be explained, excused, justified. It is an approach developed from some of the principles underlying Renaissance art from the fifteenth century on. If a style of picture-making fails to fit this standard—and all styles of art, modern or ancient, in practice fail more or less conspicuously to do so—the discrepancy is explained in one of the following ways. The draftsman lacks the skill to accomplish what he wants to do; he depicts what he knows rather than what he sees; he blindly adopts the pictorial conventions of his peers; he perceives wrongly because of defects in his eyes or his nervous system; he applies the correct principle from an abnormal point of view; he deliberately violates the rules of correct representation.

This illusionistic doctrine, as I would call it, continues to produce a great

deal of misleading interpretation. Therefore it cannot be said strongly enough, or often enough, that *image-making, artistic or otherwise, does not simply derive from the optical projection of the object represented, but is an equivalent, rendered with the properties of a particular medium, of what is observed in the object.*

The illusionistic doctrine springs from a double application of what is known in philosophy as "naive realism." According to this view, there is no difference between the physical object and the image of it perceived by the mind; the mind sees the object itself. Similarly, the work of a painter or sculptor is considered simply a replica of the percept. Just as the table seen by the eye is supposed to be identical with the table as a physical object, so the picture of the table on the canvas simply replicates the table the artist saw. At best, the artist is able to "improve" reality or enrich it with creatures of fantasy, by omitting or adding details, selecting suitable examples, rearranging the given order of things. As an example, we may cite Pliny's famous anecdote, so widely quoted in Renaissance treatises. The Greek painter Zeuxis, unable to find any one woman beautiful enough to serve as a model for his painting of Helen of Troy, "inspected the maidens of the city naked and chose out five, whose peculiar beauties he proposed to reproduce in his picture."

The manipulations ascribed to the artist by this theory might be called "cosmetic," because in principle they could be performed just as well on the model object itself. The procedure reduces art to a kind of plastic surgery. Illusionists are oblivious to the fundamental difference between the world of physical reality and its image in paint or stone.

Orientation in Space

What I have just said about the form of images refers specifically to representation in particular media, whether two-dimensional or three-dimensional. However, there are characteristics of form that come into play even in ordinary perception when we recognize or fail to recognize an object as itself or as one of its kind. The appearance of a particular object does not remain always the same, and an individual specimen does not look exactly like all other members of the same species. We therefore have to ask: what conditions must visual form meet for an image to be recognizable?

To start with a relatively simple factor, how important is spatial orientation? What happens when we see an object not right-side-up, but in an unfamiliar position?

The identity of a visual object depends, as was previously shown, not so much on its shape as such as on the structural skeleton created by the shape.

A lateral tilt may not interfere with such a skeleton, but then again it may. When a triangle or rectangle is tilted (Figure 75*a*), it does not become a different object. One sees it merely as deflected from its more normal position. This was strikingly demonstrated many years ago in experiments by Louis Gellermann, in which young children and chimpanzees were confronted with variations of a familiar triangle. When the triangle was turned sixty degrees, the children as well as the animals turned their heads by the same angle to re-establish the "normal" orientation of the figure.

If, however, one tilts a square by a similar angle it changes into a completely different figure, so different that it acquires a name of its own—diamond or rhombus (Figure 75*b*). This is so because the structural framework has not shifted with the figure. A new symmetry lets the vertical and horizontal axes pass through the corners, thereby placing the accents of the figure on the four points and transforming the edges into oblique roof shapes. Visually we are dealing with a new figure, a pointed, more dynamic, less stably rooted thing.

This may lead to misunderstandings when an experimenter unquestioningly bases his evaluations on a materialistic definition of sameness. He may cut a square from a piece of cardboard and show it to children in different positions, asking: Is this the same square? Until about age seven, children deny that the tilted figure is the same square. The rash experimenter may conclude that the child, misled by mere appearance, has failed to acknowledge the correct state of affairs. But was the child referring to the piece of cardboard or to the visual object? And who has decreed that sameness is to be based on material rather than visual criteria? Certainly any artist would protest.

Spatial orientation presupposes a frame of reference. In empty space, pervaded by no forces of attraction, there would be no up and down, no straightness or tilt. Our visual field provides such a framework—"retinal orien-

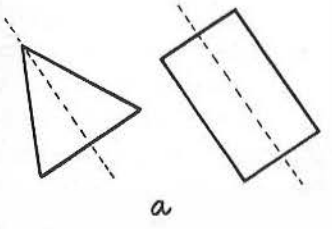

Figure 75*a*

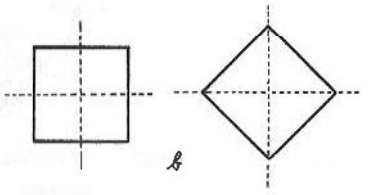

Figure 75*b*

tation," I called it earlier. When the children and chimpanzees cocked their heads, they eliminated the tilt of the figure in relation to their visual field. But there is also "environmental orientation." When a painting on the wall hangs crookedly, we see the tilt even though we may tilt our heads correspondingly, as long as we refer the picture to the framework of the walls. Within the narrower world of the painting itself, however, the verticals and horizontals of the frame determine the two basic axes. In Figure 76, taken from an investi-

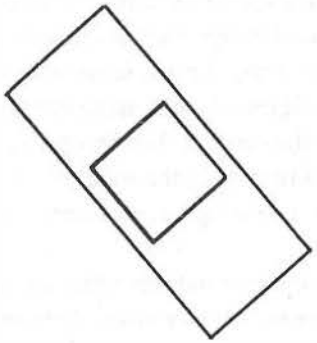

Figure 76

gation of space perception by Hertha Kopfermann, the inner figure, under the influence of the tilted frame, tends to look like a tilted square, although by itself or within a vertical or horizontal frame, it looks like an upright diamond. In Figure 77, which comes from the ornamentation of a tablecloth in a Picasso still life, the diamonds have a tendency to look parallel to one another although objectively they differ in orientation. Children often draw the chimney perpendicular to the inclined edge of the roof even though this adherence to the more specific framework puts the chimney in an oblique position. As a rule, then, the spatial orientation of units in a picture is determined by a number of

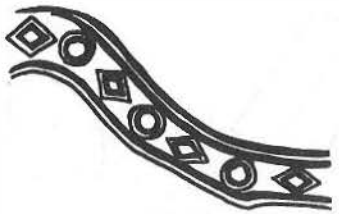

Figure 77

different influences. If a face is turned sideways, the nose will be perceived as upright in relation to the face but as tilted relative to the entire picture. The artist must see to it not only that the desired effect prevails, but also that the strength of the various local frames of reference is clearly proportioned; they must either compensate one another or be subordinated to one another hierarchically. Otherwise the viewer will be confronted with a confusing crossfire. Note the disturbingly indeterminate orientation of the central line in Figure 78.

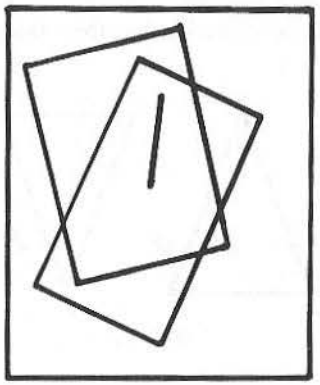

Figure 78

In addition to the coordinates of the retinal field and those of the visual environment, a third framework of spatial orientation is provided kinesthetically, by the muscular sensations in the body and the organ of equilibrium in the inner ear. In whatever position our body or head or eyes may be, we sense the direction of gravitational pull. In daily life these kinesthetic sensations are usually in harmony with those derived from the visual framework of the environment. But when one looks up at a tall building, even the awareness of the tilted head may not be quite sufficient to compensate for the apparent backward tilt of the facade; and when the same view appears on a movie screen, the observer's upright posture together with the upright picture frame make the photographed world look tilted.

Experiments by Herman Witkin have shown that people vary markedly in how much their spatial orientation relies on the visual sense and how much on the kinesthetic. The more visually responsive persons, taking their cues from the outside world, were found to be more generally outer-directed, more dependent on standards of the environment, whereas the more kinesthetically

responsive persons, listening to the signals from within their bodies, seemed to be more inner-directed, following their own judgment rather than the tenets of the world.

So far I have referred to examples of moderate tilt, which often leaves the structural skeleton essentially unaltered. A turn of ninety degrees tends to interfere with the character of visual shapes more drastically by causing the vertical and the horizontal to exchange places. When a violin or sculpted figure is seen lying on its side, the symmetry axis loses much of its compelling strength, and the shape points in a lateral direction like a boat or arrow. Even more radical is the change when the object is turned upside down. The two figures in Figure 79 are both triangular but their shapes differ. Version *a* rises

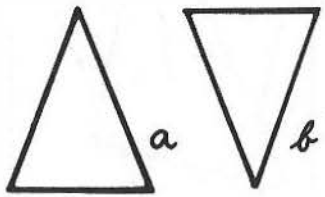

Figure 79

from a stable basis to a sharp peak; in version *b* a broad top balances heavily and precariously on a pointed foot.

These are dynamic changes, due to the direction of gravitational pull. The effect is greatest in objects for which dynamic expression determines visual identity most strongly, notably the human face. In surrealist films, faces are sometimes shown upside-down. The effect is frightening: even though we know better, visual evidence insists that we are seeing a new kind of face, a monstrous variation dominated by the blind opening of the mouth, thrusting forward with the raised prow of the nose, and displaying at the base two rolling eyes, cradled in baggy lids, which close upward.

To be able to recognize objects regardless of their spatial position is, of course, advantageous. Young children seem to handle picture books with little consideration of whether the illustrations are right-side-up or upside-down; and it used to be assumed that quite generally the spatial orientation of objects did not matter either to children or to primitive tribesmen. Recent experiments have indicated, however, that under certain conditions pictures projected on the wall are more easily recognized by the young child when they are right-side-up, and that this difference tends to become irrelevant when the child

reaches school age. At this point we cannot be certain just how much the recognition of visual objects is influenced by the modifications of perceptual appearance accompanying change of spatial orientation.

In any case, to observe the spatial orientation of objects in the physical world is one thing; to draw pictures of them is quite another. This is particularly true for young children. In the physical world they observe buildings, trees, and cars rooted to the ground, and they would be surprised to see people or animals standing on their heads. The empty space of the drawing paper, however, imposes no such constraints, and in the beginning one spatial orientation seems to be as good as any other, e.g., for the depicting of human figures. Spatial orientation is not yet differentiated. Only gradually does the "correct" upright position impose itself, for reasons yet to be explored. One of them must surely be that under normal conditions, the retinal projection obtained from the upright picture corresponds to the one received when the child looks at the physical model. Furthermore, it is true even for the simple pictures produced by children that the one-sidedness of the gravitational pull introduces the distinction between up and down, which enriches our visual world both physically and symbolically. When modern painters or sculptors create works that can be looked at validly in any spatial position, they pay for this freedom by settling for a relatively undifferentiated homogeneity.

Projections

In the examples of spatial orientation thus far discussed one might have expected no change of visual identity since geometric shape had remained unaltered. Instead we noted that under certain conditions a new orientation will bring to the fore a new structural skeleton, which gives the object a different character. Turning now to deviations that involve a modification of geometric shape we find that "non-rigid" change may or may not interfere with the identity of the pattern, depending on what it does to the structural skeleton.

Cut a fairly large rectangle of cardboard and observe its shadow cast by a candle or other small light source. Innumerable projections of the rectangle can be produced, some of them looking like the examples of Figure 80. Figure 80*a*, obtained by placing the rectangle exactly at right angles to the direction of the light source, resembles the object very closely. All other angles of projection lead to more or less drastic deviations of appearance. Figure 80*b*, though devoid of symmetry and right angles, is readily seen as an undistorted rectangle, tilted in space. Here again the principle of simplicity is at work. Whenever a three-dimensional version of a figure is sufficiently stabler and

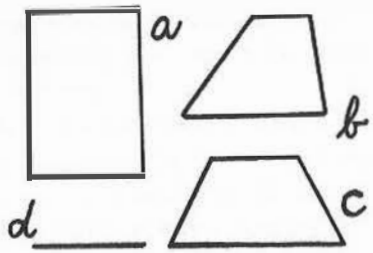

Figure 80

more symmetrical than the flat projection, the observer will tend to see the simpler shape, extended in depth. Figure 80*c* is much less likely to be seen as the projection of the rectangle which in fact it is. As a flat upright, it has a vertical symmetry of its own. It is a rather simply shaped regular trapezoid, and the tension created by the unequal angles is compensated within the plane. Its structural skeleton does not point to a rectangle.

Figure 80*d*, finally, is no longer a projection of the rectangle at all, but rather one of the thickness of the piece of cardboard. One can understand intellectually that this view, too, is derived from our object, but the deviation can no longer be *seen.* This problem, specific to the perception of three-dimensional objects, will be taken up again shortly.

Looking at projections has confronted us with the phenomenon known as the *constancy of shape and size.* More often than not, perceptual constancy is interpreted by textbooks of psychology in a misleadingly simplified fashion. It is pointed out, correctly, that if we saw physical objects the way they are projected on the retinas of the eyes, they would undergo dreadful amoebic transformations of shape and size every time the objects changed their position toward us or we changed our position toward them. Fortunately this does not happen. The percept produced by the brain from the retinal projection is such that we see the object as it *is* physically. Asked what he sees when shown the shadow of our tilted cardboard rectangle, a person will tell us that he *sees* a rectangle of constant, stable shape. Asked to draw a picture of it, he may well draw a rectangle.

All this is true enough, but the impression often given is that this particular "correction" of the stimulus pattern occurs automatically and universally, although not quite completely, and that it is due either to an inborn mechanism, which requires no further explanation, or to accumulated experience, which corrects the faulty retinal input on the basis of better knowledge. Experiments such as those by T. G. R. Bower have shown that infants between

two and twenty weeks of age discriminate among test objects, e.g., cubes, according to their objective size, and see tilted rectangles as rectangles and not according to the shape of their retinal projection. This shows that at least the elements of shape and size constancy are already present at an early age. However, this is not really the main point of interest.

Another glance at Figure 80 reminds us that by no means all projections are perceived according to objective shape, and the same is true for size. All depends on the particular nature of the projection and the other conditions prevailing in the given situation. Depending on these conditions, there may be compelling constancy, or none at all, or some intermediate effect. No matter whether constancy processing is inherent in the nervous system or acquired by experience, there must be in either case an intricate mechanism equipped to deal with the input data appropriately. We need to know two things: (1) what kind of projection leads to what kind of percept, and (2) by what principles operate the mechanisms that do the processing?

What matters to the artist in particular is to know which shapes will produce which effect. He can acquire this knowledge by studying the principles at work in shape perception. To be sure, the visual conditions prevailing in daily life are by no means identical to those prevailing in a drawing or painting. Instead of the isolated projections picked out in Figure 80, for example, in the physical environment one more commonly experiences whole sequences of continuously changing projections, and this increases the constancy effect considerably. When the cardboard square shifts gradually from position to position, momentary projections support and interpret one another. In this respect, immobile media such as drawing, painting, or photography are quite different from the mobile ones. A projection that, frozen in its momentary aspect, looks compelling, mysterious, absurd, or unrecognizable passes by unnoticed as a mere phase in a sequence of changes when an actor moves on the stage or in a film, or when the camera or a human observer moves around a piece of sculpture. In experiments on the shape and depth perception of infants, a most influential factor proved to be the motion parallax, i.e., the changes of spatial appearance caused by the movements of the viewer's head.

Figure 80*a* indicated that as long as we deal with a flat object, such as a cardboard rectangle, there exists one projection that does such complete justice to the visual concept of the object that the two can be considered identical—namely, the orthogonal projection, obtained when the plane of the object is hit by the line of sight at a right angle. Under this condition, the object and its retinal projection have roughly the same shape.

The situation is much more complicated with truly three-dimensional

things, because their shapes cannot be reproduced by any two-dimensional projection. It will be recalled that the projection on the retina is created by light rays that travel from the object to the eye along straight lines, and that consequently, the projection renders only those areas of the object whose straight-line connection with the eyes is unobstructed. Figure 81 shows how the selection and relative position of these areas change in the example of a cube (*b*, *c*, *d*), depending on the angle at which the observer (*a*) sees it. The corresponding projections are indicated approximately in *b'*, *c'*, *d'*.

Here again, as the projection changes, the observer should be expected to see the shape of the object change accordingly. The sickening sensation produced by a distorting mirror should be the normal visual reaction to most objects most of the time. This would interfere with the practical business of life since the immutable physical object would be represented by a constantly changing image. Once more, "constancy of shape" comes to the rescue. We must ask, however, what is it that remains constant since a three-dimensional solid cannot be truly represented by any flat projection?

Which Aspect is Best?

The visual concept of the object derived from perceptual experiences has three important properties. It conceives of the object as being three-

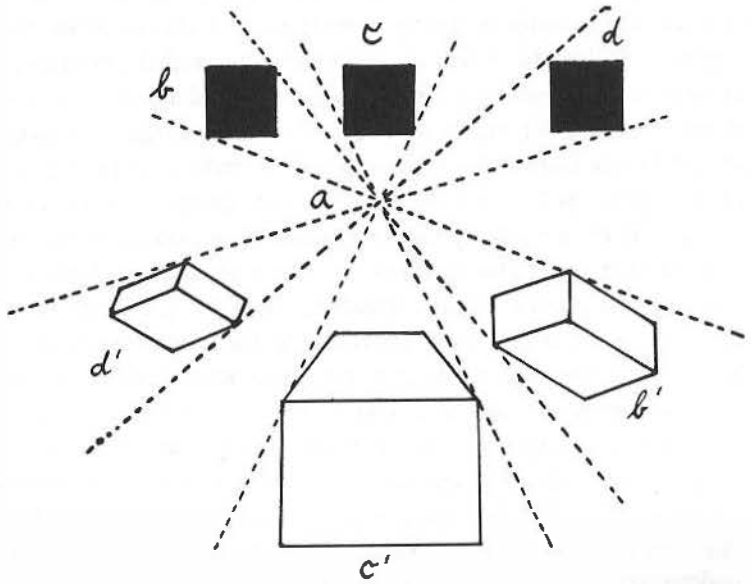

Figure 81

dimensional, of constant shape, and not limited to any particular projective aspect. Examples can be found in Francis Galton's investigations of visual imagery. He asserts that "a few persons can, by what they often describe as a kind of touch-sight, visualize at the same moment all round the image of a solid body. Many can do so nearly, but not altogether round that of a terrestrial globe. An eminent mineralogist assures me that he is able to imagine simultaneously all the sides of a crystal with which he is familiar." Galton's examples serve to show what is meant by a three-dimensional concept, which is not bound to any one aspect. If a person has an all-around concept of a crystal or a globe, no one point of observation predominates. This is so because a person's visual concept of an object is generally based on the totality of observations from any number of angles. Yet it is a visual concept, and not a verbal definition obtained by intellectual abstraction. Intellectual knowledge sometimes helps form a visual concept, but only to the extent that it is translatable into visual attributes.

Visual concepts must be distinguished also from so-called eidetic memory images, which make it possible for some persons to project upon an empty surface an exact replica of a scene they have perceived before, e.g., to read details on a geographic map as though the map were still in front of their eyes. Eidetic images can be described as physiological vestiges of direct stimulation. In that sense one can compare them with afterimages, although they can be scanned by eye movements, which is not true for afterimages. Eidetic images are substitute percepts and as such mere raw material for active vision; they are not constructs of the formative mind like visual concepts.

Strictly speaking, the visual concept of anything that has volume can be represented only in a three-dimensional medium, such as sculpture or architecture. If we wish to make pictures on a plane surface, all we can hope to do is to produce a translation—that is, to present some structural essentials of the visual concept by two-dimensional means. The pictures achieved in this way may look flat like a child's drawing or have depth like those obtained with a stereoscope or holograph, but in both the problem remains that the all-aroundness of the visual conception cannot be reproduced directly in a single plane.

If we look at a human head from some particular angle we realize that any aspect, however well-selected, is arbitrary in two ways: it creates contours where none exist in the object, and it excludes some parts of the surface while displaying others. An art student, drawing from the model, grapples with the problem of how to convey the continuity of roundness. He is tempted to take the arbitrary contour literally and to produce the image of a shield rather than

a volume. William Hogarth, in his *Analysis of Beauty*, describes the dilemma eloquently: "But in the common way of taking the view of any opaque object, that part of its surface which fronts the eye is apt to occupy the mind alone, and the opposite, nay even every other part of it whatever is left unthought of at that time; and the least motion we make to reconnoiter any other side of the object confounds our first idea, for want of the connexion of the two ideas, which the complete knowledge of the whole would naturally have given us, if we had considered it in the other way before."

How arbitrarily any view selects the portions visible in the projective image becomes most evident when we learn how much trouble the "hidden-surface problem" gives the practitioners of computer graphics. The image of a wire frame model of a solid can be rotated and distorted by the computer with relative ease. If the solid's transparent body is given in a certain position, the computer can show it from the back or from the top, thus saving today's architects much labor. But when it comes to simulating the actual look of the opaque solid from a given viewpoint, it is no longer sufficient to manipulate the properties of the solid itself. Arbitrary effects are always hard to calculate. The computer must determine the interaction between the spatial system of the object and the projective system imposed upon it—an expensive, time-consuming operation.

Once we put up with reducing a volume to one of its aspects, we must decide which view to select for any particular purpose. For some objects all aspects are equal or equally good—for example, a sphere or an irregularly shaped piece of rock. Usually, however, there are definite distinctions. In a cube the orthogonal projection of any surface dominates. In fact, oblique aspects of the surface are seen as mere deviations from the square-shaped one. This distinction is based on the law of simplicity. The dominant projections are those which produce patterns of the simplest shape.

Are these simplest and perceptually preferred aspects best suited to convey the visual concept of the three-dimensional object? Some of them are. Our visual concepts of many objects are characterized by structural symmetries, which are brought out most directly by certain aspects of the object. Thus a straight front view of a human figure displays this striking feature. But an undistorted sideface of a cube can be shown only at the price of hiding all the others. Or consider Figure 82. It is surely the simplest possible representation of a Mexican wearing a large sombrero. Yet such a view would be used only as a joke, which results precisely from the contradiction between the representation's indisputable correctness and its patent inadequacy. The picture is

certainly faithful—a similar view can be obtained photographically from a third-floor hotel window—but it is inadequate for most purposes because it does not distinguish a Mexican from a millstone or a doughnut. The structural skeleton of Figure 82 is too slightly related to the structure of the visual concept to be conveyed; instead it creates other, misleading associations.

The example reminds us that for some special purpose, the draftsman may deliberately choose a view that misleads and hides rather than informs. Early stages of pictorial representation avoid any such concealment. They aim for the clearest and most direct sight, and so do all illustrations aimed at straight instruction. At levels of higher sophistication, back views, tilted heads, and the like are admitted for the enrichment they bring to the spatial conception.

The elementary task of depicting on a surface the main properties of an object's shape is a difficult one. Should the portrait of a given person show the front-face view or the profile? G. K. Chesterton speaks of "one of those women whom one always thinks of in profile, as of the clean-cut edge of some weapon." Police records require both views, as do anthropometric studies, because important characteristics often show up in one view and not in the other. Alberto Giacometti once said jokingly to a man whose portrait he was painting: "Full face you go to jail, and in profile you go to the asylum." A further complication is introduced when some parts of an object show best from one angle whereas others do so from another. The typical shape of a bull is conveyed by a side view, which, however, hides the characteristic lyre pattern of the horns. The wingspread of a flying duck does not show in profile. The angle that must be chosen to identify the goblet and stem of a wineglass destroys the circularity of the mouth and foot. The problems multiply with combinations of objects: how can a pond, whose undistorted outline is revealed

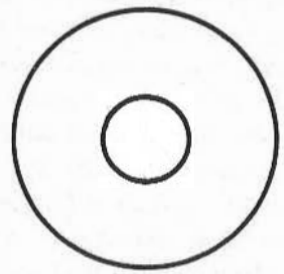

Figure 82

only through a birdseye view, and trees, which display their typical shape in profile, be shown in the same picture?

Take an apparently simple object—a chair (Figure 83). The top view (*a*) does justice to the shape of the seat. The front view (*b*) shows the shape of the

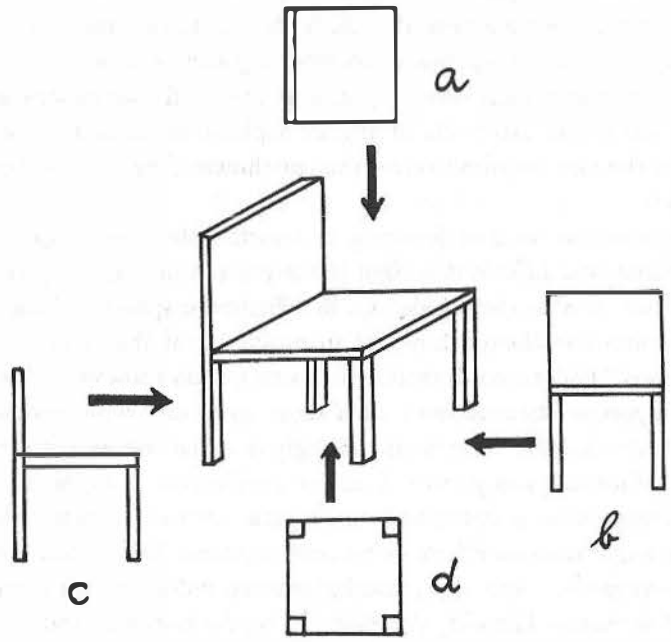

Figure 83

chair's back and its symmetrical relation to the front legs. The side view (*c*) hides almost everything, but gives the important rectangular arrangement of back, seat, and legs more clearly than any other view. Finally, the bottom view (*d*) is the only one to reveal the symmetrical arrangement of the four legs attached to the corners of the square seat. All this information is indispensable and feeds into the normal visual conception of the object. How can it be conveyed in one picture? No more eloquent demonstration of the difficulty can be given than the drawings of Figure 84, derived from findings by Georg Kerschensteiner. These drawings schematically present types of solutions worked out by school children who had been asked to reproduce from memory "a three-dimensional picture of a chair drawn in correct perspective."

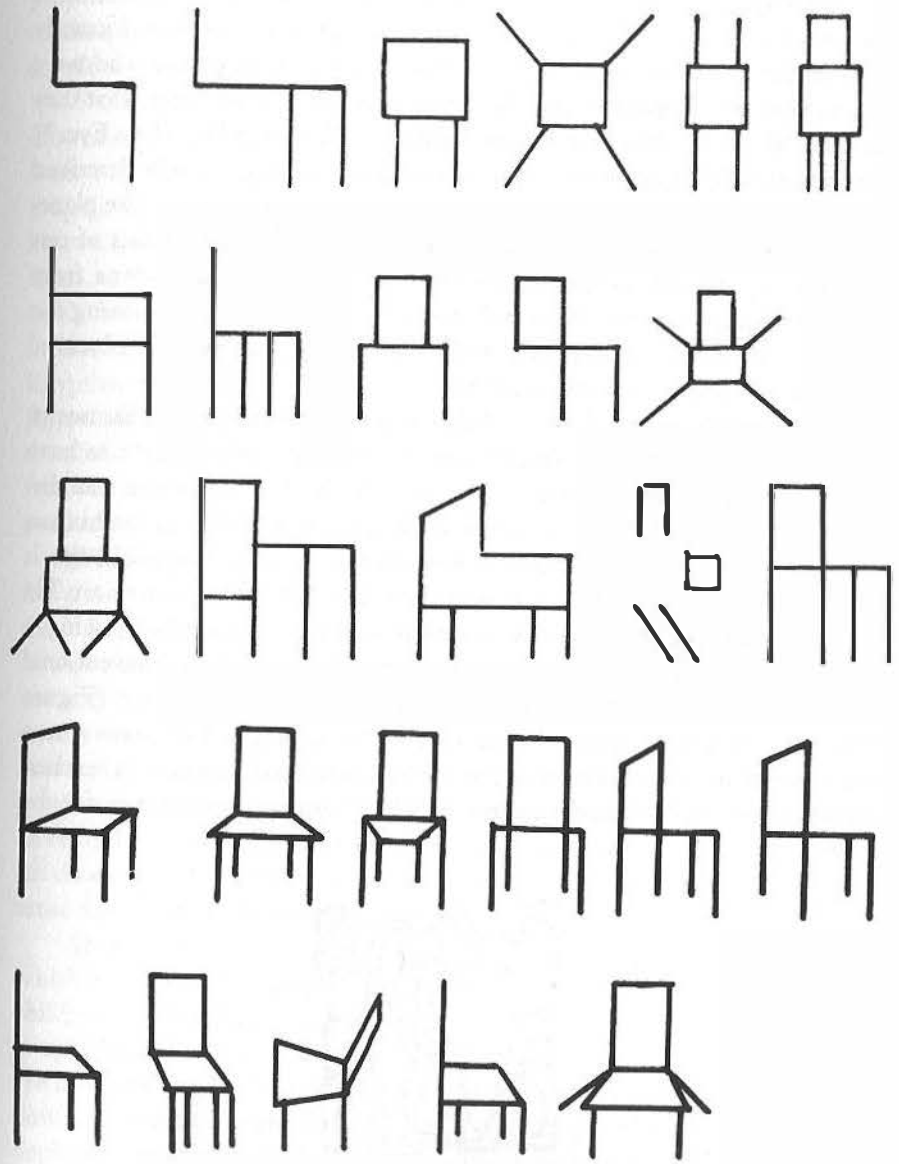

Figure 84

The Egyptian Method

One solution of the problem is best exemplified in the wall paintings and reliefs of the Egyptians and in the drawings of children. It consists in choosing for each part of an object or combination of objects the aspect that best suits the pictorial purpose. The pictures obtained by this procedure were formerly condemned, or at best tolerated, as the inferior creations of people who were incapable of doing better or who drew what they knew rather than what they saw. In 1867, Ernst Mach in a popular lecture on "Why Has Man Two Eyes?" observed that the principle employed by the Egyptians might best be described by saying that their figures are pressed in the plane of the drawing like plants in a herbarium. Only when similar methods were adopted by artists of our own century did theorists begin hesitantly to realize that deviations from correct projection are not due to such operations as twisting or squashing the faithfully perceived object, but are freely invented equivalents of the observed shape in the two-dimensional medium.

The Egyptians—as well as the Babylonians, early Greeks, and Etruscans, who used a similar style of representation—were commonly thought to have avoided foreshortening because it was too difficult. This argument was disposed of by Heinrich Schäfer, who showed that the side view of the human shoulder occurs in a few examples as early as the Sixth Dynasty, although it continued to remain an exception throughout the history of Egyptian art. He cites two examples of reliefs that represent workmen chiseling or towing a stone statue; the shoulders of the living men are given in the conventional front view, but the statue has the perspectively "correct" side view (Figure 85). Thus, in order to express lifeless rigidity the Egyptians had recourse to a procedure that, in the opinion of the average nineteenth-century art teacher, created the much more lifelike effect. Schäfer further points out that, for the

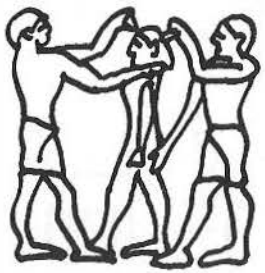

Figure 85

purpose of carving a sphinx, elevations were drawn on the sides of the rectangular block at least as early as 1500 B.C. and probably earlier. Naturally, projective drawing was required for these elevations.

It is evident, therefore, that the Egyptians used the method of orthogonal projection not because they had no choice, but because they preferred it. This method permitted them to preserve the characteristic symmetry of chest and shoulders and the front view of the eye in the profile face.

Pictorial representation is based on the visual concept of the total three-dimensional object. The method of copying an object or arrangement of objects from one fixed point of observation—roughly the procedure of the photographic camera—is not truer to that concept than the method of the Egyptians. Drawing or painting directly from the model is quite rare in the history of art. Even in the epoch of Western art that began with the Italian Renaissance, work from the model is often limited to preparatory sketches and does not necessarily result in mechanically faithful projection. When the figures in Egyptian art look "unnatural" to a modern observer, it is not because the Egyptians fail to present the human body the way it "really is," but because the observer judges their work by the standards of a different procedure. Once freed of this distorting prejudice, one finds it quite difficult to perceive the products of the "Egyptian method" as wrong.

What is required of the viewer is much more than enlightened tolerance for a method that has been "superseded by the discovery of correct perspective." Rather he must realize that there are different solutions to the problem of representing three-dimensional objects in a two-dimensional plane. Each method has its virtues and its drawbacks, and which is preferable depends on the visual and philosophical requirements of a particular time and place. It is a matter of style. Compare Figures 86 and 87. Figure 87 is a tracing after a painting of Oskar Schlemmer. Drawn in rough accordance with the rules of central perspective, it corresponds in that respect to what a camera would set down if such a scene were taken from a particular station point. In this sense the picture is quite realistic.

An advocate of the traditional realistic method would object to Figure 86, which indicates schematically how a similar scene would be represented in children's drawings and early forms of art. He would point out that the table is upright rather than horizontal, that foreground and background figures are the same size, and that one figure is lying sideways and another is upside-down. However, a partisan of this early method would object to Figure 87, deploring the representation of a rectangular table as a crooked trapezoid. He would point out that the three figures, objectively of equal size, vary in the

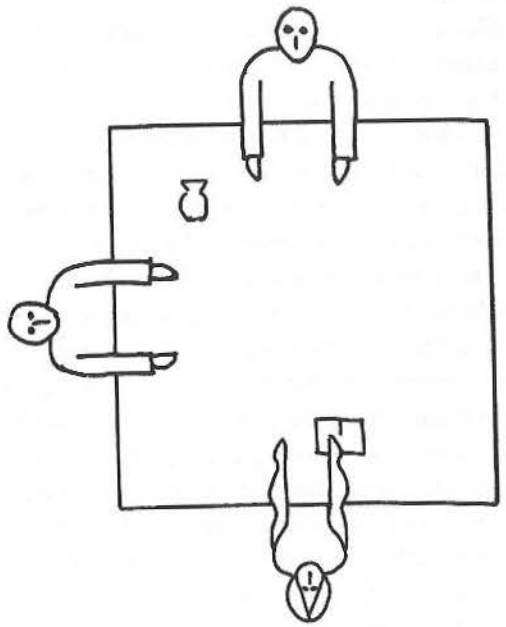

Figure 86

Figure 87

picture from giant to dwarf. Although all three should be in the same relation to the table, one is shown frontally, the second in profile, the third from the back; two figures are intersected by the table, whereas the third covers much of the table top with his own body and rubs shoulders with his neighbor, supposed to be seated at some distance. Nothing could be less realistic than such a crazily distorted picture.

Our *naïf* will show little appreciation for the fact that the distortion of size and shape makes possible a strong depth effect, or that the projection offers an interpretation of the scene from the viewpoint of one particular spatial location. Nor will he acknowledge that the alteration of sizes, angles, and shapes creates a witty and fascinating variation of the objective situation. Instead, he will tell the practitioner of perspective distortion that deplorably he has lost all the natural sensitivity to the requirements of the two-dimensional medium he had possessed as a child.

The apparently modest request that a picture reproduce the structural skeleton of a visual conception apparently has disturbing consequences. The *naïf* fulfills this demand to the letter by matching squareness with squareness, symmetry with symmetry, location with location.

Now it is true that the perspectively distorted drawing of the square looks like a square not only to the grown-up Westerner, but also to his child and to a "primitive" if he is able to look at the perspective drawing not as a surface decoration but as the real object. Schäfer reports the experience of an artist who was sketching the house of a German peasant while the owner watched him. As he was drawing the oblique lines required by perspective, the peasant protested: "Why are you making my roof so crooked—my house is quite straight!" But when he later saw the picture finished, he admitted with surprise: "Painting is a strange business! Now it is my house, just the way it is!"

The puzzle of perspective representation is that it makes things look right by doing them wrong. There is an important difference between the two procedures discussed here. The primitive or child accounts for the squareness he sees in reality with an actual square in the picture, a method that greatly strengthens the direct impact of the shape. He actually makes it be what it suggests it is. Perspective distortion, to be sure, is compensated in perception by the "constancy" of size and shape, but there is a weakening indirectness about this method. The distorted stimulus pattern, which gives rise to the experience, influences the percept even though the viewer may not be aware of it and be unable to realize or copy it. This is particularly true for flat pictures —even the most "lifelike" ones—because the depth effect is diminished and therefore constancy of shape is quite incomplete.

The power of all visual representation derives primarily from the properties inherent in the medium and only secondarily from what these properties suggest by indirection. Thus the truest and most effective solution is to represent squareness by a square. There is no question that in relinquishing this directness, Western art has suffered a serious loss. It has done so in favor of new virtues of realism and expression, which were more important to the men who developed perspective art than the qualities they had to relinquish.

Foreshortening

Both methods, Egyptian and Western, make particular two-dimensional aspects represent complete solids. Whether perspectively distorted or rectangular, the table top stands for a whole table. In order to fulfill this function an aspect should meet two conditions. It should indicate that in itself it is not the complete thing but only a part of something larger; and the structure of the whole it suggests should be the correct one. When we look at a cube head on, there is nothing in the perceived square to show that it is part of a cubic body. This may make it unsatisfactory as a projection, although it may be acceptable as a pictorial equivalent.

According to a rule in perception—again an application of the principle of simplicity—the shape of the perceived aspect (i.e. the projection) is taken spontaneously to embody the structure of the whole object. If we are shown a flat square, we see it as one aspect of a flat board. The same is true for a disk, which we see as part of a disk-shaped board. If the circular object is rounded, however—for example, by means of shading—we see it as part of a sphere. This may very well be misleading. The rounded object may be the bottom of a light bulb. Even so, perception automatically completes the whole body according to the simplest shape compatible with the perceived projection.

This perceptual tendency often produces satisfactory results. A sphere is in fact what any of its aspects promise it to be. To some extent this is true also for the human body. The whole volume roughly bears out what the front view suggests. No basic surprises emerge when the body is turned; nothing essential is hidden. Within obvious limits, the shape of the projection embodies the law of the whole.

This was not true for the drawing of the Mexican (Figure 82), where the law of completion suggested a disk-shaped object. Nor is it true in a straight front view of a horse, like the one in Figure 88, taken from a Greek vase. Knowledge may tell us that this is a horse, but contrary perceptual evidence overrules—and should always overrule in the arts—such knowledge, and tells us that this is a penguin-shaped creature, a monstrous horse-man. Atypical

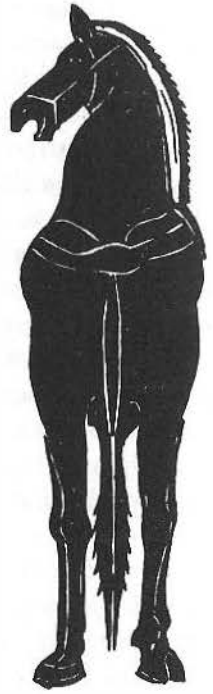

Figure 88

front views of this kind are artistically risky, though they are sought out sometimes precisely for this reason.

The term "foreshortening" can be used in three different ways: (1) It may mean that the projection of the object is not orthogonal—that is, its visible part does not appear in its full extension but projectively contracted. In this sense, a head-on front view of the human body would not be considered foreshortened. (2) Even though the visible part of the object is given in its full extension, an image can be described as foreshortened when it does not provide a characteristic view of the whole. In this sense, the bird's-eye-view of both the Mexican and the Greek horse are foreshortenings, but not in a truly perceptual and pictorial sense. It is only our knowledge of what the model object looks like that makes us regard these orthogonal views as deviations from a differently shaped object. The eye does not see it. (3) Geometrically, every projection involves foreshortening, because all parts of the body that do not run parallel to the projection plane are changed in their proportions or disappear partly or completely. Delacroix notes in his journals that there is

always foreshortening, even in an upright figure with its arms hanging downward. "The arts of foreshortening and of perspective are one and the same thing. Some schools of painting have avoided foreshortenings, truly believing that they did not use any because they were using no violent ones. In a profile head, the eye, the forehead, etc., are foreshortened, and so it goes everywhere."

Projective contraction always involves an oblique position in space. What Max Wertheimer used to call the *Dingfront*, or "façade," of the object is seen as turned, and the given projection appears as a deviation from that "façade." Obliqueness provides visual evidence that different parts of the object lie at different distances from the observer. At the same time it preserves direct perception of the structural pattern from which the projection deviates. The foreshortening of a face, brought about by a turn to an oblique position, is not perceived as a pattern in its own right but as a mere variation of the frontal symmetry. No trace of that symmetry is left in a straight profile view, which is why the profile is not generally thought of as a foreshortening. The profile has a structure of its own.

It seems best, then, to call a pattern foreshortened when it is perceived as a deviation from a structurally simpler pattern, from which it is derived by a change of orientation in the depth dimension. Not all projective contractions succeed in making clear the structural pattern from which they deviate. A number of perceptual problems are involved here, of which I shall mention only a few. If, for example, the projective pattern has a simple shape, this simplicity will tend to interfere with its function because the simpler the shape of a two-dimensional pattern, the more it resists being perceived three-dimensionally—it tends to look flat. It is difficult to see a circle as a foreshortened ellipse or a square as a foreshortened rectangle. In Figure 89 the top view of a sitting man is foreshortened into a square-shaped projection. Owing to its squareness, the figure displays great stability in the plane and resists

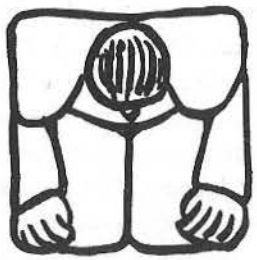

Figure 89

decomposition into a three-dimensional object. The conditions for subdivision in plane figures apply also to the third dimension.

Contractions along symmetry axes must be handled with caution. A face seen from below (Figure 90) produces a much more compelling distortion than an oblique view from the side. This is so because the symmetrical view looks "frozen," much more stable in itself. The asymmetrical side view clearly implies the "normal" front view from which it deviates, whereas the foreshortened front view has a dangerous tendency to look like a squashed creature in its own right. The same holds true for symmetrical bird's-eye and worm's-eye views of whole figures. Such "abnormal" views are rare in the arts, and in the most famous of them—Mantegna's picture of the dead Christ—the fossilizing effect of the symmetry is mitigated by the sideward leaning of head and feet.

Another problem comes up frequently in the foreshortening of inward-bent forms, when the continuity of the body is replaced in the projection by discontinuous, overlapping units. The dropping out of the hidden parts,

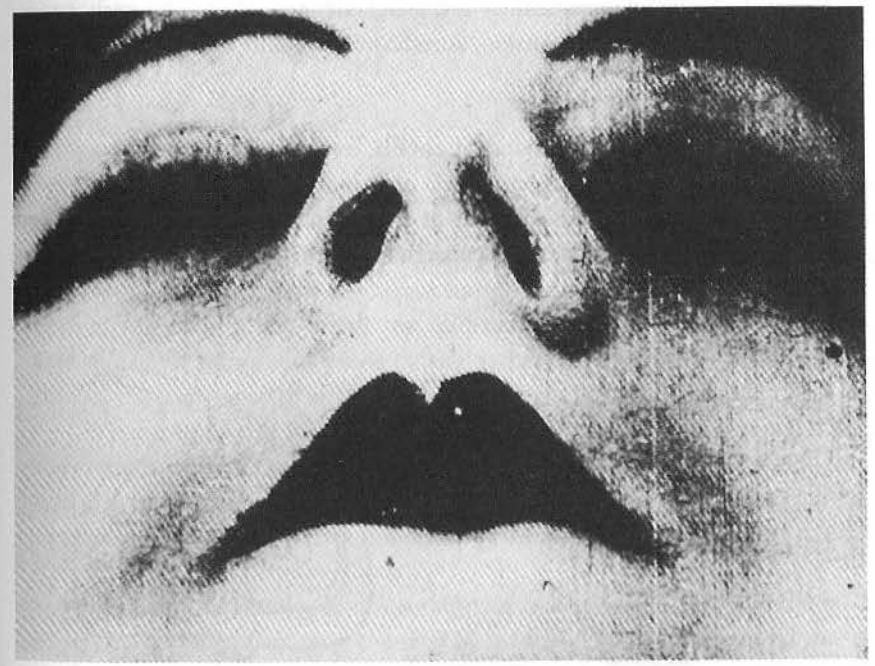

Figure 90
Fernand Léger. From *Ballet Mécanique*, 1924.

together with the change from continuity to discontinuity, produces a strong interference with the underlying visual concept. In Figure 91*b*, one of two figures roughly traced from Picasso drawings, a contour line leads without interruption from the left buttock to the foot. This same outline is interrupted in Figure 91*a*. More like a fugue than a linear melody, the drawing presents a sequence of overlaps, held together by the artist's skill in such a way that despite local leaps, the eye fuses the steps into a coherent whole. In bad drawing, it is precisely at these seams that the unity of the figure breaks down. Extreme examples of such risky discontinuity are found in fists that reach out of the picture toward the observer and often look quite detached from their arms, and in the back views of horses that show their buttocks cutting across their necks. Here visual comprehensibility approaches its limits. A sculptor, used to the continuity of his three-dimensional surfaces, may dislike such projective disruptions. Ernst Barlach writes: "I do not represent what I for my part see, or how I see it from here or there, but what *is*, the real and the truthful, which I have to extract from what I see in front of me. I prefer this kind of representation to drawing because it eliminates all artificiality. Sculpture, I would say, is a healthy art, a free art, not afflicted by such necessary evils as perspective, expansion, foreshortening, and other artificialities."

Overlapping

In spite of the visual acrobatics it entails, overlapping cannot be avoided since objects and parts of objects block one another's access to sight everywhere; and indeed, once the relations of shapes in pictorial compositions are carried beyond the simple array of coordinated units, there is great visual de-

Figure 91*a*

Figure 91*b*

light in the interferences and paradoxical juxtapositions produced by the stacking of things in space.

A requirement for the adequate perception of overlap—or superposition—is that the units which, because of projection, touch each other in the same plane must be seen as: (a) separate from each other and (b) belonging to different planes. The two drawings of Figure 92, again derived from Picasso,

Figure 92*a*

Figure 92*b*

show that overlapping is perceived when the frontal shape—in this case, the breast—renders the other, the arm, clearly incomplete (*a*). In *b*, by contrast, both elements, arm and breast, are undisturbedly complete and therefore are seen as placed ambiguously side by side rather than behind each other. I shall discuss the more specific problems of "figure and ground" in Chapter V.

When the overlapping units together form a particularly simple shape, they tend to be seen as one and the same thing. Thus in Figure 93 the shoulder and arm of the woman may be taken to belong to the man—a misinterpretation strengthened by the fact that the resulting simple symmetry also fits the basic visual concept of a human body.

Since in every example of overlapping one unit is partly covered by another, the curtailed unit must not only be made to look incomplete, it must also evoke the right kind of completion. When frames or other impediments cut across limbs at the joints (shoulders, elbows, knees), visual amputation rather

Figure 93

than overlapping is the result, because the stump looks complete in itself. Again, when the direction of the cut is in a simple relation to the structure of the visible unit, the fragment is more likely to show an inorganic completeness. See, for example, in Michelangelo's *Last Judgment*, the famous figure of the damned man (Figure 94) whose face is divided along the sagittal axis by

Figure94

the hand shielding one of his eyes from the horrors before him, while the other eye dominates the visible half of the face like a monstrous thing with a shape of its own. Oblique cuts tend to prevent such effects. When the border of a picture cuts across a figure, the painter or photographer generally avoids the effect of amputated stumps or torsos by placing the cut so that the shape is seen as continued beyond the border.

These rules are by no means limited to the images of objects known from nature, such as animals or humans. The segment of a disk will or will not appear as a part of a circular shape depending on whether the curvature, at the points of interruption, suggests continued extension or an inward turn toward closure. It is not our anatomical knowledge but the nature of the

shapes in which the body is cast that determines whether an organic object is perceived as complete, transformed, or mutilated.

What Good Does Overlapping Do?

The simplest kind of visual representation, as it is found, for example, in the drawings of young children and Mesolithic draftsmen, and in the Chinese ideogram for *man* (Figure 95), closely resembles in its structure the norm

Figure 95

images we create in our minds. These norm images serve as "key tones" for overlappings, which deviate from the base in two ways. First, the norm arrangement, which presents a surveyable deployment of all limbs in their typical interrelation, gives way to intricate crossings as soon as the artist undertakes to depict the actions of working, gesticulating, sitting, climbing, falling. This transformation is inevitable wherever the artist wishes to present more than mere unmodified existence. Second, the body is subjected to alterations resulting from projection. It is this sort of transformation that requires a more detailed justification.

If one compares Figure 96*a* with a drawing of two ducks walking in single file without overlapping (Figure 96*b*), one realizes that the parallelism of the two birds, which conveys their togetherness to the eye, is brought out more compellingly when it occurs within one visual unit. Similarly, in Figure

Figure 96

97 the contrast between the vertical body and the oblique arm imposes itself more forcefully when the two directions cross within one unit (*a*), rather than unfold in the looser lateral succession of *b*. In music the effect of harmony or disharmony is similarly more compelling when several tones are combined in one chord rather than played in succession. Overlapping intensifies the formal relation by concentrating it within a more tightly integrated pattern. The connection is not only closer but also more dynamic. It represents togetherness as interference through mutual modification of shape.

Strictly speaking, the interference caused by overlapping is not mutual. One unit always lies on top, unimpaired, violating the wholeness of the other. In Figure 98 the effect is rather one-sided. King Sethos is in front and complete, whereas Isis, who gives his majesty the support of her godship, endures all the inconveniences that befall a seat. Thus, overlapping establishes a hierarchy by creating a distinction between dominating and subservient units. A scale of importance leads, by way of two or more steps, from foreground to background.

The relationship is one-sided, however, only in the specific instance. In a complex whole the dominance-subservience relation at one place may be counteracted by its reversal at another, so that each partner is shown as both active and passive. A comparison of Figure 98 with the compositional scheme of a Rubens painting (Figure 99) illustrates the difference between the simple, one-sided relations in the Egyptian composition and the baroque counterpoint of overlapping and overlapped elements in the Rubens, which adds up to a complex intertwining of the two lovers.

Overlapping shows hiding and being hidden in a particularly expressive way. Dress is seen as covering or exposing the body. When the motion picture camera shows a prisoner behind bars, it makes all the difference for the meaning of the scene whether the shot is taken from inside or outside the cell, even

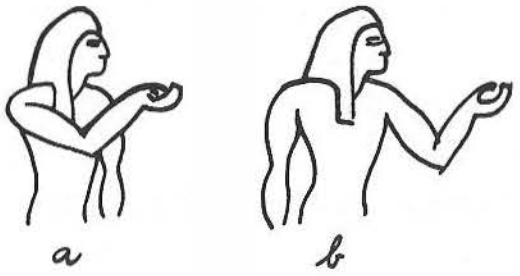

Figure 97

Figure 98

Figure 99

though the objective spatial situation is unchanged. If the scene is shot from inside the cell, we see the margin of freedom that remains to the man against the background of the prison; from outside, we see the bars shut him off visually by striking across his body. Alschuler and Hattwick found that young children who in their "abstract" easel paintings overlaid one patch of color on another tended to be "repressed" and (when cold colors were overlaid on warm ones) "of a passive nature," as distinguished from others who preferred side-by-side placement. Assuming that such a correspondence between personal attitude and pictorial expression in fact exists, it would be interesting to know to what extent the children were motivated by the physical act of hiding through overlay rather than the visual effect of the result.

Overlapping offers a convenient solution to the problem of how to represent symmetry in relation to a figure within the picture. Suppose a painter wants to depict the Judgment of Paris. The three goddesses are to be presented as having equal chances of being chosen, which means in visual terms that they should be placed symmetrically in relation to their judge. It is simple enough to show a symmetrical arrangement of the three women to the person who looks at the picture (Figure 100*a*), because his glance meets the plane perpendicularly. This, however, is not possible with the same means when

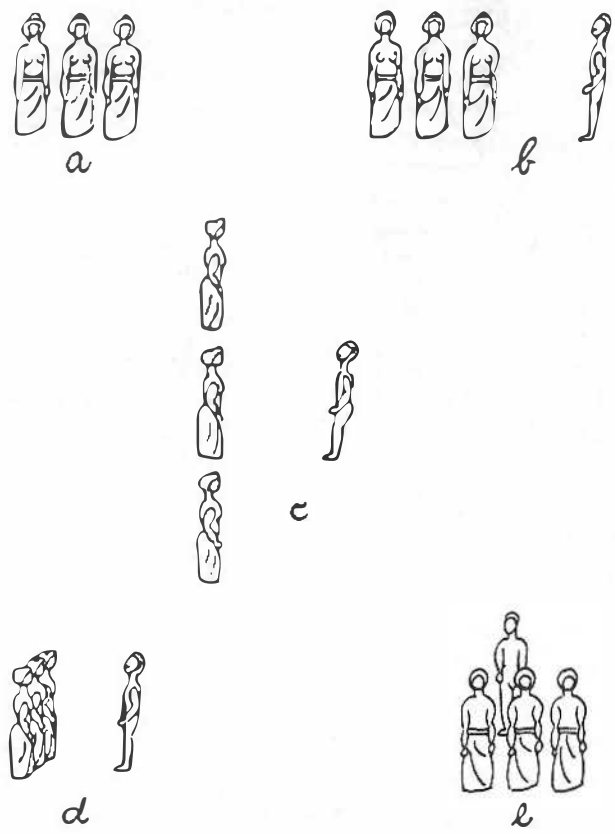

Figure 100

the beholder (Paris) is located in the picture plane (*b*). The three women do not face him symmetrically; one is closest to him, the second is farther away, and the third has the poorest chance. This arrangement undercuts the theme. The painter may show the situation in ground plan (*c*). This restores the symmetry but piles the goddesses awkwardly one on the other in totem-pole fashion. To display the pattern on the ground plane the picture space must be expanded into the third dimension by oblique arrangement, which often (though not necessarily) involves overlapping (*d*). The tilt may also be applied vertically (*e*).

The charioteer with his horses on the Greek vases and coins is another illustration of the same problem. The visual concept of the Horatii and the Curatii calls for two groups of three, set against each other symmetrically. The

task is even more difficult when the group to be related to another party in the picture is not linear but, for example, circular. Figure 101 shows the compositional scheme of a twelfth-century calendar illustration. St. Ursula, surrounded by her maidens, is attacked by an archer. The group is symmetrical to the beholder but not to the archer. Only overlapping could overcome the spatial inconsistency.

The same dilemma arises from the spatial confrontation of individual objects. Medieval painters were plagued by the problem of how to make the evangelist write in his book. The spatial concept calls for the book to be facing the writer, whereas the picture requires that both writer and book be shown in revealing frontality.

Interplay of Plane and Depth

The third dimension enriches pictorial possibilities in somewhat the same way as the addition of more voices to the monophony of the simple melodic line created new opportunities in music. There are striking parallels in the development of the two arts. In music, the several voices are at first relatively independent of each other. With the passage of time, they become interrelated in an integrated composition; finally, the separate voices fuse in modern homophony (compare Figures 186 and 187). Rather similarly, pictorial depth is represented at early stages by separate horizontal strips, one on top of the other. At a later stage, overlapping is employed to obtain a three-dimensional stacking of foreground, middle ground, and background, more or less interrelated. Later still, the whole depth dimension fuses into one indivisible continuum, leading from front to back, from back to front.

When pictorial compositions are meant to occupy three-dimensional

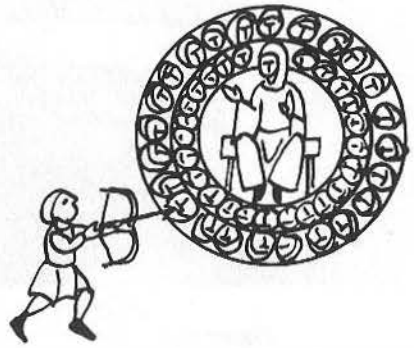

Figure 101

space, they are at a midpoint between two extreme spatial conceptions, to both of which they must be related. The two conceptions are those of zero percent constancy and one hundred percent constancy. At zero percent constancy, the picture is a total projection squashed in a flat frontal plane; at one hundred percent it occupies a fully three-dimensional stage. In practice, no picture occupies either of these extreme positions. Any picture has intermediate spatiality, tending to one or the other extreme in accordance with its style; it derives its meaning precisely from the interplay of both views.

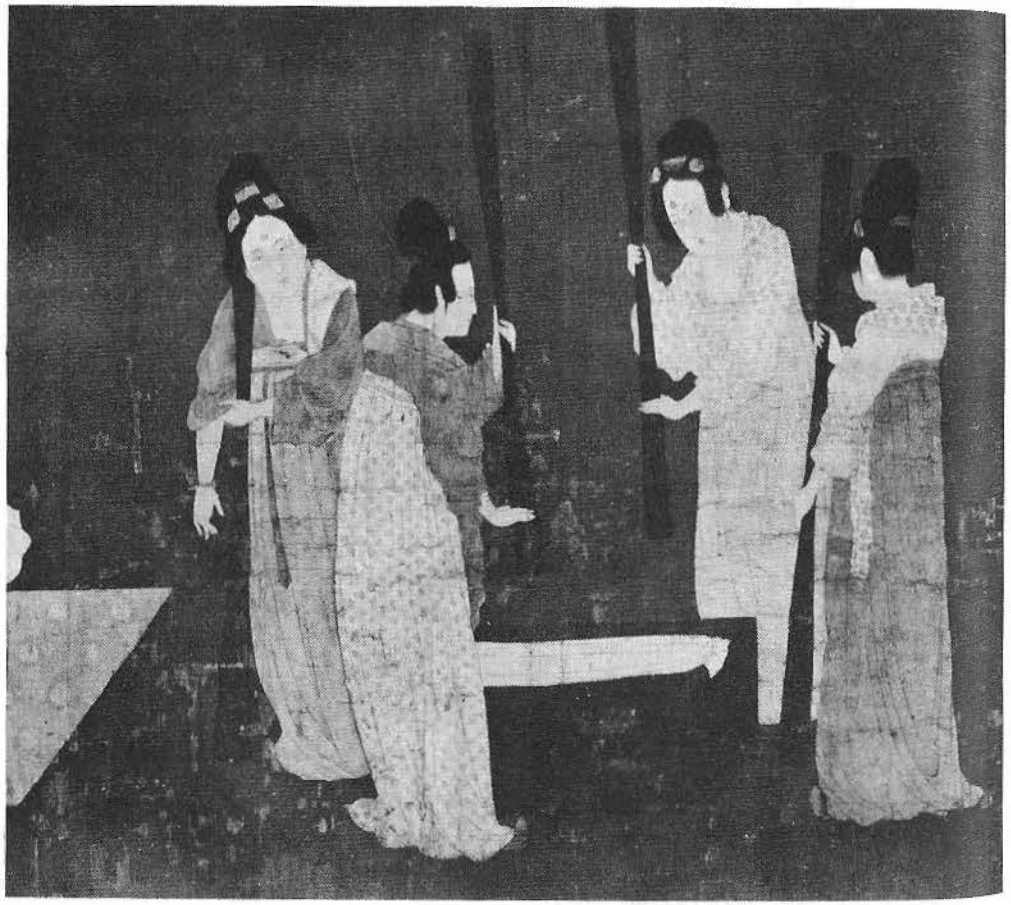

Figure 102
Hui Tsung. The Silk Beaters. Detail of a scroll, c. 1100. Boston Museum of Fine Arts.

The three-dimensional arrangement of the *Silk Beaters* (Figure 102) has four women standing around the table in a rectangular group, which is an oblique variation of the shape of the table itself (Figure 103). Three of the figures face one another symmetrically (II, III, IV); the fourth, getting herself ready to work, stands turned away. Thus the group of four is subdivided into a triangle and an outsider, woman IV being the connecting link between the two who are working already and the one who is not. The connections between the two dark robes and the two light robes correspond to the diagonals of the rectangular group. The two dark figures establish the lateral limits of the group. The light ones do the same for the depth dimension, woman II dominating in the foreground and III being removed to the greatest distance.

The arrangement in the projective pattern of the picture plane is quite different. The women are not located around the table. Two of them flank it, and of the other two one overlaps it and the other is overlapped by it. The group now subdivides more clearly into two pairs, each knitted together by overlapping and separated from the other by empty space. The triangular symmetry of II, III, IV has disappeared; the fourth figure is no longer separate. Instead there is something like a sequence of four lunar phases that leads in a decrescendo from the dominating full face of I over the obliqueness of III to the profile of II and finally the almost hidden face of IV. This establishes a linear zigzag connection, which does not exist in the three-dimensional composition. There are now two outer figures (dark) and two inner figures (light)—an approximate lateral symmetry around a central axis formed by the two sticks. The four heads are the corners of a flat parallelogram, in which women I and III dominate the other two by the higher position of their heads, but are overlapped by them if the whole figures are considered.

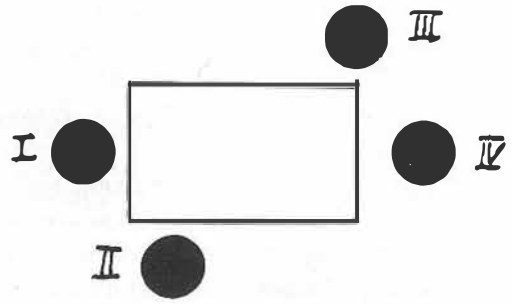

Figure 103

A wealth of form and meaning springs from the interaction of the two compositional structures, which partly support and partly oppose each other contrapuntally. It would be worthwhile to study the relative functions of the two patterns more precisely. Obviously, the three-dimensional grouping always describes more accurately the factual or "topographic" situation (for example, Christ surrounded by his disciples), whereas its expressive or symbolic function may well be weaker than that of the visually more direct projective pattern. Since the relative strength of the two depends on the strength of the depth effect in the particular picture, however, an investigation of their functions may lead to different results for different styles.

Competing Aspects

No more than one aspect of any three-dimensional object is visible at any place and time. In the course of his life and in fact during almost any particular episode of his daily experience, a person overcomes this limitation of visual projection by looking at things from all sides and thereby forming a comprehensive image from the totality of partial impressions. I have mentioned the difficulty arising when such all-around visual concepts are to be represented on a pictorial surface.

Inevitably, some aspects are selected, to the derogation of others. The tradition established by Renaissance art admitted of only one solution for this dilemma. The painter had to choose the one aspect best suited for his purpose and had to put up with whatever was hidden, foreshortened, or distorted from that particular point of view. We have noted that early forms of art are unaffected by this rule and freely combine the most informative aspects of each part of an object or spatial situation, disregarding the concomitant discrepancy of viewpoints. Such styles of representation are committed to the object or situation as such, not to any one of its views.

There is one rule, however, that these early styles tend to respect. In general, they do not use more than one aspect of an object or part of an object in the same picture. They would not, for example, show both a front view and a back view of the same object. However, occasional transgressions of the rule are found even at fairly primitive levels. In children's drawings the combination of a frontal nose with a profile nose in the same face may occur at stages of transition from one form of representation to another.

Genuine examples of such dual-aspect representation occur here and there as local inventions of limited range, often for playful, decorative purposes. The American Indians solved the problem of presenting the characteristic side view and the frontal symmetry of an animal at the same time by splitting the body

into two side views. These were combined in a symmetrical whole and kept precarious contact with each other by sharing either the middle line of the back or the head or by cohering at the tip of the nose or the tail (Figure 104). Morin-Jean has shown that similar forms, which he misinterprets as "monsters

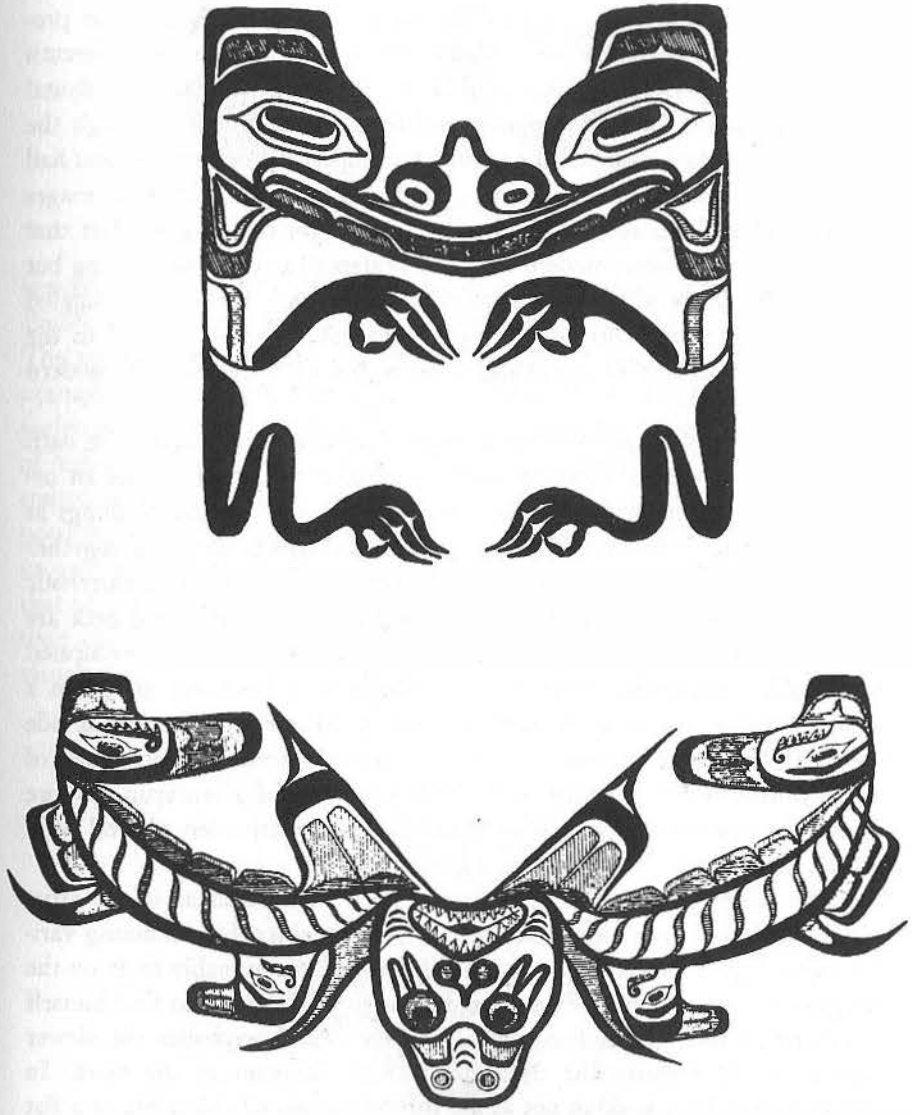

Figure 104

with a double body and single head," occur in Oriental decorative art, on Greek vases and coins, and again on Romanesque capitals. All these examples, however, are fanciful exceptions from the general rule.

Some modern art, especially cubism, also resorted to combining views from several angles in the same whole, but it did so in a characteristically different way. The modern artist was heir to a tradition that had come to identify an object with its pictorial projection. The correctness of the projection seemed to guarantee the validity of the image. Later, in the nineteenth century, such representation was found to be one-sided, subjective, accidental —which at first occasioned applause, and then apprehension. Although the fleeting images aptly reflected the passing and superficial experiences that had come to typify the life of Western man, the world represented by these images began to look alarmingly insubstantial. Artists were exposing the fact that in his relation to reality, modern man was sentenced to catching nothing but glimpses. When the following generations, in reaction to this trend, struggled to recover the stable world of the more innocent eye, they resorted to the "primitive" procedure of combining aspects, but in a significantly modern way.

At early stages of representation, aspects are always put together in such a manner that, despite inherent spatial contradictions, there results an organic and characteristic whole. Since the intention is to reproduce things as correctly, clearly, and completely as possible, the aspects are fitted together harmoniously, organically, and often symmetrically. The most characteristic aspects are chosen, especially front views and side views; head and neck are placed symmetrically between the shoulders; and a frontal eye can be located in a profile head because it represents a relatively independent entity. In a child's drawing of a glass of water (Figure 105*a*), the combination of side view and top view in a symmetrical pattern expresses the solid completeness of a trustworthy reality, whereas in Picasso's rendering of a saucepan (Figure 105*b*), front view and side view, roundness and angularity, left tilt and right tilt, all coincide in a clashing contradiction.

The cubist procedure has sometimes been interpreted as if the artist wanted simply to give a more complete view of an object by combining various aspects. To appreciate the result, the beholder is presumably to fly on the wings of his mind from one perspective view to the other, or to find himself at different locations simultaneously. By such mental acrobatics the viewer himself would perform the dynamics actually inherent in the work. In fact, of course, he is looking not at the three-dimensional object but at a flat picture of it, in which the aspects clash in deliberate contradiction. The tension

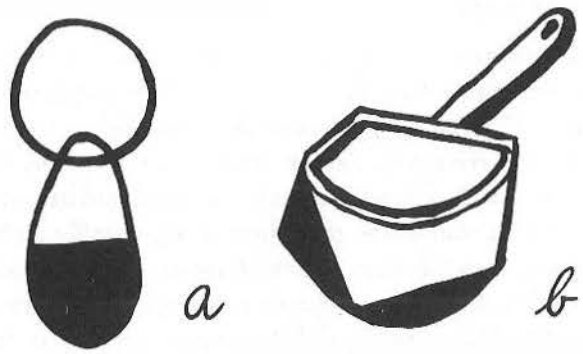

Figure 105

created by visual incompatibility is heightened when different, mutually exclusive views appear together, e.g., a profile view fitted into a frontal view. The more intimately fused the two views, the stronger the tension, as for example in Figure 106, a tracing after the head of a bull by Picasso. Even in sculpture, where no need exists to collect incompatible aspects in the interest of realistic completeness, the cubist artist practices the same violent interpenetration of units. He presents the image of a world in which interaction is possible only as the mutual invasion of self-contained units, each intent on its own purpose. The whole is kept in balance by no higher principle than that of a multiplicity of pushes compensating one another by the variety of their directions. The contradictions of which the Marxists speak are made visual.

Figure 106

Realism and Reality

In dealing with the two-dimensional representation of three-dimensional space we have encountered a peculiar paradox. The example of three persons sitting at a table (Figures 86, 87) showed that when such a scene is presented as a mechanically correct projection, it leads to awkward distortions in the frontal plane. Conversely, when the scene is translated into its two-dimensional equivalent, it can be read as the projection of a physically absurd scene, in which the table top stands upright and the three persons are attached to it like flaps. It follows that there are appropriate and inappropriate ways of reading pictorial representations of space, and that the proper way is determined in each case by the style of a given period or developmental stage.

It is in keeping with this paradoxical situation that when the influence of scientific optics made pictorial representation move toward mechanical projection, the objective correctness of this procedure authorized an unheard-of freedom from the structural norm. It gave license to radical distortions of the simple visual skeletons by which people understood and continue to understand the build of a human body, an animal, a tree. Protected by the "correctness" of their foreshortenings, artists twisted the axes of objects, destroyed the symmetrical correspondence of parts, altered proportions, and rearranged the relative location of things. In a realistic painting, a human figure could reach above the trees into the sky, the feet could adjoin the face, and the outline of the body could assume almost any shape. Heinrich Wölfflin writes about the Slaves Michelangelo painted on the Sistine ceiling: "The deviation from the norm in the structure of the bodies is insignificant by comparison with the way Michelangelo arranges the limbs. In their relations he discovers entirely new effects. Here he brings an arm and the two lower legs tightly together as a set of three parallels; there he crosses the thigh with the downward-reaching arm so that they form almost a right angle; then again he comprehends the whole figure from head to heels in one unitary sweep of line. And these are not mathematical variations that he sets himself as an exercise. Even the most outlandish posture looks convincing." For a similar example see the figure of Abias in Figure 107.

Evidently, the Renaissance artists practiced the new skill of faithful projection not only in tribute to the ideal of scientifically authenticated realism, but because of the inexhaustible variety of appearances derivable from natural objects in this fashion and the corresponding wealth of individual interpretation. It is not surprising that this extreme exploitation of projective distortion eventually led to a radical countermovement, a return to elementary shapes and the elementary schemata of permanent structural norms. The reaction became conspicuous in the geometrical simplifications of Seurat and Cézanne and the primitivism pervading much art of the early twentieth century.

Figure 107

At the same time, however, that art sought refuge from complexities of distortions that the human eye could no longer organize, an expressionist trend took advantage of the new freedom from the basic norm and adopted all the licenses of projective art without any longer bothering to justify them as the mechanically correct projections of physical objects. The realists had initiated the destruction of organic integrity. They had made objects incomplete or separated their parts with intervening foreign bodies. Modern artists did the same without the requirements of overlapping as an excuse. Obliqueness had been introduced to represent depth. Modern artists distorted the orientation of axes without that justification. The destruction of local color had been carried to its extreme by the impressionists, who had used reflections to apply the green of a meadow to the body of a cow or the blue of the sky to the stones of a cathedral. In consequence, modern artists became free not only to make a red object blue, but also to replace the unity of one local color with any combination of different colors. In the past, artists had learned to reorganize organic subdivisions with paradoxical results. They fused several human figures into one triangle, or detached an arm from the mass of the body and united it with the arm of another figure to make a new, continuous whole.

This enabled the modern artist, for example, to split up a face and fuse part of it with the background. By illuminating objects from a particular direction, artists had come to cast shadows across them, subdividing them in ways that had little organic justification. Carrying this device still further, Braque made one female figure consist of two—a black profile woman and a light front-face woman (see Figure 233).

What Looks Lifelike?

We have come a long way from the narrow belief that only mechanically faithful replication is true to nature. We realize that the whole range of infinitely different styles of representation is acceptable, not only to those who share the particular attitude that created it, but also to those of us who can adapt to it. However, mere tolerance for different approaches to the same goal is not good enough. We must go further and realize that just as persons of our own civilization and century may perceive a particular manner of representation as lifelike even though it may not look lifelike at all to the adherents of another approach, so do the adherents of those other approaches find their preferred manner of representation not only acceptable, but entirely lifelike.

This would be hard to believe had we not documents to prove it. Stories about paintings or statues so lifelike that they deceived man and beast have come to us from periods of Chinese and Greek art whose style would by no means deceive us into believing that we were facing reality rather than man-made images. We do not know exactly what the paintings of Zeuxis looked like, but we have reason to doubt that his painted grapes really made sparrows peck at them in the belief that they were real. More probably these stories express the visual experiences of contemporary viewers, to whom the pictures looked most lifelike.

Boccaccio tells in the *Decamerone* that the painter Giotto "was a genius of such excellence that there was no thing of nature . . . that he did not depict with the pencil or the pen or the brush in a manner so similar to the object that it seemed to be the thing itself rather than merely resembling it; so much so that many times the visual sense of men was misled by the things he made, believing to be true what was only painted." The highly stylized pictures of Giotto could have hardly deceived his contemporaries if they had judged lifelikeness by direct comparison with reality. Compared with the work of his immediate predecessors, however, Giotto's rendering of expressive gestures, depth, volume, and scenery could indeed be considered very lifelike, and it was this deviation from the prevailing norm level of pictorial representation that produced the astonishing effect on Giotto's contemporaries.

The principle of adaptation level, introduced into psychology by Harry Helson, indicates that a given stimulus is judged not according to its absolute qualities, but in relation to the norm level established in the person's mind. In the case of pictorial representation, this norm level seems to be derived not directly from perception of the physical world itself, but from the style of the pictures known to the observer.

Reactions to photography and film have shown that progress in pictorial lifelikeness creates the illusion of life itself. The first motion pictures, shown about 1890, were so crude technically that they give us little illusion of reality today, but the mere addition of movement to the black-and-white image sufficed to make the first spectators scream with fear when the train rushed headlong toward them. Curiously enough, the advent of color produced hardly any additional increment; but the spatial resonance of sound temporarily increased the visual depth and volume of the picture considerably. And the first life-size holographs, which added the powerful motion parallax to the still image, were so shockingly real that the absence of live motion made the portrayed person look like a corpse.

Actual illusions are, of course, rare; but they are the extreme and most tangible manifestation of the fact that, as a rule, in any given cultural context the familiar style of pictorial representation is not perceived as that at all—the image looks simply like a faithful reproduction of the object itself. In our civilization this is true for "realistic" works; they look "just like nature" to many persons who are unaware of their highly complicated and specific style. However, this "artistic reality level" may shift quite rapidly. Today we can hardly imagine that less than a century ago the paintings of Cézanne and Renoir were rejected not only because of their unusual style, but because they in fact looked offensively unreal. It was not merely a matter of different judgment or taste, but of different perception. Our forefathers saw on those canvases incoherent patches of paint that we are no longer able to see, and they based their judgment on what they saw.

Those of us who live with the art of our century find it increasingly difficult to see what "the man in the street" means when he takes exception to deviations from realistic rendition in the Picassos, the Braques, the Klees. In Picasso's portrait of a schoolgirl we see the elementary liveliness of the young creature, the girlish repose, the shyness of the face, the straightly combed hair, the burdensome tyranny of the big textbook. The strongly colored, wildly overlapping geometrical shapes do not detract from the subject but carry its expression with such mastery that we no longer see them as mere shapes: they are consumed in the task of representation. In fact, it seems safe to assert that

every successful work of art, no matter how stylized and remote from mechanical correctness, conveys the full natural flavor of the object it represents. Picasso's painting not only depicts a schoolgirl; it *is* a schoolgirl. "I always aim at resemblance," said Picasso in 1966. And he exclaimed that an artist should observe nature, but never confuse it with painting. "It is only translatable into painting by signs."

If someone sees the shapes instead of the subject, something may be wrong with the picture. Or the observer may be perceiving from an inappropriate adaptation level. (In fact, the "man in the street" is often fixated at a style level established by the painters of the seventeenth century.) It is also true that for informational illustrations in anthropology textbooks or biology manuals, a different style, perhaps the linear classicism of the Ingres school, is taken for granted; a painting by Matisse, perceived as though it were intended as such a textbook illustration, will necessarily show its shapes rather than its subject.

As far as the artists themselves are concerned, there seems to be little doubt that they see in their work the embodiment of the intended object. The sculptor Jacques Lipchitz tells of admiring one of Juan Gris' pictures while it was still on the easel. It was the kind of cubistic work in which many a layman even today discovers little but an agglomeration of abstract shapes. Lipchitz exclaimed: "This is beautiful! Do not touch it any more! It is complete." At which Gris, flying into a rage, shouted in reply: "Complete? Don't you see that I have not finished the moustache?" To him the picture contained the image of a man so clearly that he expected everyone to see it immediately in all its detail.

The utterances of artists make it clear that they think of "style" simply as a means of giving reality to their image. "Originality" is the unsought and unnoticed product of a gifted artist's successful attempt to be honest and truthful, to penetrate to the origins, the roots, of what he sees. The deliberate search for a personal style inevitably interferes with the validity of the work, because it introduces an element of arbitrariness into a process that can be governed only by necessity. Picasso once said: "Always strive for perfection. For instance, try to draw a perfect circle; and since you can't draw a perfect circle, the involuntary flaw will reveal your personality. But if you want to reveal your personality by drawing an imperfect circle—*your* circle—you will bungle the whole thing."

One misunderstanding must be avoided. When I assert that in a successful work of art one perceives the subject rather than the shapes, I may seem to be suggesting that form does not matter. Nothing could be further from my intention. In fact, the same suggestion holds for "abstract" or nonmimetic art. It makes all the difference whether in an "abstract" painting we see an arrangement of mere shapes, i.e., visual objects that can be completely described by their area, outline, color, location, etc., or see instead the organized action of expressive visual forces. In the latter case, the shapes vanish in the dynamic play; and it is only this dynamic play that conveys the meaning of the work. The bulging, twisting columns, the swinging scrolls and roofs of a Baroque façade leave the geometry of their shapes and the material substance of the stone behind as the total architectural composition transfigures itself into a symphony of movement. Similarly, in a representational work of painting or sculpture, the shapes made by the artist and the pigment or metal or wood of the medium are transformed into visual action, which gives life to the subject matter. Good form does not show.

Form as Invention

Many of our examples will have helped to illustrate what I suggested early in this chapter, namely that image-making, artistic or otherwise, does not start from the optical projection of the object represented, but is an equivalent, rendered with the properties of a particular medium, of what is observed in the object. Visual form can be evoked by what is seen, but cannot be taken over directly from it. It is well known that the death masks and plaster casts of actual persons, which are mechanically lifelike, nevertheless often have a purely material presence and tend to let us down when we expect them to interpret character through visual appearance. They are essentially shapeless and therefore cannot serve as form. Any beginner, drawing from the model, discovers that the shapes he expects to find by looking carefully at a face, a shoulder, a leg, are not really there. The same problem, however, seems to have caused the tragic struggle that Alberto Giacometti never overcame. It started in 1921, when he wanted to portray a figure and found that *tout m'échappait, la tête du modèle devant moi devenait comme un nuage, vague et illimité*—"everything escaped me, the head of the model in front of me became like a cloud, vague and limitless." He tried to represent this unreachability of the model in the evasive surfaces of his sculpted and painted figures, while insisting at the same time upon the pursuit of the shapes he thought had to exist objectively in those human heads and bodies.

The attempt to find representational form in the model was doomed to failure because all form must be derived from the particular medium in which the image is executed. The elementary act of drawing the outline of an object in the air, in the sand, or on a surface of rock or paper means a reduction of

the thing to its contour, which does not exist as a line in nature. This translation is a very elementary accomplishment of the mind—there are indications that young children and monkeys recognize the outline pictures of familiar objects almost spontaneously. But to grasp the structural similarity between a thing and any depiction of it is a tremendous feat of abstraction nevertheless.

Each medium prescribes the way in which the features of a model are best rendered. For example, a round object may be represented as a circular line by means of a pencil. A brush, which can make broad spots, may produce an equivalent of the same object by a disk-shaped patch of paint. In the medium of clay or stone, the best equivalent of roundness is a sphere. A dancer will create it by running a circular course, spinning around his own axis, or arranging a group of dancers in a circle. In a medium that does not yield curved shape, roundness may be expressed by straightness. Figure 108 shows a snake

Figure 108

pursuing a frog as represented in a basketry pattern by the Indians of Guyana. A shape expressing roundness best in one medium may not do so in another. A circle or disk may be the perfect solution in the flat picture plane. In three-dimensional sculpture, however, circle and disk combine roundness with flatness and thus represent roundness imperfectly. A black-and-white apple becomes "colorless" when transferred from a monochromatic lithograph to an oil painting. In a painting by Degas a motionless dancer is a suitable representation of a moving dancer, but in a film or on the stage a motionless dancer would not be in motion but paralyzed.

Form is determined not only by the physical properties of the material, but also by the style of representation of a culture or an individual artist. A flat-looking patch of color may be a human head in the essentially two-dimensional world of Matisse; but the same patch would look flat instead of round in one of Caravaggio's strongly three-dimensional paintings. In a cubist statue by Lipchitz a cube may be a head, but the same cube would be a block of inorganic matter in a work of Rodin. Figure 109 shows Picasso's drawing *The End of a Monster*. The way in which the head of the monster is drawn serves in other works by the same artist to represent undistorted, non-monstrous shape (compare the bull of Figure 106). There is no paradox here.

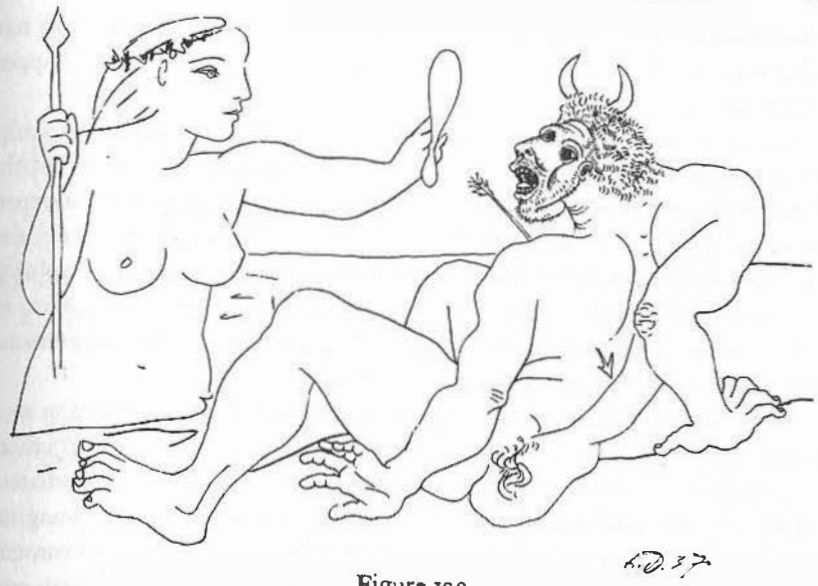

Figure 109
Pablo Picasso. *La Fin d'un Monstre*. Coll. Roland Penrose, London.

A pattern that produces a monster in a relatively realistic picture may stand for "straight" anatomy in a work that applies the same manner of distortion to everything.

Such translations of the appearance of physical objects into the form appropriate to particular media are not esoteric conventions thought up by artists. They are in common usage everywhere in life. Scale models, line drawings on blackboards, and road maps all deviate markedly from the objects they depict. We easily discover and accept the fact that a visual object on paper can stand for a quite different one in nature, provided it is presented to us in its structural equivalent for the given medium. In the next chapter I shall demonstrate the unerring logic and consistency of children in this matter.

The psychological reason for this striking phenomenon is, first, that in human perception and thinking, similarity is based not on piecemeal identity but on the correspondence of essential structural features; second, that an unspoiled mind spontaneously understands any given object according to the laws of its context.

It takes a great deal of "spoiling" before we come to think that representation is not only an imitation of the object but also of its medium, so that we expect a painting not to look like a painting but like physical space, and a statue not like a piece of stone but like a living body of flesh and blood. This

unquestionably less intelligent concept of representation, far from being natural to man, is a late product of the particular civilization in which we happen to have lived for a while.

As one walks through a museum and looks at the shapes given by sculptors of different ages and cultures to the human head, one realizes that the same simple prototype can be reflected in an infinity of equally valid representations. The head may be fitted to a very few overall shapes or subdivided into many small ones; the shapes may be straight or curved, edged or voluminous, clearly separated or fused; they may derive from cubes or spheres, ellipsoids or paraboloids; they may employ deep cavities or slight depressions. Each has its validity, and each makes its point.

This capacity to invent a striking pattern, especially when applied to such familiar shapes as a head or a hand, is what is known as artistic imagination. Imagination is by no means first of all the invention of new subject matter, and not even the production of just any kind of new shape. Artistic imagination can be more nearly described as the finding of new form for old content, or—if the handy dichotomy of form and content is eschewed—as a fresh conception of an old subject. The invention of new things or situations is valuable only to the extent that they serve to interpret an old—that is, universal—topic of human experience. There is more imagination in the way Titian paints a hand than in hundreds of surrealist nightmares depicted in a dull, conventional manner.

Visual imagination is a universal gift of the human mind, a gift that in the average person demonstrates itself at an early age. When children start to experiment with shape and color, they are faced with the task of inventing a way to represent in a given medium the objects of their experience. Occasionally they are helped by watching others, but essentially they are on their own. The wealth of original solutions they produce is all the more remarkable because their subject matter is so elementary. Figure 110 shows representations of the human figure copied from drawings by children at early stages of development. Certainly these children were not trying to be original, and yet the attempt to put down on paper what he sees makes each of them discover a new visual formula for the old subject. Every one of these drawings, which could easily be multiplied by the hundreds, respects the basic visual concept of the human body—as witnessed by the fact that it is understood by the beholder—and at the same time offers an interpretation that distinguishes it from the other drawings.

It is evident that the object itself dictates only a bare minimum of structural features, thus calling for "imagination" in the literal sense of the word—

Figure 110

that is, the activity of making things into images. If we examine the drawings more closely, we find broad variations in many formal factors. The considerable differences in absolute size do not show in Figure 110. The relative size of parts, for example, that of the head in comparison with the rest of the body, varies considerably. Many different solutions are found for the subdivision of the body. Not only the number of parts but also the placing of boundary lines varies. There is much detail and differentiation in some, little in others. Round shapes and angular shapes, thin sticks and solid masses, juxtapositions and overlappings, all are used to represent the same object. What is more, the simple enumeration of geometric differences does not do justice to the individuality evident in the overall appearance of these drawings. Some of the figures look stable and rational, others are carried away in reckless action. There are sensitive ones and crude ones, simple ones and subtly complex ones, plump ones and frail ones. Every one of them expresses a way of living, of being a person. The differences are due partly to the stage of development, partly to the individual character of the child, partly to the purpose of the drawing. Together these pictures demonstrate the abundant resources of pictorial imagination that are found in the average child until lack of encouragement, unsuitable teaching, and an uncongenial environment suppress them in all but a fortunate few.

A successful artistic solution is so compelling that it looks like the only possible realization of the subject. Different renditions of the same theme must be compared before the role of imagination can be truly appreciated. Systematic accounts of the various ways in which a particular subject can be represented have been given much too rarely. A good example is Lucien Rudrauf's analysis of Annunciations as "variations of a plastic theme." He shows how differently the famous encounter has been interpreted, depending on which moment of the event the artist chose and how his imagination distributed active and passive function, dominance and submission, and so on. Historic surveys, which follow a given theme through the ages, are more frequent. Among other things they show how on occasion an artist comes upon an image that embodies some basic subject with a spellbinding validity. The same story, the same composition, or the same posture lives on for centuries as an indelible contribution to the way man visualizes his world.

Levels of Abstraction

One dimension in which the artist can exercise his freedom is the degree of abstraction he uses to render his subject. He can replicate the appearance of the physical world with the meticulous faithfulness of the *trompe l'oeil* painter,

or, like Mondrian and Kandinsky, he can work with completely nonmimetic shapes, which reflect human experience by pure visual expression and spatial relations. Within the representational realm, many styles of picture-making limit themselves to portraying the things of nature with just a very few structural features. This highly abstract mode is prominent in early stages of art, i.e., in the work of children and "primitives," but also in certain aspects of the Byzantine style of Christian art, modern Western art, and the artwork of schizophrenics. These are strange bedfellows, but if we assume that similarity of form points to some corresponding similarity of mental state, we shall have to resort to bold generalization.

The patterns that result from limiting representation to just a few features of the object are often simple, regular, and symmetrical. Offhand there would seem to be no compelling reason for this. Shape may be made more complicated by omissions. The theorists of the last century, who were inclined to derive all properties of images from observed aspects of reality, tried to account for this tendency by pointing to regular shapes in nature that man was supposed to have imitated—the disk of the sun, the symmetrical build of plant, animal, and man himself. As an extreme example, Wilhelm Worringer cites an anthropologist who undertook to show by means of snapshots that the shape of the cross was derived from the pattern made by flying storks. Obviously, this approach does not take us very far, since it cannot explain why man should have picked the regularly shaped percepts among the immensely more frequent irregular ones. Occasionally the simple form of an image can be derived in part from the medium in which it was executed—for example, in basketry—but nothing like a generally valid principle can be obtained from such an observation.

More plausibly, we might observe that when by some circumstance the mind is freed from its usual allegiance to the complexities of nature, it will organize shapes in accordance with the tendencies that govern its own functioning. We have much evidence that the principal tendency at work here is that toward simplest structure, i.e., toward the most regular, symmetrical, geometrical shape attainable under the circumstances.

It should be noted that although in the instances under discussion the representational features derived from the physical world are few, the artist may nevertheless develop those few features into an elaborate play of shapes, which may be described variously as geometric, ornamental, formalistic, stylized, schematic, or symbolic.

As a first step toward the understanding of such highly abstract styles, we note that under certain cultural conditions more realistic art would not serve

the artist's purpose better, but on the contrary interfere with it. Primitive images, for example, do spring neither from detached curiosity about the appearance of the world nor from the "creative" response for its own sake. They are not made to produce pleasurable illusions. Primitive art is a practical instrument for the important business of daily life; it gives body to superhuman powers so that they may become partners in concrete undertakings. It replaces real objects, animals, or humans, and thus takes over their jobs of rendering all kinds of services. It records and transmits information. It makes it possible to exercise "magic influences" on creatures and things that are absent.

What counts in all these operations is not the material existence of things, but the effects they exert or submit to. Modern natural science has accustomed us to thinking of many of these effects as physical events that reflect the composition and behavior of matter. This view is of relatively recent origin, and is quite different from a simpler notion that finds its purest expression in primitive science. We think food is necessary because it contains certain physical substances that our bodies absorb and utilize. To the primitive, food is the carrier of immaterial powers or forces whose vitalizing virtue is transferred to the eater. Disease is caused not by the physical action of germs, poisons, or temperature, but by a destructive "fluid" emitted by some hostile agency. For the primitive it follows that the specific appearance and behavior of natural things, from which we derive information about probable physical effects, are as irrelevant to their function as a book's shape and color are to the content we find in it. Thus, for example, in depicting animals the primitive limits himself to the enumeration of such features as limbs and organs, and uses geometrically clear-cut shape and pattern to identify their kind, function, importance, and mutual relations as precisely as possible. He may use pictorial means also to express "physiognomic" qualities, such as the ferocity or friendliness of the animal. Realistic detail would obscure rather than clarify these relevant characteristics. (Similar principles of representation are found in our own civilization, in the illustrations for medical treatises written before the advent of modern natural science.)

Early stages of development produce highly abstract shapes because close contact with the complexities of the physical world is not, or not yet, pertinent to the task of picture making. It is not possible, however, to turn this statement around and assume that highly abstract shape is always the product of an early mental stage. People often create elementary images, not because they have so far to go, but because they have so far withdrawn. An example may be found in Byzantine art, which was a withdrawal from the most realistic

style of representation the world had then seen. Art became the servant of a state of mind that, in its extreme manifestations, condemned the use of images altogether. Life on earth was considered a mere preparation for life in Heaven. The material body was the vessel of sin and suffering. Thus visual art, instead of proclaiming the beauty and importance of physical existence, used the body as a visual symbol of the spirit; by eliminating volume and depth, by simplifying color, posture, gesture, and expression, it succeeded in dematerializing man and world. The symmetry of the composition represented the stability of the hierarchic order created by the Church. By eliminating everything accidental and ephemeral, elementary posture and gesture emphasized lasting validity. And straight, simple shape expressed the strict discipline of an ascetic faith.

The art of our own century offers another striking example of high abstraction obtained through withdrawal. Like Byzantine art, it renounced the skillful illusionism of its forebears. Here, a specific psychological reason can be found in the changed position of the artist. The craftsman who had fulfilled an established need in the affairs of government and religion was gradually transformed into an outsider—the producer of surplus luxury goods to be stored in museums or used to demonstrate the wealth and refined taste of the rich and privileged. This exclusion from the economic mechanism of supply and demand tended to transform the artist into a self-centered observer.

Such a detachment from the give and take of civic existence has its pros and cons. On the positive side, a spectator can stand back, and thus see better and more independently. At a distance, personal commitments lose their power; accidental detail drops out and essence reveals its broad shape. The detached artist, like the scientist, withdraws from individual appearance to seize more directly upon fundamental qualities. An immediate grasp of the pure essentials, for which Schopenhauer praised music as the highest of the arts, is attempted through the abstractness of the best modern painting and sculpture. Pure form aims more directly at the hidden clockwork of nature, which more realistic styles represent indirectly by its manifestations in material things and events. The concentrated statement of these abstractions is valid as long as it retains the sensory appeal that distinguishes a work of art from a scientific diagram.

Negatively, high abstraction risks detaching itself from the wealth of actual existence. The great works of art and science have always avoided this limitation; they have encompassed the whole range of human experience by applying the most general forms or principles to the greatest variety of phenomena. We need only think of the teeming variety of creatures that a Giotto,

Rembrandt, or Picasso subordinates to the overall principles determining his view of life and thereby his style. When contact with a full range of human experience is lost, there results not art, but formalistic play with shapes or empty concepts.

Extreme instances of this danger can be studied in certain types of schizophrenic art, in which ornamental geometric patterns are elaborated with as much precision and care as the disorganization of the patient's mental state permits. Striking examples are the drawings made by the dancer Nijinsky during his years of confinement in a mental institution. If we inquire about the corresponding state of mind, we find a freezing of feeling and passion accompanied by a withdrawal from reality. A shell of glass seems to surround the schizophrenic. Life around him appears as an alien and often threatening spectacle on a stage, which can be watched, but which permits no give and take. The secluded intellect weaves fantastic cosmologies, systems of ideas, visions, grandiose missionary projects. Since the sensory sources of natural form and meaning are clogged and the vital passions dried up, formal organization remains, as it were, unmodulated. The tendency to simple shape operates unhampered in the void. The result is order as such, with little life to be ordered. Remnants of thoughts and experiences are organized not according to their meaningful interaction in the world or in reality, but by purely formal similarities and symmetries. Patterns are built around visual "punning"—the fusion of heterogeneous contents on the basis of external resemblance. In some of Van Gogh's last paintings, pure form overpowered the nature of the objects he depicted. The violence of his disturbed mind transformed the world into a tissue of flames, so that the trees ceased to be trees and the cottages and farmers became calligraphic brush strokes. Instead of being submerged in the content, form interposed itself between the viewer and the theme of the work.

An example of schizoid art is "Dance of the Swan Dolls" (Figure 111), one of many pictures executed in colored crayon by Friedrich Schröder, who called himself the "Sun Star." After spending much of his life in prisons and mental hospitals, this alcoholic vagrant, a faith healer and leader of a religious sect, began to paint systematically at the age of fifty-seven. All the traits of alienated art are strikingly present. A rigidly symmetrical, ornamental pattern is placed on a landscape of reduced depth. The shapes of nature, devoid of their organic complexity and imperfection, have the smooth regularity of an unmodulated carrier wave. Extricated from their natural context, the limbs and trunks of animal and man combine without restraint on the basis of purely formal affinities: arms are fitted with birds' heads instead of hands,

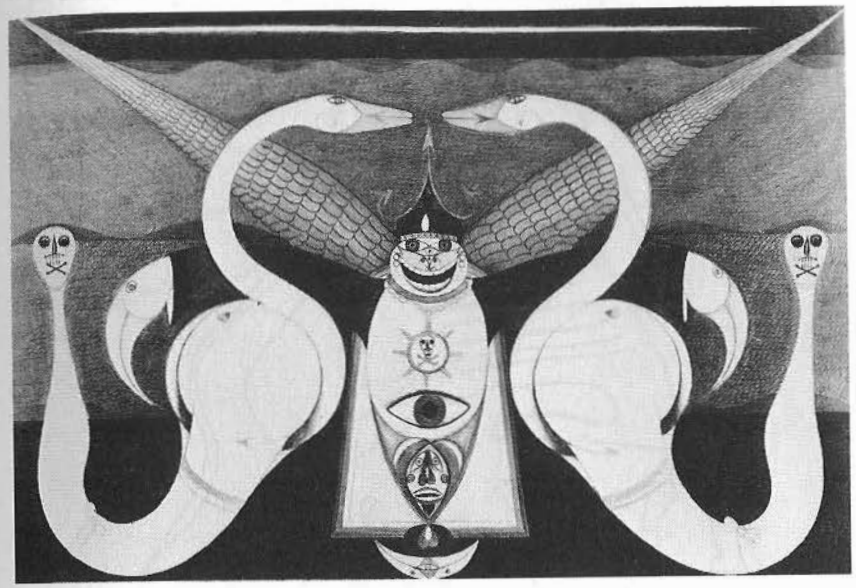

Figure 111
Friedrich Schröder-Sonnenstern. *The Swan-Doll's Dance of Death.* Color crayon. Coll. Siegfried Poppe, Hamburg.

swans' necks lead into human buttocks.

Not by accident, similar formalistic characteristics are found in the "doodles" of persons whose minds are empty or concentrated on some other train of thought while their sense of visual organization, uncontrolled by guiding idea or experience, directs the eyes and hands. Geometric shapes generate one another, sometimes combining to form well-structured wholes, but more often just chance agglomerations of elements (Figure 112).

Finally, there is a significant relation between formalism and ornament. When we speak of ornament, we mean, first of all, visual form subordinated to a larger whole, which it completes, characterizes, or enriches. Thus scepter, crown, or wig serve as ornaments of king or judge, and wooden scrolls or lion's paws enrich the appearance of traditional furniture. Second, we call a pattern ornamental when it is organized by a simple formal principle. In works of art, such ornamental features are used with caution. Strict symmetry, for example, is as rare in painting and sculpture as it is frequent in decorations and the applied arts, such as ceramics or architecture. Figure 113

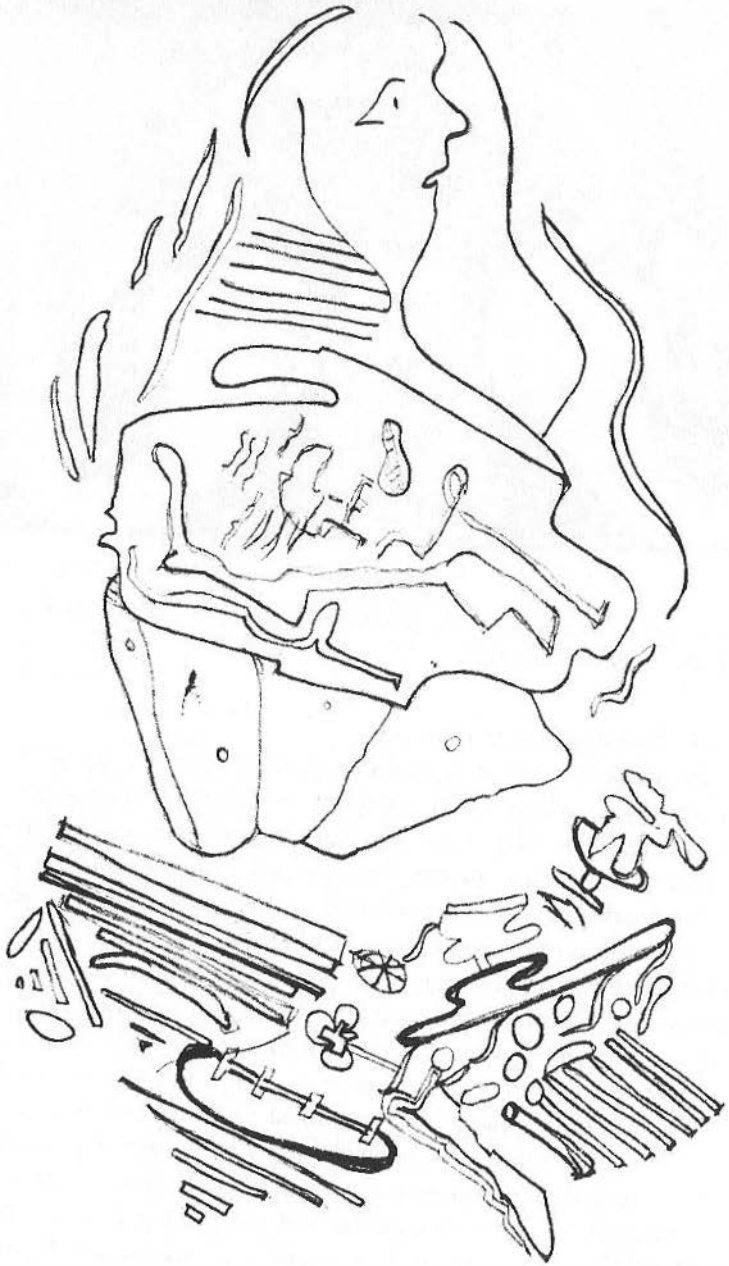

Figure 112

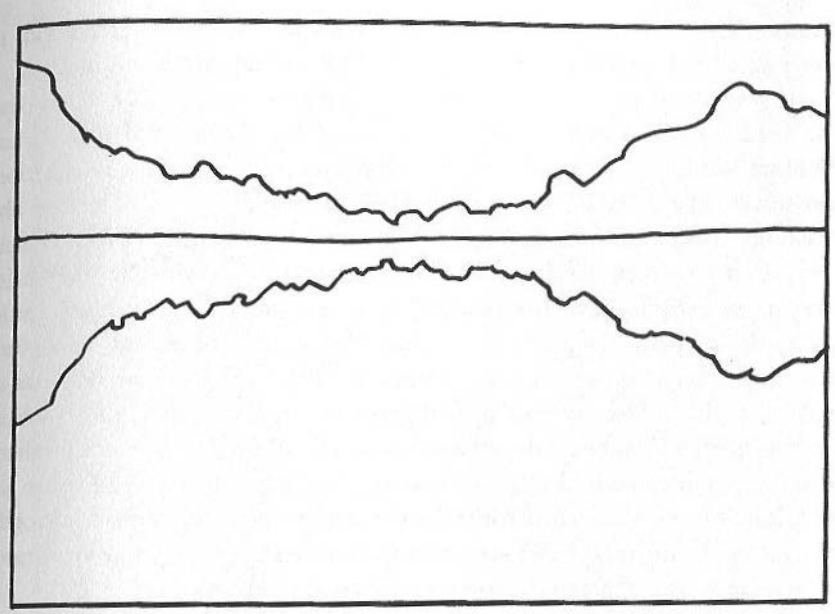

Figure 113

gives the main outlines of a landscape by Ferdinand Hodler depicting mountains reflected in a lake. The basic composition is completely symmetrical around a horizontal axis, and almost symmetrical around the central vertical. By turning nature into ornament, the artist has obtained a chilly preponderance of order. William Hogarth was aware of this danger when he wrote: "It may be imagined that the greatest part of the effects of beauty results from the symmetry of parts in the object, which is beautiful: but I am very well persuaded this prevailing notion will soon appear to have little or no foundation." He said it was a constant rule of composition in painting to avoid regularity. In fact, even in works in which an overall symmetry is appropriate to the subject, its severity is always mitigated by enlivening deviations.

Strict symmetry and repetition are frequently used to obtain a comic effect. Symmetrically arranged action occurs in comedy on the stage. As an example from literature, the humorous opening scene in Flaubert's novel *Bouvard et Pécuchet* may be cited. Two men of the same profession walk at the same moment to the same park bench from opposite directions and in sitting down discover that they both have the habit of inscribing their names in their hats. The use of twins, the repetition of situations, the persistent mannerisms in a person's behavior, are all favorite "ornamental" devices in comedy

because they uncover mechanical order—that is, lifelessness—in life, which is precisely what Henri Bergson has described as the function of all humor.

If we look at an ornamental design as though it were a work of art, the one-sidedness of its content and form makes it look empty and silly. If, on the other hand, a work of art is used for decoration, it will overstep its function and disturb the unity of the whole it has been asked to serve. The late abstractions of Mondrian, although composed of a few elementary formal features, are by no means ornaments. An ornament, as we can now define it, presents an easy order, undisturbed by the vicissitudes of life. Such a view is quite justified when the pattern is not intended as an independent whole but as a mere component of a larger context, in which an easy harmony has a legitimate place. The patterns of wallpaper or dress material fulfill such a limited function. Architectural design has in all cultures so insistently relied on symmetry because buildings serve as an element of stability and order in the midst of human existence, which is pervaded by struggle, accident, discord, change, and irrationality. The same is true for jewelry, pottery, and furniture, but not for works of art in the more restricted sense of the term.

Paintings or sculpture are self-contained statements about the nature of human existence, and therefore they refer to this existence in all its essential aspects. An ornament presented as a work of art becomes a fool's paradise, in which tragedy and discord are ignored and an easy peace reigns. A work of art displays the interaction between underlying order and the irrational variety of clashes. *Nostra res agitur.*

La Source

In a work of art, an abstract pattern organizes the visual matter in such a way that the intended expression is directly conveyed to the eyes. This is perhaps most strikingly demonstrated by analyzing in some detail a work that at first glance seems to offer little more than pretty triteness displayed in a standard naturalistic manner.

La Source, painted by Ingres at the age of seventy-six in the year 1856, represents a girl standing upright in a frontal position and holding a water jug (Figure 114). At first sight it shows such qualities as lifelikeness, sensuousness, simplicity. Richard Muther notes that Ingres' nudes make the observer almost forget that he is looking at works of art. "An artist who was a god seems to have created naked human beings." We may well share this experience and at the same time ask: How lifelike is, for example, the posture of the figure? If we judge the girl as a person of flesh and blood, we find that she is holding the jug in a painfully artificial way. This discovery comes as a

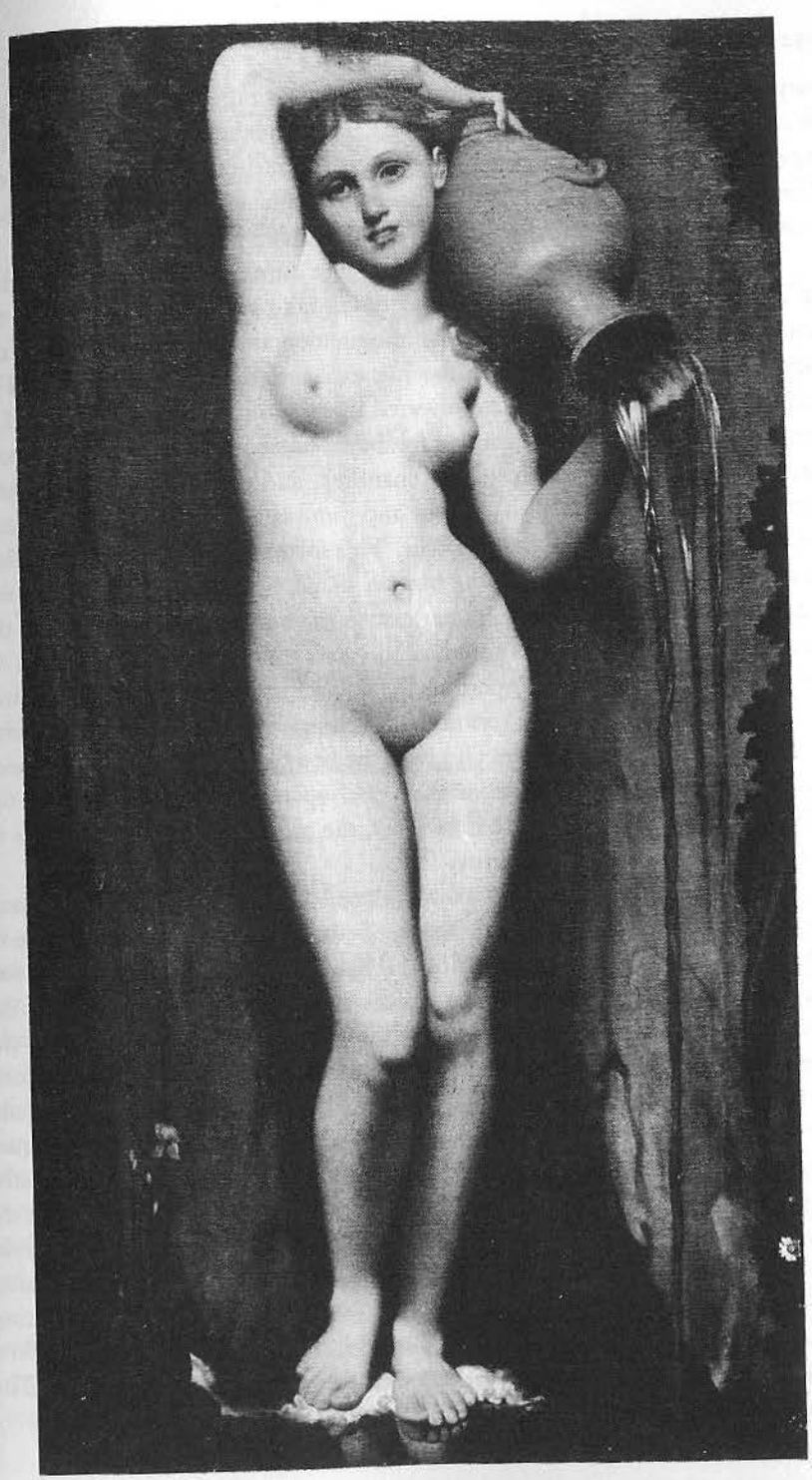

Figure 114
Jean Auguste Dominique Ingres. *La Source*, 1856. Louvre, Paris.

surprise because to the eye her attitude was and is rather natural and simple. Within the two-dimensional world of the picture plane it presents a clear and logical solution. The girl, the jug, and the act of pouring are shown completely. They are lined up side-by-side in the plane with a thoroughly "Egyptian" passion for clarity and neglect of realistic posture.

Thus the basic arrangement of the figure turns out to be anything but an obvious solution. To make the right arm take such a detour around the head and "get away with it" required imagination and mastery. Moreover, the location, shape, and function of the jug evoke significant associations. The body of the jug can be seen as an inverted likeness of its neighbor, the head of the girl. Not only are they similar in shape, but both have one free, unobstructed flank, which carries an ear (handle), and one flank that is slightly overlapped. Both are tilted to the left, and there is a correspondence between the flowing water and the flowing hair. This formal analogy serves to underscore the faultless geometry of the human shape, but by inviting comparison it also stresses the differences. In contrast to the empty "face" of the jug, the features of the girl establish a more conspicuous contact with the observer. At the same time, the jug openly permits the flow of the water, whereas the girl's mouth is all but closed. This contrast is not limited to the face. The jug with its uterine connotations rhymes also with the body, and again the resemblance serves to emphasize that whereas the vessel openly releases the stream, the pelvic area of the body is locked. In short, the picture plays on the theme of withheld but promised femininity.

Both aspects of this theme are developed in further formal inventions. The virginal refusal in the compression of the knees, the tight adherence of the arm to the head, and the grip of the hands are counteracted by the full exposure of the body. A similar antagonism can be found in the posture of the figure. Its overall shape indicates a straight vertical axis of symmetry; but the symmetry is nowhere strictly fulfilled, except in the face, which is a small model of completed perfection. The arms, the breasts, the hips, the knees, and the feet are merely swinging variations on a potential symmetry (Figure 115). Similarly, the vertical is not actually realized anywhere; it merely results from the obliquities of smaller axes, which compensate one another. The direction changes at least five times in the axes of the head, the chest, the pelvis, the calves, and the feet. The straightness of the whole is made up of oscillating parts. It offers us the serenity of life, not of death. There is in this undulating movement of the body something truly waterlike, which puts the straight flow from the jug to shame. The still girl is more alive than the running water. The potential is stronger than the actual.

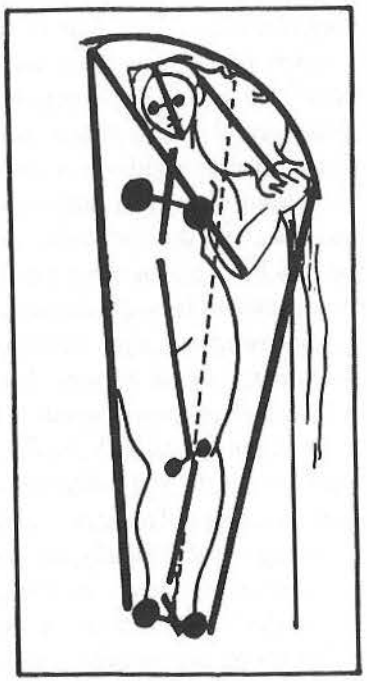

Figure 115

Looking further at the oblique central axes on which the body is built, we notice that these axes are short at the extremities and get larger toward the center. A crescendo of size leads from the head over the chest to the long expanse of belly and thighs, and the same is true for the approach from the feet over the calves to the center. This symmetry between top and bottom is enhanced by a decrescendo of pictorial "action" from the extremities toward the center. In both the top and the bottom areas there is an abundance of small units and angular breaks, a crowding of detail and forward and backward movement in the depth dimension. This action dies gradually as the units grow in size, until beyond the gateways of the breasts and knees all small motion is hushed, and in the center of the silent plane lies the closed sanctuary of sex.

In the left contour of the figure from the shoulder downward, there are small curves leading to the large arc of the hip, followed again by curves of decreasing size in the calf, the ankle, and the foot. This left contour strongly contrasts with the right, which is nearly a straight perpendicular. The vertical

is lengthened and strengthened by the raised right arm. This combined trunk and arm contour is a good example of formal reinterpretation of a subject, because it is a discovery, a new line, not foreseen in the basic visual concept of the human body. The right contour spells out the vertical that is only implied in the zigzag of the central axis. It embodies rest and approximates geometry, and thus fulfills a function similar to that of the face. The body, then, lies between pure statements of the two principles it unites in itself: the perfect calm of its right contour, and the undulating action of the left.

The symmetry of top and bottom that the artist invented for his figure is not derived from organic structure. It is also checked by the overall outline of the figure. The figure is inscribed in a slim, tilted triangle, formed by the raised elbow, the left hand, and the feet as corners. The triangle establishes a secondary, oblique central axis, which teeters unstably on a narrow base. Its sway adds subtly to the life of the figure without disturbing its basic verticality. It relieves the plumb line of the right contour of some of its rigidity because the vertical contour is read as a slanted deviation from this secondary axis of the triangle (compare Figure 72*b*). Finally, the oblique symmetry of the two elbows should be observed because here is an element of angularity that is quite important in giving the "salt" of sharpness to a composition that otherwise might have suffered from the monotony of sweet curves.

A few of the features described above follow simply from the objective shape and construction of the human body, but a comparison of *La Source* with a Venus by Titian or Michelangelo's *David* will demonstrate how little the bodies artists create have in common. The remarkable fact about a painting like *La Source* is that in looking at it we sense the effect of the formal devices that make it represent life so fully, even though we may not be conscious of these devices at all. So smoothly are they blended into a whole of great overall simplicity, so organically is the compositional pattern derived from the subject and the pictorial medium, that we seem to see simple nature at the same time that we marvel at the intelligence of the interpretation it conveys.

Visual Information

What has been said against the mechanical replication of physical things and about the visual interpretation of meaning through organized abstract form may have seemed to apply only to art. When it comes to images intended to convey factual information for scientific texts, dictionaries, technical manuals, etc., mechanical exactness of representation would seem to be the one obvious requirement. And yet this is not so.

Recording by photography, the most faithful method of image-making,

has not really superseded the human craftsman, and for good reasons. Photography is indeed more authentic in the rendering of a street scene, a natural habitat, a texture, a momentary expression. What counts in these situations is the accidental inventory and arrangement, the overall quality, and the complete detail rather than formal precision. When pictures are to serve technological or scientific purposes—for example, illustrations of machines, microscopic organisms, surgical operations—the preference is for drawings, or at least for photographs retouched by hand. The reason is that pictures give us the thing "itself" by telling us about some of its properties: the characteristic outline of a bird, the color of a chemical, the number of geological layers. A medical illustration is meant to distinguish between smooth and rough texture, to show the relative size and position of organs, the network of blood vessels, the mechanism of a joint. A technological picture must give exact proportions and angles, establish the concavity or convexity of a given part, and distinguish between units. Properties of this kind are all we need to know. This means not only that the better picture is one that omits unnecessary detail and chooses telling characteristics, but also that the relevant facts must be unambiguously conveyed to the eye. This is done by means of perceptual factors, some of which are discussed in this book: simplicity of shape, orderly grouping, clear overlapping, distinction of figure and ground, use of lighting and perspective to interpret spatial values. Precision of form is needed to communicate the visual characteristics of an object.

A draftsman charged with producing a faithful likeness of an electric clockwork or a frog's heart must invent a pattern that fits the object—exactly as the artist must do. And since producing a likeness means nothing but bringing out the relevant traits, it is not surprising that the draftsman must understand what these traits are. Biological, medical, technological training may be needed to make a usable reproduction of an object. Such knowledge will suggest to the artist an adequate perceptual pattern to be found in the object and applied to the picture. All reproduction is visual interpretation. The interpretations of the uninformed draftsman, based on nothing but what he can see at the moment, are likely to be misleading or too vague. Leonardo da Vinci's scientific drawings are remarkable because he thoroughly understood the structure and function of the things he was depicting and at the same time could organize complex perceptual patterns with the utmost clarity (Figure 116).

The relation between intellectual knowledge and visual representation is frequently misunderstood. Some theorists talk as though an abstract concept could be directly rendered in a picture; others deny that theoretical knowledge

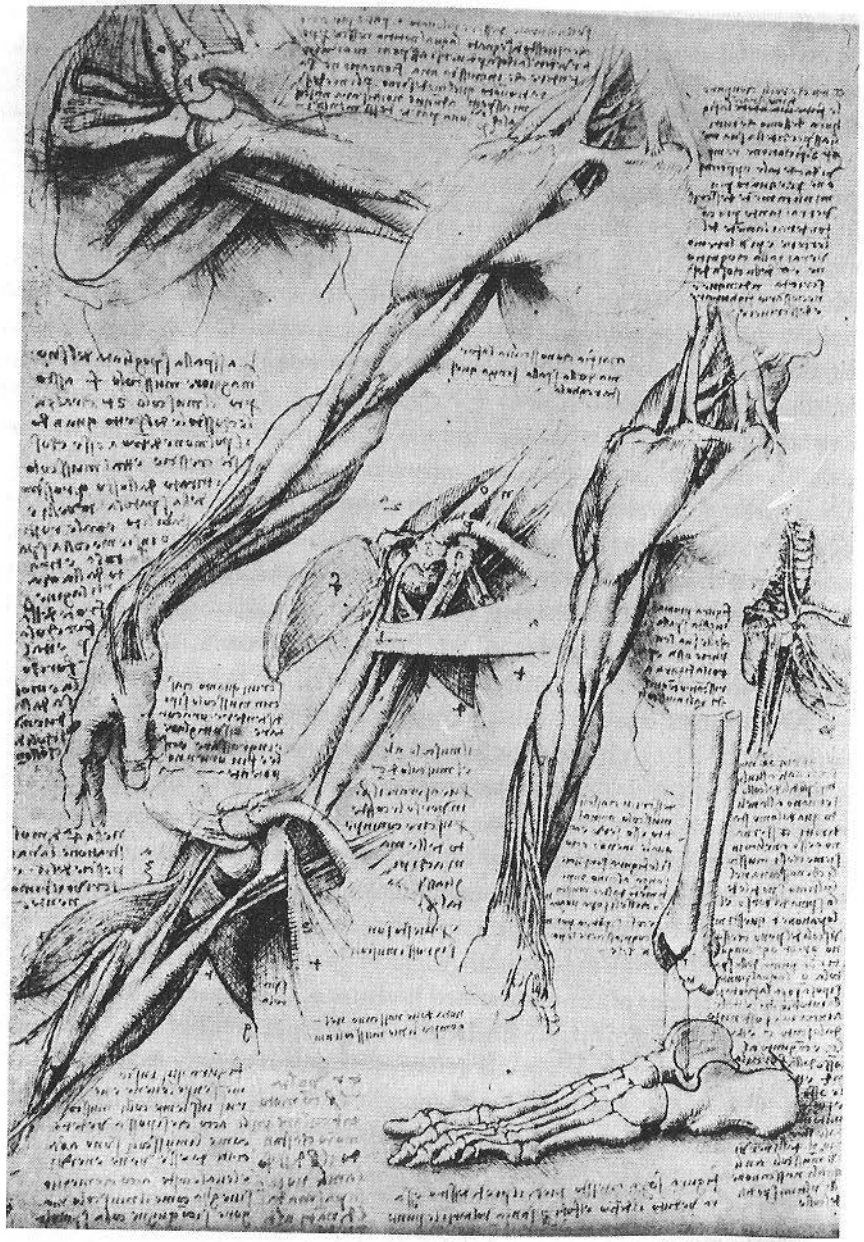

Figure 116

can do anything but disturb a pictorial conception. The truth would seem to be that any abstract proposition can be translated into some kind of visual form and as such become a genuine part of a visual concept. Leonardo's statement, "The neck has four movements, of which the first consists of raising, the second of lowering, the face, the third of turning right or left, the fourth of bending the head right or left" does not in itself dictate a particular image. But it is based on a visual conception, and anybody can use this bit of theory to look for the mechanisms of the four movements in the human body and articulate a visual idea of his own.

Although temporarily out of fashion, the study of anatomy is valuable to the artist because it permits him to acquire a visual concept of things that cannot be seen directly but that help shape what can be seen. The human body is like a Christmas stocking stuffed with objects whose shapes, though they produce conspicuous bulges, cannot be discerned clearly because the bag smooths over the contours and hides everything that does not emerge on the outside. Thus the shape of the bag is likely to look chaotic and elusive. A pattern of form must be imposed upon it, and, as I pointed out earlier, there are an infinite variety of ways to do it. Some of them can be derived from knowledge of how the muscles and tendons and bones beneath the skin are shaped and how they fit together. With the memory image of this internal structure in his mind, an artist can invent patterns that interpret the outside in ways that accord with the inside. Something very similar is true for the illustrator of anatomical, physiological, or biological material.

Since representing an object means showing some of its particular properties, one can often achieve the purpose best by deviating markedly from "photographic" appearance. This is most evident in diagrams. The pocket map of subway lines issued by the London Transport Corporation gives the needed information with utmost clarity, and at the same time delights the eye with the harmony of its design (Figure 117). This is achieved by renouncing all geographic detail except for the pertinent topological features—that is, the sequence of stops and interconnections. All roads are reduced to straight lines; all angles to the two simplest, ninety and forty-five degrees. The map omits and distorts a great deal, and because it does so is the best possible picture of what it wants to show. Still another example may be taken again from Leonardo, who suggests: "When you have represented the bones of the hand and you wish to represent above this the muscles which are joined with these bones, make threads in place of muscles. I say threads and not lines in order to make known what muscle passes below or above the other muscle, which thing cannot be shown with simple lines." Nothing but the points of

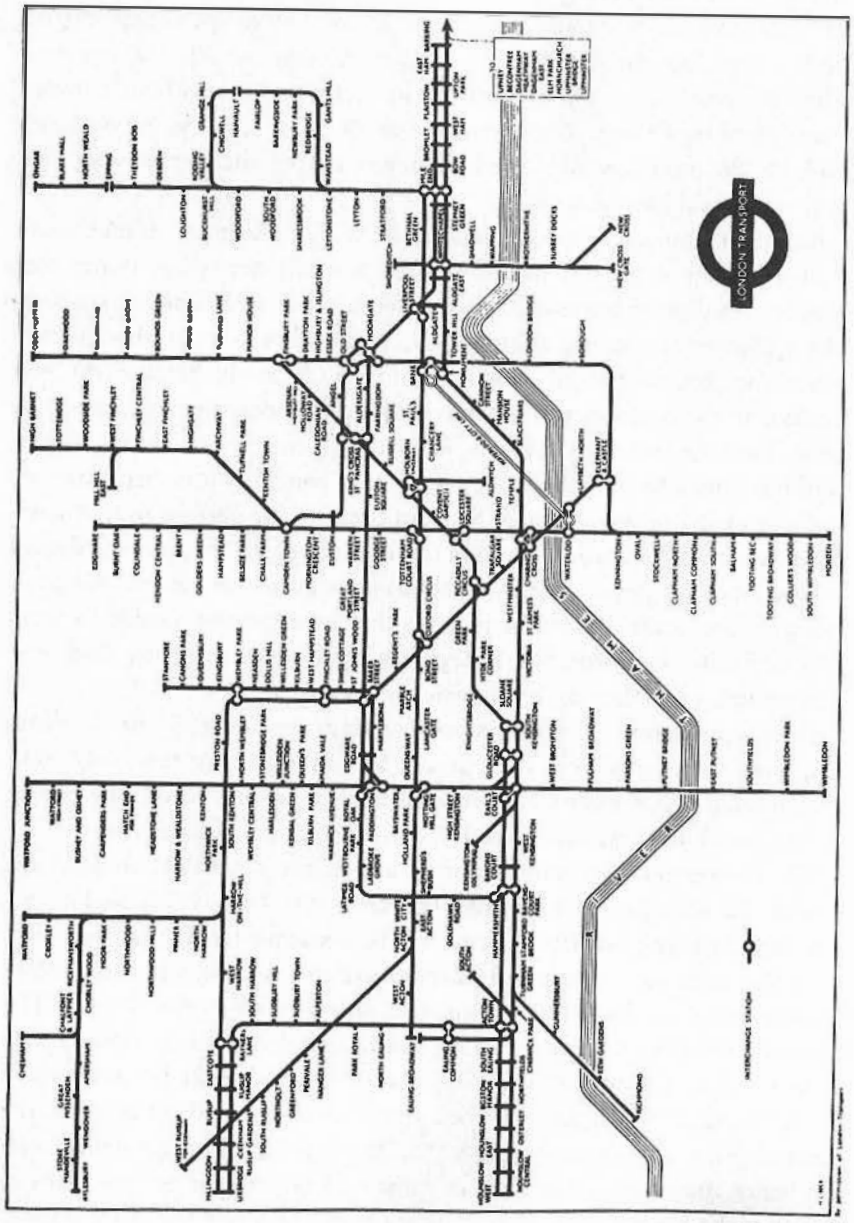

Figure 117

attack and the crossings in space is considered. Rendition of the size and shape of the muscles would distract and obstruct the view.

The expression conveyed by any visual form is only as clear-cut as the perceptual features that carry it. A clearly curved line expresses its swing or gentleness with corresponding clarity; but a line whose overall structure is confusing to the eye cannot carry any meaning. An artist may paint a picture in which a ferocious tiger is easily recognizable; but unless there is ferocity in the colors and lines, the tiger will look taxidermic, and there can be ferocity in the colors and lines only if the pertinent perceptual qualities are brought out with precision. Figure 118 is taken from a Dürer woodcut that shows Christ's head crowned with thorns. Direction, curvature, brightness, and spatial position are defined in such a way that each perceptual element helps to convey to the eyes a precise expression of anguish, which rests on such features as the heavy lid overhanging the staring pupil. Not often does visual form offer such a simple weave of simple elements; but however complex the pattern of color, mass, or contour, it can deliver its message only if in its own way it has the precision of Dürer's lines.

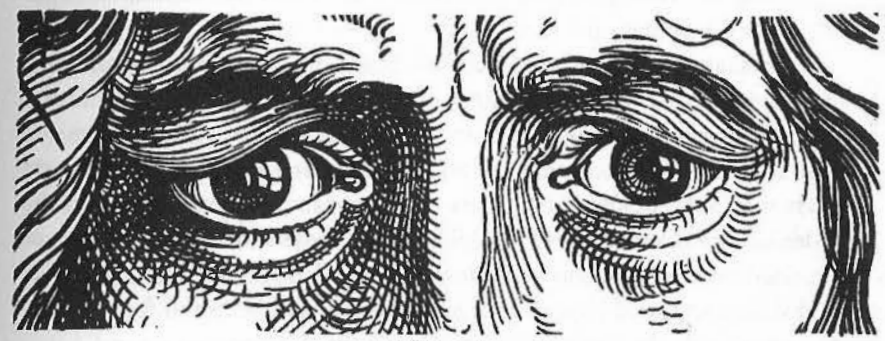

Figure 118