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LETTERS

Readers' comments are welcomed on articles published in Leonardo. In general, short letters stand best chance of publication. The Editors reserve the right to shorten letters for reasons of space. Letters should be written in English or in French.

ON INFORMATION AVAILABLE IN PICTURES

I feel greatly honoured by the editor's invitation to comment on Professor Gibson's paper in the Winter, 1971 issue of , for there is no student of perception from whom I have learned more. In a more extensive discussion of his theories published elsewhere [1], I ventured to describe his account of the relation between perception and painting as a 'Copernican Revolution'. But Copernicus was not quite right and neither, I think, is Professor Gibson.

I should like to take as my starting point his description of a photo-mural that permits an observer at the proper station point to 'perceive' the distance of one of the trees and its height while he still remains aware of the distance of the wall and I should like to begin by discussing the first of these observations. To what degree of accuracy could the distance and height be estimated? How was this accuracy tested? Assuming for argument's sake that the estimate was very good indeed, what other questions about the landscape represented in the photo-mural was Gibson's observer able to answer? Clearly, if the mural was black-and-white, questions about the colour of objects would have been inappropriate. But we may also ask up to what distance features were correctly interpreted? Were distant hills? Were trees silhouetted against the sky read correctly as a three-dimensional array? Were clouds seen at the correct distance and the correct shape? However pedantic and irritating these questions may sound, they must be asked if we are to establish first of all that the information provided by the picture was necessarily incomplete and that there are degrees of incompleteness. I think Professor Gibson and I are in agreement about this limitation of pictorial information.

The next question now to be asked seems to me to concern the difference between such incomplete information and the one provided by a perfect duplication of the sheaves of light impinging on the retina when looking first at the real landscape and then at the reproduction through a peephole at proper distance. It is a fact established by projective geometry and mentioned by Professor Gibson that the information content of the duplicate is still very far from perfect. There are many questions about the scenery 'out there' which we could not answer during such an inspection. In fact, it is only our knowledge of the 'ecology' of our normal environment that prevents such a view from collapsing into total indeterminacy. We know that the surfaces of lakes are level and that roads do not really converge into a point, that there is generally one source of light, the sun, which shines from above and accounts for the shadows, that walls are rarely tilted and that grass is more or less green so that the modifications of this colour may be due to light. But all this knowledge will not enable us to draw a completely accurate map of the landscape we perceive through the peephole.

But granted that the information offered in either case is and remains incomplete, is there really such a tremendous gulf between the 'facsimile' landscape and the black and white photo-mural? In my

book on Art and Illusion [2], I argued that there was not and that there was a gradual and continuous reduction of information content that led from the naturalistic view to a line drawing. Professor Gibson cannot accept this postulate of continuity because he is committed to the view that for an observer who is free to move as he wishes, the sight of the real scenery provides complete information about the visual array.

Salutary as I have always found Professor Gibson's admiration for the achievement of visual perception, which has certainly been much underrated in the tradition that extends from Berkeley to Helmholtz, I still fail to see entirely what he would want us to believe. Granted that we need never be in doubt when moving around the world that things are arranged in space, granted also that people with normal eyesight are rarely in danger of bumping into objects, does this prove more than that sight usually (not always) offers us all the information we need for the business of getting about? Even if we replaced the photo by a real environment, most of the questions listed above would have to remain unanswered. Clearly, primitive man accepted the illusion of the vault of heaven without enquiring about the real relation of the stars in space; he can also have had little conception of the distance and [195] shape of clouds he observed moving across the sky. Moving closer he will not have asked himself about the angle taken by distant blue hills on the horizon or, again, of the true spacial configurations of trees and branches outside his reach. It is indeed difficult to accept literally Professor Gibson's belief that 'our primitive ancestors, before the discovery of pictorial representation by the cave painters, had never noticed the aspects of objects and the perspectives of the environment'.

I should like to suggest with great respect that Professor Gibson may be a victim of modern industrial civilization. It is undoubtedly true that in our ordered and pre-fabricated environment we are generally aware of the unseen aspects of our tables and cups, cars and traffic lights. In a less domesticated environment, these aspects matter more. Early man must have known that danger may be lurking on the unseen side of a tree and that surprises await one when picking up a stone. Nobody who has ever walked in the mountains can uncritically accept Professor Gibson's theory that we perceive the three-dimensional features of our environment and only learn about aspects from painting. The same peak which may be described as the *Dent Blanche* in one valley may look neither white nor like a tooth from another side. Those who are familiar with the famous silhouette that Mont Cervin presents from Zermatt may sometimes be incredulous when the same mountain is pointed out to them from a different vantage point.

Even in our own type of environment different aspects of the same thing may puzzle a child in contexts which have nothing to do with our familiarity with images. The windows of my nursery on the fifth floor of a Viennese apartment house opened on a narrow court that was frequented by street musicians to whom we threw coins wrapped in paper. I never ceased to puzzle at the different impression the court made from above and from the ground floor. It looked much larger in bird's eye view.

I can think of innumerable similar instances that must have obtruded themselves also on populations that lacked any contact with representational art. In other words, there are many situations in which homo sapiens must have become aware of the fallibility of sight and of the need to take stock of what is really seen. None of these situations may have been quite as taxing as that of the naturalistic painter but this is a matter of degree rather than of kind.

In other words, I still feel unable to accept the radical separation between the perception of reality and the perception of pictures that Professor Gibson proposes in opposition to the views I put forward in *Art and Illusion*. Of course, I am grateful for his generous reference to that book but I fear that in his

description even he has confused its title with its content. The lecture series on which it was based was called 'The Visible World and the Language of Art' and this formulation still describes the content better than the snappier title which my publishers preferred. Far from identifying the picture with the window, I discussed at some length the information content of line drawings and of caricatures. It is true that in doing so I stressed what I called 'the beholder's share', our interpretative activity in reading and accepting notations. I saw - and still see - the problem of representation as an experiment in reduction, the cutting down of information available to the viewer. The first reduction - and here I have paid tribute to Professor Gibson in *Art and Illusion* for making us aware of the radical nature of the step - is the elimination of the time element, the freezing of the flow of information on which we rely in our orientation. There are many styles of art that try to compensate for this deprivation by embodying in the image many of the invariant or distinctive features of our environment on which we rely for information. Hence the characteristics of the so-called conceptual image. Even the naturalistic artist or the photographer will tend to look for such compensation if he wants to avoid a confused and muddling picture. The impressionists went notoriously far in the elimination of such compensatory moves but they introduced others, such as the induction of flicker to restore something of the time element to the painting.

It lies outside the scope of a letter to discuss this problem of reduction and compensation in all its complexities. Instead, I should like to stress in conclusion that we must not confuse the veridical aspect of an image with its effect. Professor Gibson is right when he stresses that a perspective picture only produces the same sheaf of light-rays when viewed from exactly the same point and the same distance from which the record was made. However, though we may see something different from a different vantage point, we still see a picture of something and interpret it differently but, maybe, equally convincingly. The illusion of the gun or finger that keeps pointing at you from wherever you stand is an example of this plasticity of images that is too rarely discussed.

In trying to think it through (as I have done in a forthcoming contribution to a volume of essays in honour of Nelson Goodman), we discover strange facets of our perception of pictures that do not quite tally with Professor Gibson's analysis. It is here, in fact, that I should like to return to his second observation about the viewer of the photo-mural who could estimate his distance from the wall quite correctly. No doubt he could. But does it follow that he could perceive the whole wall in exactly the same way as he could have perceived it with a neutral paint or a patterned wallpaper? There are reasons to doubt this. The apparent shift in the orientation of objects in the virtual space of the mural is of course due to changing configurations resulting from a foreshortening of the surface but it is the first that is perceived, not the second. It is of course true that a complete illusion of reality is rarely achieved by pictorial representation but it does not follow that the painter has no means to unsettle our normal perception when he presents us [196] with his tricks and puzzles that are so hard to pin down in any definition of a picture.

REFERENCES

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2. E. H. Gombrich, *Art and Illusion* (Princeton: Princeton University Press, 1961).

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I would like to make some comments on James J. Gibson's article, 'The Information Available in Pictures', in the Winter, 1971 issue of Leonardo. It is heartening to see a leader in the field of perceptual psychology move closer to an adequate theory of pictorial representation. Such is the gap between psychology and the arts that for years Dr. Gibson could describe a picture as a mechanically exact duplicate of a corresponding scene of physical reality, even though in the entire history of art such duplication has rarely been attempted, let alone achieved. Always alert to better observation, he now revises his conception of a picture in two respects. The revision to be discussed first takes notice of the fact that ordinary perception does not reflect the optical projection on the retina. The perceptual constancies modify the size, shape, color and movement of retinal projections radically, often in the direction of making them appear more nearly like what the objects are physically. This leads to the notion that a wide range of different views and pictures can deliver the same 'information' even though they vary so much as to the shapes and colors they actually present.

The term 'information' is used here by Dr. Gibson in a very particular way. It refers to what people want to know for practical purposes when they are interested in nothing but the identification of objects.

A teapot is a teapot, from whatever side it is viewed. A man's wife is the man's wife, whether from the front or the back. Or is she? We are seized by the suspicion that the perceptual variations, neutralized by constancy mechanisms under certain conditions, often matter greatly and, in fact, may deliver the most important information by far. If my best friend turns his back to me or keeps at a distance, do I content myself with having recognized him?

In the arts, the problem of information, in Dr. Gibson's meaning of the term, exists and is interesting. We ask under which pictorial conditions, say, a human figure is identified as such. An ancient Egyptian would have trouble with Mantegna's foreshortenings and Uccello would be baffled by cubist portraits. We know much too little about the exact range of such invariants in different styles of interpretation and to speak simply of 'conventions' is to be satisfied with words.

At the same time, this is a minor problem. If the identification of subject matter were the principal task of pictorial communication, one mother and child would convey the same information as any other mother and child, and this would be the total denial of art. Pictorial information in the arts resides, of course, in the thousand specificities of rendering shape, color, distance and size. The information conveyed by a Giacometti drawing is not that there is a man sitting on a chair but that Man is an unfathomable, elusive, webbed apparition. And if we return from the lessons of art to everyday perception, we find that there, too, information barely begins with the invariants. Perception seizes, fortunately, on much of the inexhaustible wealth of sensory experience, not as a marginal luxury but as the very essence of what we need to know.

If, then, for the purposes of artistic representation, information does not consist of invariants and, if, therefore, Dr. Gibson's ecological optics - I suppose the term should be: ecological perception - does not apply, we must refer him to what he discovered in caricatures, namely, that an image can be true without presenting any version of what meets the eye in the outside world. This, of course, holds not only for caricatures; it is the very nature of all art. The information conveyed by Daumier's caricature of a statesman or Velasquez' Pope Innocent or the bronze portrait of a Benin ruler resides in the

totality of their shapes and colors, not in an invariant core, from which these shapes and colors must be subtracted. If so, the term information loses the precise meaning given it by Dr. Gibson and refers instead to the desperately complex, unruly array of data with which many of us have been struggling for a lifetime. In this struggle, the arrival of a capable new ally is a happy event.

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Professor Gombrich disagrees with me about pictures because he disagrees with me about perception. I have a new theory of visual perception based on unfamiliar assumptions instead of the familiar ones we have all been taught and it is not easy to understand. But since disagreements sometimes lead to the clear formulation of the issues, let me try to state where we disagree. If I exaggerate our differences no great harm will be done and he will forgive me.

He believes that visual perception is inevitably [197] weakened by error and illusion, whereas I do not. This is an old, old idea, that perception cannot be separated from misperception but it seems to me logically unsound. I believe that we can learn to see the world truly and that painters could, if they would, help us to see the truth.

He believes that what we remember or know contributes to what we see, that a large share of seeing is contributed by the beholder, not by the environment, and that our faith in the direct act of seeing the world is misguided. This is another old idea but I believe it to be a muddle of thinking, not a fact - of psychology. My theory tries to explain the direct act of seeing.

He believes that the color patches of visual sensation are the basic ingredients of perception, whereas I maintain that they have nothing to do with perception. He assumes that sensations are depthless and that the third dimension of space has to be added to sensations, whereas I deny this and assert that the way the surfaces of the world are laid out is seen directly. He believes that visual sensations (the flat aspects and perspectives of things) are obtrusive in our experience, whereas I believe that they are obtrusive only when we pay attention to the aspects and perspectives of things. He thinks that aspects and perspectives are necessary for perception, whereas I think they are only incidental symptoms of perception, having no relevance to the pickup of information.

He believes that a sheaf of elementary light-rays is the optical basis of perception, each ray being a stimulus. This is what physics tells us and I too used to accept it with due respect, but not any longer. I am now convinced that the information in an optic array lies in its invariants of structure, not in its rays of light. The rays of light coming from a picture and the rays of light coming from the scene pictured should never have been compared with one another.

Professor Gombrich believes that there can be a gradual and continuous reduction of information content' from the extreme of naturalistic viewing to the opposite extreme of being presented with a line drawing. But this is precisely what I was denying in my article; I denied that a picture can ever be wholly indistinguishable from the thing pictured. I make a 'radical separation between the perception of reality and the perception of pictures' but he cannot accept this separation for he believes the

postulate of a continuity between them. In short, he believes there is no clear and logical break between the real and the illusory.

He suggests that pictorial representation is always, an experiment in the reduction, the cutting down of information available to the viewer'. But what he means by information and what I mean by it are different. He means light-rays, whereas, I now mean invariants of structure - what I called the formless and timeless invariants that specify the distinctive features of things. On this theory, a successful caricature is not a reduction of the information in a natural array but an enhancement of it.

Professor Gombrich has probably read more about the psychology of perception than has any other art authority in the world. The trouble is that the psychology of perception is a tangle of contradictions. He has tried to distill some useful truth from the various conflicting theories. He has not rejected their very foundations, as I have done.

What I am now saying about pictures is closer to what Professor Arnheim says about them than what I used to say. That is true. And what he now believes is closer than formerly to what I believe. This is very encouraging. The gap between psychology and the arts, which we both deplore, may really be getting narrower. I very much want to be his ally in bridging the gap. But there is still a considerable difference between his theory of perception and mine.

He says that 'an image can be true without presenting any version of what meets the eye in the outside world'. But that is to reassert the old, old muddle, the tiresome contradiction, of supposing that perception comes only partly from outside the perceiver and partly from inside. I would say that an image cannot be true unless it presents some version of what meets the eye in the outside world. There has to be information available in the light for true perception to occur.

Professor Arnheim does not catch the significance of what I mean by invariants. The information conveyed by caricatures and portraits, he says, resides in the totality of their shapes and colors, not in an invariant core from which the shapes and colors must be subtracted'. But I meant to suggest that the information resides neither in shapes nor in colors nor in a totality of shapes and colors. I was arguing that information is absent not only from visual sensations but also from the total Gestalt of visual sensations. The invariants of structure that convey information in an optic array are formless and timeless. What makes a Daumier portrait informative, I think, is neither concrete forms and colors nor abstract symbols but lawful invariants.

He says that I use the term 'information' to mean what a perceiver gets when he is interested in nothing but the identification of an object. A teapot is a teapot and a wife is a wife, in any perspective. I did describe optical information at that level in my article but I do not mean that it is limited to that level. There are delicate, subtle and profound things to be noticed even about teapots, let alone wives, and painters have noticed them. These subtleties have to be in the optic array over time in order to be noticed. They have to exist in some features of its enormously complex structure. Professor Arnheim says that perception seizes on the inexhaustible wealth of sensory experience whereas I say that it selects from the inexhaustible wealth of optical information. There is the difference between us. I wish he could be persuaded to think of the visual sense in the new way, as a perceptual system instead of a pipeline for visual sensations. If he did so, perhaps, 'the desperately complex, unruly array of [198] data with which many of us have been struggling for lifetime' would seem less chaotic and more orderly.

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Letters, Leonardo 4, p. 308, 1971

ON INFORMATION AVAILABLE IN PICTURES (cont.)

I have learned too much from Professor Gibson not to be aware of the problems raised by the traditional accounts of perception, notably in relation to the perception of space. But I may be forgiven if I wish he had attended in his reply to the problems which, in my view, are raised by his revolutionary account and which I tried to formulate in a number of specific questions. I still wonder, for instance, what Professor Gibson would say to a painter who wanted to paint the Mont Cervin out of his hotel room in Zermatt. Would he ask him to tour all the surrounding valleys in order to embody in his picture the invariant features rather than a particular aspect? And what would the finished result look like?

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CORRECTIONS RECEIVED

The last note at the end of my article, 'The Information Available in Pictures', Leonardo 4, 27 (1971), refers to Pirenne's new book *Optics, Painting and Photography*. He and I agree about the power of perspective. But the last sentence of this note implies that we also agree about the analogy between the eye and a camera (a typographical error having crept in). I do not accept the eye-camera analogy, since I strongly disbelieve that the retinal image is an image in any proper sense of the term. It cannot be looked at, for there is no seer inside the head to see it. The so-called retinal image is a complex of optical invariants. The matter is important for an understanding of what I was trying to suggest. Hence this correction.

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