E. H. Gombrich, 'The sky is the limit'; The Vault of Perception and Pictorial Vision, Perception: Essays in Honor of J.J. Gibson, Ithaca and London, 1974. [Trapp no.1974F.1]

'THE VISUAL field is the product of the chronic habit of civilized men of seeing the world as a picture. "This statement by J.J. Gibson, dating from 1952,[1] which he has subsequently described as a 'half-way stage' to his developed views, must serve as an explanation for the presence of an art historian among professional psychologists."[2], In Art and Illusion I picked up this remark which assigned such crucial importance to the role of pictorial art in our visual habits, and paid tribute to 'this bold reversal of the traditional way of putting things'[3], I had reason to welcome this departure from orthodoxy, for originally I had accepted the current opinion that what Gibson called 'the visual field', the two-dimensional mosaic of sensations registered by the retina, should be described as what we 'really' see, while the three-dimensional 'visual world' was to be explained as the product of our knowledge, mainly derived from the experience of touch. This account of perception, which played such a vital part in the theory of Impressionism, I found increasingly hard to square with the observed facts of image making. Indeed I was prompted to add that 'the psychologist might with profit test his theories against the material offered by the historian. He might find … that the "chronic habit of civilized men" is not sufficient for most of them to adopt the necessary attitude to paint without training.'

In his book of 1966, *The Senses Considered as Perceptual Systems*, Gibson came to even more radical conclusions, arguing that 'the optical (not retinal) gradients and the other invariants that carry the information for perception are often not open to analytic introspection, and that perception is therefore, in principle, not reducible to sensations.' [4] It is this impossibility consciously to analyse our act of perception, I would suggest, which accounts for the *[162]* artist's need to approach the problem of naturalistic painting by trial and error. Though he cannot foretell exactly what device may have the desired effect, he can judge whether he can recognize the effect in his picture.

But if that is so, the problem remains how painters and psychologists (including, after all, Gibson himself) could ever have thought that we can reduce our perception to pure sensation. The answer which I gave to this question in Art and Illusion was hardly a model of clarity. 'Our belief that we can ever make the world dissolve into such a flat patchwork of colours rests in itself on an illusion, connected, maybe, with the same urge for simplicity that makes us see the indeterminate sky as the vault of heaven.'[5]

I hope J. J. Gibson will accept an elaboration of this cryptic remark as a modest contribution to these essays in his honour and as a continuation of the friendly debate in which we have been engaged in the journal *Leonardo*.[6]

Gibson does not much like the student of perception to call heaven as his witness. 'The night sky,' he writes, 'is not the case with which to begin the analysis of stimulus information … Points of light can structure the darkness … but it is not the kind of structure that evokes a perception of space.[7]

It is undeniable that what Gibson has described as the 'old, old idea, that perception cannot be separated from misperception'[8] derived much strength from that example. For the night sky may well have been the case with which mankind began the analysis of stimulus information. It was in the discussion about astronomy in ancient Greece that the famous phrase 'saving the phenomena'

was first coined.[9] No hypothesis about the real movement of the planets in space that did not account for their apparent movement on the night sky was acceptable. In this case, at least, Gibson would surely agree that 'our faith in the direct act of seeing the world is misguided', though in the course of our debate in *Leonardo* he brands this opinion as a muddle of thinking, not a fact of psychology.[10]

The student of art certainly has reasons to take note of Gibson's attack on the traditional distinction between appearance and reality, for at least since the time of the Greeks art has always been said to be concerned precisely with the imitation of appearances.[11] This dualism has indeed caused a good deal of muddle in the theory of art, not least in the teaching of painting. At a time when painters were taught anatomy and perspective in order to enable them to create a semblance of the natural world, the demand that the painter should stick to appearances to the extent of trying to forget what he merely 'knew' proved to be in flagrant conflict with actual practice. Nor were the arguments against these methods and in favour of the 'innocent eye' ever consistent or effective. The phenomenal world eluded the painter's grasp and he turned to other pursuits. *[163]*

Art and Illusion is largely concerned with the reason for the collapse of a theory of art which concentrated on the need to copy the phenomenal world. Most of these reasons have of course long been known to students of perception, but it still remains difficult to avoid confusions when applying them to the painter's problems. This is happily not the place to return yet once more to that perennial question of the validity of various systems of perspective. I have argued elsewhere[12] that what Brunelleschi invented was a method of working out what will be occluded by what in our field of vision from any given station point. The objectivity of this demonstration is not in doubt; what caused and still causes the trouble is the concept of 'apparent size' that has been imported into these discussions.[13]

I recently watched the moon rising over Hampstead Heath when I noticed a child holding a toy balloon. My effort to find the point at which the balloon would exactly occlude the moon was unfortunately frustrated by the unwelcome attention my eccentric behaviour appeared to arouse. Yet I still can recommend this exercise to less inhibited students of vision who are interested in the various factors influencing apparent size, such as the constancies and Emmert's Law, which has been connected with the notorious moon illusion.[14] But my walks on the Heath have also convinced me that, though apparent size is an elusive entity, apparent orientation is still more elusive. While observing the vapour trails of jet planes which so frequently disturb the calm of a cloudless sky I have come to appreciate the reasons why some students of art, including the great Panofsky, asserted with such conviction that we 'really' see straight lines as curved.[15] To appreciate, but not to accept. I believe, with Gibson, that normally the visual array contains all the information we need to perceive the invariant forms of edges and solids. If we did not recognize a straight line as straight and a plane as plane we would soon come to grief. But somewhere near the limit of my visual world this assurance obviously breaks down. Even though I have reason to think that the course of the jets is straight, I tend to see the trail rising over the horizon and arch around me, flattening overhead, but turning down steeply before it vanishes. I tend to see a similar curvature when the flight path is closer to eye level and appears to swing round parallel to the horizon. I say I 'tend to', because it is only the distant flight that appears more or less traced on the dome of the sky. As soon as the aircraft is seen to recede and the trail is visibly structured in its rhythmical puffs of vapour, the real orientation of the line asserts itself.

It is the same with real, as distinct from these artificial, clouds. Some appear to be distributed like flat patches along the vault of heaven or to race around the horizon in a storm, but lighting

conditions and mutual occlusion *[164]* of shapes may suggest alternative orientations. This occurs most dramatically when aircraft weave in and out of these concentrations and give us additional information about their approximate distance so that a bank of clouds which had appeared to be far up suddenly becomes part of our world.

I believe a similar elasticity can be experienced with all features of the scenery which obey the conflicting pulls of the foreground and the background. Students of landscape painting know indeed that the transition between these two zones, with their very different representational problems, have caused a good deal of trouble to various conventions of landscape painting. Both the Graeco-Roman and the Chinese masters of the genre refused to acknowledge the middle ground and preferred to veil it in haze or mist (Figs. 142 and 143). Thus they achieve a sharp distinction between houses or rocks in the proximity, which are made to look solid, and *[165]* the mountains or trees in the distance, which are projected as flat shapes against the sky. In other words, such features are (or can be) seen at an unspecified distance but in an imaginary orientation aligned with the distant panorama which we scan.

The phenomenon is both akin to and different from the experience of the night sky, for now it is the objects in front of the imaginary back-cloth which arrange themselves in a sphere or spheres parallel to the enveloping limit.

With regard to this limit then, Gibson's formulation 'that the way the surfaces of the world are laid out is seen directly' does not apply,[16] since in his own analysis the perception of invariants depends on information conveyed through texture, parallax and illumination. All these fail us with distance, and the decrease in information is gradual and uncertain. At dusk or in mist the silhouetted world around us will come closer; when the air is clear and the light sharp, the forms even of distant features will reveal their layout. Sometimes, perhaps, we may also be able to switch from one attitude to the other, particularly in the middle ranges, where we can ignore information even without half-closing our eyes as painters sometimes do when they want to concentrate on 'appearance'.

Is it really likely that we owe this mode of perception entirely to the painters? Long before anybody ever painted a cloud, the Biblical chronicler described dramatically how the prophet Elijah's prayer for rain was answered. 'Behold, there ariseth a little cloud out of the sea, like a man's hand' (I Kings 18: 44). Clearly the perception of such a sign or portent can never be veridical. The witnesses had no information about the cloud's real size or shape, their perception was what Gibson might call 'pictorial'.

The reason why Gibson considers this to be merely derivative lies, I believe, in his strong evolutionist bias. The eye was given us so that we should find the way to our food and our mate without bumping into things or falling prey to predators. But though this function of the system is certainly paramount, there are some tasks for which veridical perception is irrelevant. I am referring to the need for orientation, for which Gibson only considers the general layout of ambient light.[17] What is also needed for that task is the perception of landmarks or perhaps skymarks, as in the navigational use which birds appear to make of the night sky.[18] These perceptions of the enveloping limit, in other words, may follow their own laws and requirements without being purely cultural developments.

Be that as it may, I would suggest that man must have reflected on this tension in his visual world as he scanned the horizon and searched the heavens. Once these reflections began, the difference

between appearance and reality must have become an object of his thought. *[166]*
If I am right in stressing this duality of purposes, Gibson was amply justified in rejecting the traditional account of the visual field as a uniform patchwork of colours spread out, we do not know where. But he may be mistaken in denying that we can experience visual fields. These fields form the limit of our visual world.

The relevance of this dematerialized distant view to art is the subject of a much-discussed book by the nineteenth-century German sculptor Adolf von Hildebrand, who incidentally counted Helmholtz among his sitters. *Das Problem der Form in der bildenden Kunst* (The Problem of Form in the Visual Arts, 1893) has many subtle observations, but I am not out to revive an interpretation which certainly has its full share of those muddles of which Gibson has spoken. One of those muddles may lie precisely in the confusion between the two modes of perception, the treatment of appearance on a par with objects. Panofsky's belief in the visual curvature of straight lines may be a case in point. If I am right, the curvature does not represent what we really perceive, but what we really do not perceive. It marks the transition from the world of solid objects to the field we scan for orientation.[19] These two distinct modes of perception may thus account for the existence of two warring schools in the theory of perspective, though it can be shown that their claims and counterclaims have very little practical relevance.
Gibson has warned us that the night sky is not the case with which to begin the analysis of stimulus information, but what about ending it in this way, or rather regarding it as a limiting case in every sense of the term? What interests the student of art in this phenomenon is precisely that it can be simulated by artifice and not only for humans but also for migratory birds. I have referred before in this context to the device of the planetarium which aims at giving the impression of the starry sky by the projection of light beams from a source in the centre of the room.[20] If it were necessary to demonstrate the importance of visual angles, this arrangement would indeed furnish the proof, since anyone placed close to the centre should see the same constellation in the dark regardless of the height of the vault. The same arrangement would also confirm Brunelleschi's procedure of a flat projecting plane, for if the room can be made sufficiently dark to make the projecting plane disappear from our awareness, the apparent configuration of dots should remain invariant regardless of the shape and orientation of the overhead screen. But what interests me in this situation, which may well be amenable to experimental tests, is the prediction that any suitable arrangement would also result in the illusion of a phantom vault of heaven which might in theory become indistinguishable from the open sky.

In discussing the problem of images Gibson has, in fact, denied this very *[167]* possibility. 'A mediated perception', he wrote in 1971, 'cannot become a direct perception by stages.'[21] And yet Gibson himself has admirably described the mediation of such a perception precisely in the context that interests me.

The appearance of sky is produced, as every theater-goer knows, by a finely textured curved surface at the back of a stage which can be flooded with illumination. It is called a cyclorama. The actual surface may be only a few feet behind the garden wall of a stage setting, but to the audience 50 feet away the illusion of depthless space will be compelling.[22]

Even for him the sky is the limit of our visual world, and a suitable limit can mediate the perception of the sky.

Perhaps I may at this point draw attention to a difference in emphasis between Gibson's definition of an image and my own attempts to discuss these matters. For Gibson, 'a picture is a surface so

treated that a delimited optic array to a point of observation is made available that contains the same kind of information that is found in the ambient optic arrays of an ordinary environment.' What matters in this definition is that it does away with 'visual sensations or appearances'. 'An artist can capture the information about something without replicating its sensations.'[23]

What I suggested in *Art and Illusion* may seem rather similar. but differs in one important respect:

To say of a drawing that it is a correct view of Tivoli does not mean, of course, that Tivoli is bounded by wiry lines. It means that those who understand the notation will derive *no false information* from the drawing - whether it gives the contour in a few lines or picks out 'every blade of grass' . . . The complete portrayal might be the one which gives as much correct information about the spot as we would obtain if we looked at it from the very spot where the artist stood.[24]

I agree with Gibson that this complete portrayal, even if it were possible, would never yield an illusion of looking at Tivoli through a window, precisely for the reason which I italicized in the preceding sentence. Any such portrayal would inevitably carry with it an amount of 'false information', or rather, the true information that we are faced with a picture.

We can reduce some of this false information, the simplest method being a narrowing of our field of vision as when we screen off the surround with our hands, the most difficult being the elimination of visible texture in a treated transparency shown in a darkened room. However we may choose to interpret the resulting experience, it seems to me hard to deny that it can be *[168]* described as enhancing the illusion by stages, even though the illusion will still fall short of the one produced by Gibson's cyclorama.

This, of course, duplicates the absence of information of the real experience by a similar absence from the stage setting. Yet it would be misleading to identify this absence with a complete negation of information. Such negation begins outside the fringe of our visual field while the empty sky expands within the field. We are thus led to fill in, to project, or whatever other word we may prefer to use for this activity. Gibson rejects with particular emphasis 'the tiresome contradiction of supposing that perception comes only partly from outside the perceiver and partly from inside'[25] but it would be a pity if the debate here got entangled in verbal definitions.

For Gibson himself has discussed such limiting cases in which something - whatever we call it - certainly comes 'partly from inside'. I refer to the section of his book on 'The Consequences of Inadequate Information', which ranges from the consequences of sensory deprivation to conditions

when the system hunts more widely in space and longer in time. It tests for what remains invariant over time, trying out different perspectives. If the invariants still do not appear, a whole repertory of poorly understood processes variously called assumptions, inferences, or guesses come into play … the general formula of the search for meaning seems to fit them all fairly well.[26]

The hypothesis which has appealed to me, as a student of art, is connected with this search. I have regarded these phantoms as gropings or testings which normally await confirmation or refutation through the incoming flow of information but which obtrude themselves on our awareness in the absence of any further results of the search. I have suggested that such gropings exhibit the strategy of testing for Simplicity.[27] I readily accept Gibson's caveat that these processes are poorly understood and I realize that the concept of simplicity itself is far from simple.[28] But I believe that the vault of heaven illustrates this process to perfection. In Art and Illusion I have

referred in this connection to an observation in V. Cornish's interesting book on *Scenery and the Sense of Sight* to the effect that in the absence of contrary information 'we instinctively regard an object as extended in the plane at right angles to the line joining the object to the eye'.[29] The author connects this phenomenon with the shape of the retina, but I preferred to interpret it as an example of a non-refuted test for simplicity.

Why, then, do we not see a flat expanse but a convex field? Because-my answer would have to be - we can never separate the static view from the flow of information that precedes and follows it. If the apparent vault is really *[169]* composed of a succession of narrow fields of vision at right angles to the momentary line of sight, we must not only expect such a curvature while we scan the heavens, we are bound also to perceive it while we try to keep our eyes fixed on one point in the sky. Introspection suggests to me that in such an unnatural situation the very processes described by Gibson for conditions of inadequate information come into their own because the area of focused vision is then surrounded by a halo of uncertainties onto which anticipatory phantoms are projected in accordance with the simplicity principle. Could this experience, perhaps, be used as a basis for further generalizations?

I am sure all students of vision have learned from Gibson a new and healthy respect for the richness of information which is ordinarily present in the visual array, but perhaps an appreciation of these resources and of these redundancies on which we can rely when finding our way through the world does not compel us to postulate a discontinuity between ordinary perception and those methods of search under conditions of reduced information. True, it is only in moments of uncertainty that we become aware of the constant productivity of the system, but if I understand Gibson correctly the hunt for invariants is always, at least to some extent, a process over time that responds, to the match or mismatch between anticipation and information. If this is indeed of relevance, as Gibson suggests in his discussion of the relation between perceiving and expecting,[30] many of the visual sensations of which we are aware may not be directly caused by the stimuli of which sensationalists speak, but rather originate in the system itself. In normal circumstances these anticipatory phantoms and the incoming information fuse so readily and so efficiently that we are neither aware of the visual stimuli nor of our visual expectancies. Only when this fusion is inhibited by external or internal causes do we actually see what I have described as 'pre-images',[31] as distinct from after-images (which are generally attributable to purely physiological processes). I have come to wonder, however, whether this distinction is likely to hold. If the 'waterfall illusion' and other sensations attending on movement can be described as anticipations based on the simple assumption that a process will continue, is the same not also true of the stationary after-image? May it not be connected with the same assumption of continuity that guarantees our stable world? Maybe, then, these images are not 'luxuries', as Gibson calls sensations, but important aids in what he so eloquently describes as 'the serious business of perceiving the world'.[32]

My excuse for such brainstorming must be found in the real subject under discussion, which is the relation between our experience of the visual world and our reaction to pictures. For Gibson, there can be no continuity between the two, but for me it is precisely where the rainbow ends that art begins. *[170]*

'Heard melodies are sweet, but those unheard are sweeter.' When Keats wrote this line about the music makers on the Grecian Urn he was only giving a new twist to the old response that we actually hear the sounds the artist asks us to imagine. For Keats the 'ditties of no tone' are 'more endear'd' than if the pipes were to play to the 'sensual ear'. It sounds far-fetched, but the human imagination is a powerful thing when expertly manipulated. Conjurors know many devices for

creating convincing phantoms through the setting up of uncontradicted expectations[33] and so, on a different level, do the purveyors of erotic art with their varieties of suggestive veiling.[34]

When Plato called pictures 'dreams for those who are awake',[35] he was perhaps more profound than many students of art, even though he disapproved of such dreams. For no account of the artist's image can be complete that ignores what Baudelaire called the 'Queen of the Faculties', the faculty of the imagination. Though he may dislike the use of this loaded term, Gibson, it seems to me, appeals to this faculty when he asserts that 'even when one sees a pictured object one ordinarily does not see its front surface only but the whole of it'.[36] Perhaps I may go beyond his paradox by suggesting that the less information is given, the more what I would still like to call 'the beholder's share' comes into play, provided of course the search for meaning is suitably guided. The visual information the painter can simulate may never actually duplicate the information we pick up from solid objects close by. But is it not possible that he can mobilize the system to produce the same phantom sensations which come into play in those processes of search or probing for simplicity precisely in situations of inadequate information? If that is true, our perception of pictures would indeed differ from the perception of the visual world, but the right stimulation from the canvas may still engender a reaction similar to that which we experience in front of nature. A fine landscape or seascape by one of the Dutch masters certainly does not give me the illusion that the museum wall opens into parts of Holland. But I would claim that in getting absorbed in such a painting my search for meaning between and behind its brushstrokes weaves on its surface a rich fabric of uncontradicted sensations. Following the artist's suggestion I begin to forget the textured surface. I see the horizon curving and the sky arching over the earth, not a mediated perception so much as a mediated phantom. I doubt whether the illusion would be stronger if the panel were rounded rather than flat or that it is much influenced by the position from which I view the painting. Little is needed, but little of the right kind, for my visual system to pick up the scent and to enjoy the pleasures of the chase, even when it is hunting that notorious Snark - the non-existent vault of heaven. *[171]*

Footnotes:
* This study appeared in *Perception: Essays in Honor of James J. Gibson* (Ithaca and London, 1974) and was republished in E. H. Gombrich *The Image and the Eye: Further studies in the psychology of pictorial perception* (Oxford: Phaidon 1982).
1 J.J Gibson, 'The Visual Field and the Visual World', in *Psychological Review*, LIX, 1952, pp. 148-51, 237.
2 J.J. Gibson, *The Senses Considered as Perceptual Systems* (Boston, 1966).
3 *Art and Illusion* (New York and London, 1960), ch. 9, section xiii.
4 *The Senses Considered as Perceptual Systems*, op. cit. , p.237. For Gibson's ultimate formulation (not yet available at the time of writing) see The Ecological Approach to Visual Perception. (Boston, 1979).
5 *Art and Illusion* , op. cit. ch 9, section xiii.
6 J.J. Gibson, 'The Information Available in Pictures' in *Leonardo*, 4, 1971, pp. 27-35; my response, ibid. pp. 195-7 ; Gibson's rejoiner, ibid., pp. 197-9, and my reply, ibid. p. 308. After the publication of this article, Gibson wrote 'The Ecological Approach to the Visual Perception of Pictures', in *Leonardo*, 11, 1978, p. 227, on which I commented in *Leonardo*, 12, 1979, pp. 174-5.
7 Gibson, *The Senses Considered*, op. cit, p. 220.
8 Gibson, Letter, *Leonardo*, op. cit., p. 198.
9 J.Mittelstrass, *Die Rettung der Phaenomene* (Berlin, 1962).
10 Gibson, Letter, op. cit. p. 198.
11 I first learned about these connectiuons between astronomy and aesthetics through a paper on

Friedrich Schiller's philosophy of art by Marie-Luise Wardeck: 'Shadows, Reflections, Mirror-Images and Virtual "Objects" in "Der Kunstler" and their relation to Schiller's concept of " Schein"' in *Modern Language Review*, LVIII, 1963, pp. 33-7.

12 See my 'The "What " and the "how" : perspective representation and the phenomenon of world' in R.S. Rudner and I. Scheffler (eds.), *Logic and Art: Essays in Honor of Nelson Goodman* (New York 1972).

13 For a lucid survey see the admirable article by B.A.R.Carter, 'Perspective', in H.Osborne (ed) , *The Oxford Companion to Art* (Oxford 1970).

14 L. Kaufman and I.Rock, 'The Moon Illusion', in *Scientific American* , VII, 1962, p. 204.

15 Erwin Panofsky, *Early Netherlandish Painting* (Cambridge, Mass., 1953).

16 Gibson, Letter, op. cit., (note 6), p. 198.

17 Gibson, *The Senses Considered*, op. cit. (note 2) , pp. 156 ff.

18 G.V.T. Matthews, *Bird Navigation* (Cambridge 1968).

19 See 'The "what" and the "how"', op. cit. (note 12).

20 See my *Art and Illusion*, op. cit. (note 3), ch. 8, section IV.

21 Gibson, 'The information available', op. cit. (note 6), p. 31.

22 *The Senses Considered*, op. cit. (note 2), p. 293.

23 Gibson, 'The Information Available', op. cit. (note 6) p. 31.

24 *Art and Illusion* op. cit. (note 3) ch.2 , section VI.

25 Gibson, *Leonardo*, 4, op. cit. (note 6) p. 198.

26 Gibson, *The Senses Considered*, op. cit. (note 2) pp. 303, 304.

27 *Art and Illusion* op. cit. (note 3), ch 8, section X, especially.

28 J.E.Hochberg, *Perception* (Englewood Cliffs, N.J. 1964).

29 *Art and Illusion* op. cit. (note 3) ch 7, section VI.

30 Gibson, *The Senses Considered*, op. cit. (note 2), pp. 279 ff.

31 *Art and Illusion*, op. cit. (note 3) ch 7, section VI.

32 Gibson, 'The Information Available', op. cit. (note 6), p. 31. Ulric Neisser in *Cognition and Reality* (San Francisco, 1976) speaks of images as 'anticipations'.

33 *Art and Illusion*, op. cit. (note3) ch 7, section I.

34 See my *Meditations on a Hobby Horse* (London, 1963), pp. 10, 40ff.

35 *Art and Illusion* op. cit. (note 3), Introduction , section II.

36 Gibson, 'The Information Available', op. cit. (note 6), p. 31.