

## 21 Descartes' theory of visual spatial perception

*Celia Wolf-Devine*

Descartes regarded his theory of vision as important to his project of replacing theories of a broadly Aristotelian sort with his own mechanistic natural philosophy. It is, for example, in his *Dioptrique* rather than in his more narrowly philosophical writings that he claims to have laid to rest the 'intentional species' that had played such an important role in scholastic epistemology.<sup>1</sup> Developing a satisfactory account of vision was necessary, he believed, because 'the principal reason which moved philosophers to posit real accidents was that they thought the perceptions of the senses could not be explained without them'.<sup>2</sup> And vision, of all the senses, is, on the face of it, the least amenable to mechanistic explanation; objects do not touch our eyes, and sight had long been regarded as the most spiritual of the senses. For vision was thought to have the highest power to abstract forms from matter, by contrast with touch which had the lowest power to do so; the eye can see a colour without physically becoming coloured, whereas the hand literally becomes warm when feeling a warm object. Thus, if he could explain vision without employing traditional Aristotelian concepts such as forms, species, or real qualities, providing a mechanistic account of the other senses would presumably pose no difficulties.<sup>3</sup>

His attempt to develop an alternative account of vision couched in mechanistic terms was, in his own eyes, successful.<sup>4</sup> His theory is, however, imperfectly mechanistic; he often supplements his mechanism by postulating various mental acts, such as directing attention out from one's hands or eyes, or making judgments to correct for perspective distortions of size and shape. As a metaphysical dualist, of course, he believes himself entitled to do this, but serious difficulties arise if one tries to integrate the components of his theory into a coherent whole.

In section 1, I briefly describe the formation of the retinal image, the anatomy of the visual system, and the way in which the retinal image is transmitted into the cerebral cavities and, ultimately, to the pineal gland. In Part 2, I show how mechanistic explanations of our perceptual abilities exist side by side with an inner homunculus in his explanation of visual spatial perception, citing some representative texts. In Part 3, I point out some of the difficulties that arise as a result of this juxtaposition of differ-

ent models. In Part 4, I offer some concluding thoughts about why Descartes became entangled in the particular difficulties he did, and how he might extricate himself from them; I suggest that resolving the sorts of problems Descartes was struggling with will necessitate, among other things, getting clearer about just what it is that we are looking for in seeking an explanation of our perceptual abilities.<sup>5</sup>

## 1

Like Aristotle, Descartes holds that our perception of light and colour results from a kind of action of the intervening medium (rather than something travelling from the object to the eye), but while Aristotle understands this action in terms of qualitative modifications of the medium, Descartes provides a mechanistic account of it. He explains light in terms of the pressure that luminous bodies exert upon the air particles, which in turn press upon the eye. Descartes' theory of colour is not without difficulties and obscurities,<sup>6</sup> but the key idea is that colour is a function of the movement of the little balls that represent light (his third model for light). More specifically, it is a function of the ratio between the speed at which they spin around their own centres and their forward motion.<sup>7</sup> Objects impart various sorts of spinning motions to the balls when they are reflected from them and this is why they appear to have the colours they do.

The light rays reflected from objects are brought to a focus on the retina by the lens. The formation of the retinal image is depicted in this illustration of an experiment which Descartes himself performed (Figure 21.1). He instructs the reader to take the eye of a cow or a newly dead man and remove the back surface or retina, leaving the rest of the eye as undisturbed as possible, to place a piece of opaque paper or egg shell behind it, and in a dark room to put the eye in the hole of a specially made window that looks out on a brightly illuminated scene so that light enters only through the eye. The reader will then, he says, see a picture (*'peinture'*) appear on the paper that represents all the objects in perspective. Light travels from objects V, X, and Y, the light from each point on the object being reunited at a corresponding point on the opaque sheet of paper. If the light being reflected by object X is yellow, then as it shines through the paper it will cause us to see yellow at point S; if V is reflecting blue light, we will see blue at point R, and so also for Y (say it is red), and T. What appears on the paper will have the same colours in the same order as V, X, and Y, thus resembling them.

This little picture, however, has certain imperfections: it is clear only in the middle, 'its parts are reversed, that is to say in a position completely contrary to that of the objects; and . . . they [the parts] are elongated and shortened some more, some less, because of the differing distance and situation of the things which they represent, in the same way as in a perspective painting'.<sup>8</sup> A small, close object occupies as much space as a

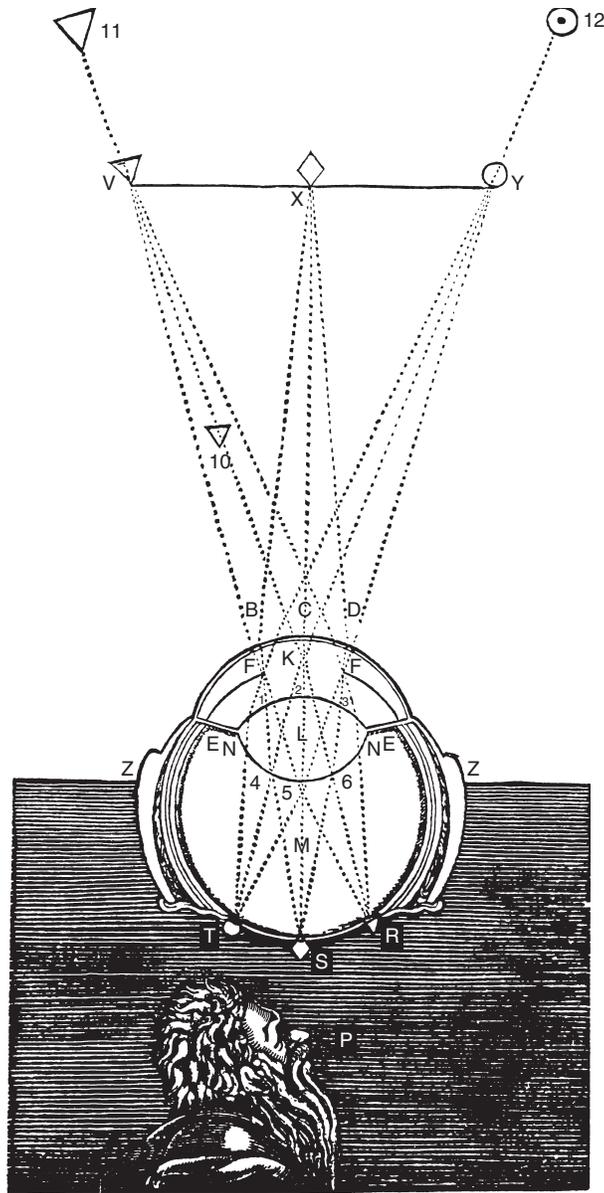


Figure 21.1

larger, more distant one, and a straight line, VXY, is represented by a curved line, RST, due to the curvature of the eye.

This explanation of the retinal image and its manner of formation is dramatic and easily visualisable. However, an unwary reader could easily be misled into supposing that in vision the soul, like the man in the dark room, somehow gazes upon the pictures painted on the bottom of the eye – a view that would obviously lead to a vicious regress, since another eye would be needed with which to see the picture. For, although the light rays impart various sorts of motions to the nerves in the retina, no ‘picture’ appears until the causal chain is broken, the retina replaced by an opaque white body, and another eye introduced.

Descartes is aware of the dangers of this sort of inner homunculus gazing at the retinal image. He insists that ‘the soul has no need to contemplate any images which are similar to the things it senses’,<sup>9</sup> and tries to head off the threat of an infinite regress by noting that

while this picture [*peinture*], in passing thus into the inside of our head, always retains some resemblance to the objects from which it proceeds, we must nonetheless not be persuaded that it is by means of this resemblance that it enables us to sense them, as if there were yet other eyes within our brain with which we could perceive it.<sup>10</sup>

But even though the soul has no *need* to contemplate images similar to the things it senses, the retinal image clearly *does* bear a resemblance to the objects depicted in it, and it retains this resemblance as it is transmitted inward to the seat of the soul at the pineal gland. Descartes is in a better position to explain what happens beyond the retina than his predecessors were because his mechanisation of light and colour enables him to treat the retinal image as a pattern of motions which can be transmitted mechanically along the nerves. The images from the two eyes are transported into the cerebral cavities (Figure 21.2), and from there to the pineal gland where they are merged to form one image. This is, he believes, necessary in order to account for the fact that we see one object with two eyes. Descartes provides no diagram of this last stage in the perceptual process,<sup>11</sup> and his characterisation of it in the *Dioptrique* differs somewhat from that in *L’Homme*, where he spells out the role of the animal spirits in the formation of the pineal image, but these differences need not concern us here.<sup>12</sup>

Essentially, then, what Descartes has done is to provide a sort of mechanised Aristotelianism in which the ‘figure’ rather than the ‘form’ of the object is conveyed to the soul at the pineal gland. A pattern of light projected onto the retina is converted into a pattern of motions at the surface of the pineal gland. The visual system, thus, functions rather like an Opticon – a device, used by blind people, which is moved along a line of print. It converts the pattern made by letters on a page into a pattern of

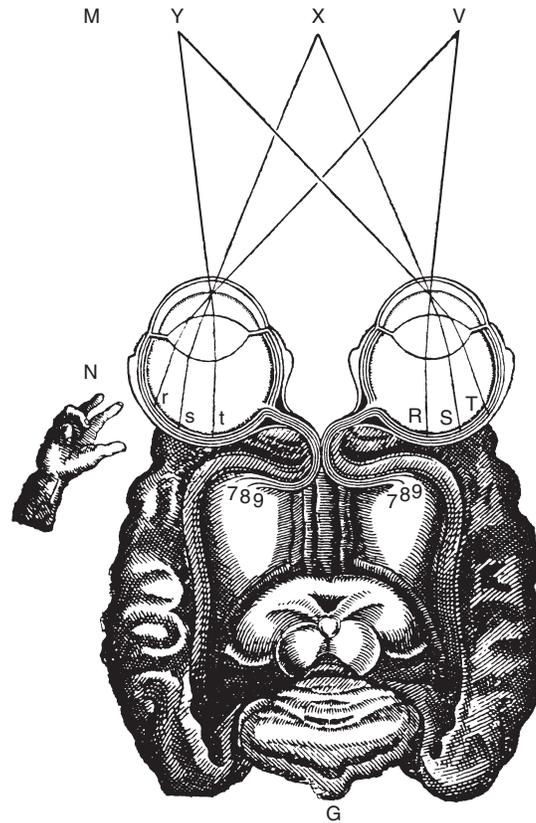


Figure 21.2

vibrations that can be felt on the tip of a finger. The pattern of motions at the surface of the pineal gland, then, acts immediately upon our soul (*agissant immediatement contre notre âme*)<sup>13</sup> in a way instituted by Nature to make us have certain sensations.

## 2

Light and colour perception would seem, on the face of it, to be adequately explained by the mechanisms described above. Although the motions that compose the pineal image bear no resemblance to light or colour as we experience them, they make us have sensations of light and colour because of the way God joined our mind with our body (just as the motions in the nerves coming from the ears cause us to hear sounds). But, even leaving aside the problem of colour constancy (which Descartes does not seem to be aware of),<sup>14</sup> things are not quite so simple. We perceive colours (unlike, say, odours) as spread out in space, and thus colour per-

ception is interwoven with our perception of size and shape, which are in turn connected (on Descartes' view) with our perception of situation and distance. And since, according to Descartes, the pattern of motions at the pineal gland is structurally isomorphic with the retinal image (which is roughly two-dimensional, inverted, reversed, and subject to perspective distortions of size and shape), an explanation must be given of how we are able to perceive correctly by sight the situation, distance, size and shape of objects.<sup>15</sup>

Supplementary mechanisms, then, must be postulated over and above the point-to-point projection of the retinal image to the pineal gland, and the ones Descartes provides form a rather heterogeneous and ill-assorted group. Some of them do not seem to require any sort of activity by the soul. A certain change in the position or motion of the parts of our brain simply causes a certain perception as a result of the 'institution of Nature' (i.e. the way God joined our souls and bodies together). But others involve a kind of inner homunculus; the soul *does* things like directing attention out from various body parts to determine the situation of objects, or correcting for perspective distortions in the retinal image on the basis of its knowledge or opinion about their distance and situation.

The clearest example of Descartes' reliance on a mechanistic model is in *L'Homme*, where he suggests that the degree to which the pineal gland leans toward or away from the centre of the brain is one of the things by which we are able to know the distance of objects.<sup>16</sup> And in the *Dioptrique*, he supposes that when we change the shape of our eye to bring a near object into focus, we 'change also a certain part of our brain, in a way which is instituted by Nature to make our soul perceive this distance (*faire appercevoir à notre âme cette distance*)'. This happens ordinarily without our thinking about it, he says, just as we grasp an object which is in our hand without having to think about the movements our fingers make.<sup>17</sup>

Simple situation perception (perception of the direction in which an object lies relative to our body) is likewise explained mechanistically. Our perception of this builds upon our awareness of where the various parts of our body are in relation to each other (itself a result of the institution of Nature). Our awareness of the direction in which our eye or head is turned enables us to determine where the object is located relative to our body, just as a blind man touching an object with a stick can tell what direction it lies in because he knows the direction in which his hand is turned.

But in the more complicated case of determining the relative position of several objects seen with one eye fixation, Descartes begins to drift in the direction of an inner homunculus, developing an analogy between a blind man with crossed sticks who is able to feel an object to the right with his left hand and one to the left with his right hand and a person who sees objects in their true situation 'although the picture which they print in the eye has a wholly contrary situation'.<sup>18</sup> The blind man is not confused by the crossed sticks because he can direct his attention out from his hands

along straight lines to tell where the objects are (even though ordinarily he may not do this consciously). Descartes does not explicitly say that we can direct our attention out from various retinal points, but if one takes the analogy seriously it would seem to follow that we at least *can* do this.

The homunculus model is most prominent in his discussions of shape and size perception and in his account of monocular distance perception.

In *L'Homme*, Descartes says that shape perception can be explained simply by the fact that the light rays trace on the retina a figure which corresponds exactly to that of the object.<sup>19</sup> But in the *Dioptrique* he says:

Figure is judged by the knowledge or opinion we have of the situation of the different parts of the object, and not by the resemblance of the pictures in the eye: for these pictures usually contain only ovals and rhombuses when they make us see circles and squares.<sup>20</sup>

Size perception likewise involves judgment according to Descartes:

Their size is estimated by the knowledge or opinion we have of their distance, compared with the size of the images which they imprint on the bottom of the eye; and not absolutely by the size of these images, as is obvious enough from the fact that when they [the images] are a hundred times larger when the objects are very close to us, they do not, for all that, make us see them as 100 times larger, but as nearly the same size, at least if we are not deceived about their distance.<sup>21</sup>

Descartes' account of distance perception involves the same analogy between vision and a blind man feeling objects with sticks that he used for situation perception. (This is, of course, more than just an analogy since Descartes' theory of vision essentially treats vision as a special form of touch.) In the case of binocular distance perception, he says that we 'know' distance (and here the French verb is *connaître*, which has the meaning of 'to be acquainted with' – the same verb he uses in the situation section)

by the relation which the two eyes have to each other. For as our blind man, holding two sticks AE, CE, whose length I suppose him not to know, and knowing [*savoir*] only the distance between his two hands A and C, and the size of the angles ACE and CAE, can from that, as though by a natural geometry, know [*connaître*] where E is [Figure 21.3]; thus when our two eyes RST and rst are turned towards X, the length of the line Ss and size of the two angles XSs and XsS make us know [*connaître*] where the point X is [Figure 21.2].<sup>22</sup>

There are three interesting things about this passage. The first is his use of the verbs *savoir* and *connaître*. The verb *savoir* (connoting an intellectual



Figure 21.3

kind of knowledge) is used to describe the blind man's knowledge of the distance between his hands and the angles made by the sticks, while *connaître* (meaning 'to be acquainted with') is used to describe his knowledge of where the point E is, as though he is trying through this use of the different verbs to arrive at the sort of directness and immediacy associated with the verb *connaître*, starting from intellectual and perhaps implicitly mathematical knowledge.<sup>23</sup> Second, Descartes refers to natural geometry only in his discussion of the blind man, whereas in the case of vision, he says that the length of the line and the size of the angles 'make us know' (*connaître*) where the point E is. Third, Descartes says that we know where the point E is 'as though by a natural geometry', and does not claim that we actually *use* geometry – a claim that would cause all sorts of problems even in the more plausible blind man case. It may be plausible to assert that the blind man knows the direction his hands are turned, but surely one would hesitate, for example, to say that he knows his hands are 18 inches apart and that the base angles formed by the sticks are  $55^\circ$ . This would obviously be a hopeless over-intellectualisation of perception.

In the case of monocular distance perception, however, Descartes relies more explicitly on an act of judgment. A blind person with only one stick whose length he does not know, could not tell how far away an object was. So a person with only one eye must look at the object from point S and then move to look at it with the same eye from point s (Figure 21.2).

This will suffice to make the size of the line Ss and of the two angles XsS and XsS found together in our imagination, and to make us notice the distance of point X; and this by an act of thought which, being only a completely simple imagination, nonetheless includes within itself a reasoning similar to that which surveyors use when they measure inaccessible places by means of two different observation points.<sup>24</sup>

Here, at last, we have an explicit reference to an act of thought which includes reasoning. However, its status is quite unclear. It is an act of thought essentially involving the imagination, since the imagination retains the information necessary for determining the distance of the object – namely, the length of the line and the size of the angles. It is a simple act of thought, presumably because we discover no parts in it; it occurs in such a way that we are not aware of making any inferences or doing any reasoning. Yet it includes some sort of reasoning, and it must be the soul that does this, since only mental substances can engage in reasoning.

### 3

The homunculus model generates some serious difficulties for Descartes. For when he employs it, he speaks of the soul making judgments of various sorts – for example, correcting for perspective distortions of size and shape. Such judgments are anomalous for two reasons. First, it is clear that the retinal image and/or its pineal correlate have a privileged status in vision, but very unclear just what that status is. Descartes clearly rejects the view that the soul somehow gazes at the retinal image on the grounds that it would require the soul to have eyes. Yet his account of size perception, for example, requires that we have access to the retinal image in *some* sense. In what sense do we and in what sense do we not have access to it? Second, given Descartes' equation of mind with consciousness, any mental act must be something we are aware of or at least *can* be aware of. But it seems (prima facie at least) impossible for us to be conscious of many of the sorts of activities Descartes attributes to the mind when using the homunculus model. The blind man *could* consciously think about the position of his hands and direct his attention out along the sticks (even though he normally does not do so), but directing our attention out from various points on our retinae does not seem to be something we can do consciously at all.

Furthermore, how are his two different sorts of explanations to be fitted together? While Descartes may be entitled to use two different models, he appears to be unaware that he is doing so, and therefore fails to address some important questions. How are we to tell when we should employ one model rather than the other? Are some types of perceptual abilities wholly explainable by only one of the models or are both of them operative in all perception? If both are operative, how can the soul be, at the same time, wholly passive (as it is on the mechanical model) and actively involved in reasoning and judging (as it is on the homunculus model)? Is there any reason, in principle, why we must retain the homunculus model, or could it be dispensed with as our mechanistic explanations become increasingly complex and sophisticated?

Consider, for example, the case of monocular distance perception discussed above. Why does he find it necessary to postulate reasoning here?

There are several possible reasons. The most distinctive thing about this case is that it necessarily involves memory, at least the sort of short-term memory involved in the imagination retaining information between the first and second eye fixations. This, however, seems to be merely the sort of corporeal memory we share with the animals and not anything that would make it necessary to postulate an act of reasoning.

Another possible reason is that we find with both binocular and monocular distance perception a certain sort of irreducible complexity not found with our perception of situation. Given Descartes' explanation of vision by means of a point-by-point projection of the retinal image to the pineal gland, one fixation of one eye just cannot be enough – either two eyes or two eye fixations are required. Thus, it would seem that the mind must somehow be involved in the comparing and combining of the different inputs. This may well be what moves Descartes to speak of reasoning here, although if it is, it is not clear that the necessity of combining several inputs requires us to postulate any reasoning process or involvement of the mind. After all, several inputs are involved in even the simplest of perceptions – such as my seeing a blue object to my right, which involves at minimum the different motions that cause me to perceive blue, plus the changes in the brain that enable me to tell which direction my eyes and head are turned. There seems, thus, in principle, no reason why a mechanistic explanation could not accommodate any number of inputs simply by hypothesising that when all these changes occur in the brain simultaneously, they cause us to have certain perceptions, without reference to the mind engaging in any reasoning process.

The only other possible reason for postulating an act of reasoning here is that in these two cases the inputs to be combined are at least implicitly mathematical – the length of lines and the size of angles – so it would seem that the powers of reason would be required. An animal would, presumably, be quite incapable of perceiving distance in this way. Had Descartes provided any account of animals' visual spatial perception, it would have been very helpful for our understanding of human distance perception, but the part of the *Principia* that was to deal with plants and animals was never completed.

Finally, then, how could Descartes' explain the perceptual capacities of animals? To take distance as an example, if judgment or reasoning is necessarily involved in distance perception, it would follow that animals could not perceive distance. And if the standard interpretation of Descartes' view of animals is correct<sup>25</sup> – namely, that they lack any sort of consciousness at all – then we cannot explain their perceptual abilities by the way God joined the motions in their brains with sensations either.<sup>26</sup> Yet some animals at least are clearly able to tell by sight how far away things are. Although we do not know how Descartes would have explained this fact, there are indications that he saw animal perception operating in much the same way that human perception does, at least for some range

of perceptual abilities, since the drawings he uses in the *Dioptrique* were drawn from a sheep's brain.<sup>27</sup> As he explains in a letter to Mersenne in 1637,

the figure of the brain which I put in the *Dioptrique* is drawn from that of a sheep, of which I know that the ventricles and other interior parts are much larger because of all of the mass of the brain, than in that of a man; but I judged it even more appropriate for this subject to make it possible to see that of which I was speaking, which is common to beasts and men; for I did not suppose anything new or controversial in anatomy.<sup>28</sup>

Descartes employs the drawing in the *Dioptrique* while talking about the physiology of the visual system, and therefore it follows that he believes that the basic physiological mechanisms he describes there are 'common to beasts and men'. How, then, does a sheep perceive the distance of objects? Even those who contend that Descartes does not deny consciousness to animals,<sup>29</sup> or that Descartes need not have denied consciousness to animals and had no good reason to do so,<sup>30</sup> still do not contend that Descartes believes animals to be capable of making judgments of the sort he ascribes to the human soul in his discussion of spatial perception. So how *do* animals perceive the spatial properties of objects? These problems did not arise in the same way in the Aristotelian framework, since the sensitive soul, which was common to animals and human beings, performed many of the functions which Descartes attributes to the mind.

On the other hand, if we suppose that a wholly mechanistic explanation *could* be given for animals' visual spatial perception,<sup>31</sup> then it would seem unnecessary to postulate judgment in the human case. Descartes, thus, seems forced to choose between either intellectualising animal perception (which is, of course, out of the question), or completely mechanising human perception (or at least those perceptual capacities we share with beasts).

It might seem, in light of what has been said so far about his desire to replace the Aristotelian account of sense perception with one more compatible with the new mechanistic science, that Descartes would unambiguously welcome increasingly sophisticated mechanistic accounts, in the hope that these would eventually obviate the necessity of assigning any role to judgment in perception.<sup>32</sup> I am inclined, however, to think that Descartes might be hesitant to eliminate completely the element of judgment from his account of human perception. Just how far he wants to go in mechanising the various processes that occur in the body-soul composite is not entirely clear. Several other essays in this volume discuss this question (especially those by John Sutton and Dennis Des Chene), so I limit myself to a few comments bearing on sense perception.

Certainly, Descartes is not *required* to eliminate the element of judg-

ment from perception.<sup>33</sup> He is after all a dualist and not a materialist. True, he wants to eliminate Aristotelian forms, real qualities and species from the world, and having eliminated them from the world, he cannot postulate them in explaining the processes that occur within the perceiver's body; they are not out there to act on our senses. He also wants to eliminate the Aristotelian nutritive and sensitive souls,<sup>34</sup> but the existence of an immaterial soul that distinguishes humans from beasts is something Descartes is strongly committed to. Certain human capacities can only be explained by reference to the rational soul – language use, for example.<sup>35</sup>

Not only is Descartes not required to eliminate the element of judgment in perception, but he might regard it as ineliminable in principle, since perception is a cognitive faculty (unlike, say, digestion or respiration). He says at the start of Discours IV of the *Dioptrique* 'it is the soul that senses and not the body,' citing as evidence the fact that when the soul is distracted by ecstasy or contemplation the body remains without sensation.<sup>36</sup> He would not say that it is the soul that digests our food or causes our hearts to beat. Since the only soul we have is the rational soul, our sensory capacities would seem to be interwoven with and pervaded by reason. The perceptual capacities of the soul-body composite, then, being the powers or capacities of a rational being, at least *may* diverge in some important ways from the perceptual capacities of animals. Just where the divergences occur is, I believe, something Descartes had not worked out to his satisfaction,<sup>37</sup> although there are intriguing hints scattered about in his works.

#### 4

Why did Descartes get entangled in the sort of difficulties he did, and how might he extricate himself from them?

One reason for his difficulties, I think, is that he retained certain features of the Aristotelian way of thinking about perception, which, when coupled with his mechanism, led him into erroneous suppositions about the role of the retinal image in vision. He was, as Wittgenstein might say, held captive by a picture. Descartes really knew very little about the structure and function of the visual system (his ideas about the animal spirits and the pineal gland, for example, were almost pure science fiction<sup>38</sup>). For this reason philosophical assumptions played a large role in shaping his physiological hypotheses, and his own philosophical training had been largely in the Aristotelian tradition.

Like Aristotle, Descartes believes that some sort of unification of the input from the senses must occur on a physiological level in order to explain the unity and integration of our sensory consciousness. And while Aristotle sees sensation as a process in which the sense receives the form of the object and conveys it inward to the seat of the common sense, Descartes thinks in a similar way, but replaces 'form' with 'figure':

It is necessary to beware of assuming that in order to sense, the mind needs to perceive certain images transmitted by the objects to the brain, as our philosophers commonly suppose; or at least the nature of these images must be conceived quite otherwise than as they do. For inasmuch as they [the philosophers] did not consider anything about these images except that they must resemble the objects they represent, it is impossible for them to show us how they can be formed by these objects, received by the sense organs, and transmitted by the nerves to the brain.<sup>39</sup>

Descartes' theory, then, fills in this gap, showing how the retinal image is formed and projected to the cerebral cavities and, ultimately, to the surface of the pineal gland, thus producing a resembling image of sorts. The pattern of motions at the surface of the pineal gland is not an image in the sense of being something we can look at, but it is structurally isomorphic with the retinal image. Each retinal point is represented in the pineal gland image – or rather as many retinal points are represented as the number of the optic nerves – and spatial relationships between them are preserved. It thus bears a resemblance to the object seen, but the resemblance is an *imperfect* one, due to perspective distortions of size and shape, and thus an explanation must be given of how the imperfections of the retinal image are corrected for. This, in turn, entangles him in the thorny problems discussed above concerning our access to the retinal or pineal images and the nature of the corrective judgments involved. Paradoxically, Aristotle, knowing less about vision, did not fall into this sort of difficulty, since he did not try to specify what physical processes were occurring when the sense faculty was taking on the form of the object.

Aristotle took the heart to be the seat of the common sense, while Descartes took it to be the pineal gland, but the underlying rationale given for believing that some sort of unification of the input from the senses had to occur on a physiological level was surprisingly similar.<sup>40</sup> Subsequent research on the visual system, however, has discovered that the retinal images are not in fact merged; they are projected to several different areas of the brain and are subject to topological distortion. The eyes are in constant rapid motion so that the image projected on the retina changes constantly while our visual field remains stable. So while the retinal image still retains a central role in vision, that role must be quite unlike that envisioned by Descartes, and the unity of our visual field cannot be read off the physiology of the visual system in any simple way.<sup>41</sup>

In light of all this, then, how might we try to resolve Descartes' problems about visual spatial perception? If we remain within the basic framework he set out – his dualistic metaphysics and his account of the structure and function of the visual system (described in section 1 above) – then some explanation must, indeed, be given for why we do not perceive

things as they are represented in the retinal image. His successors tried several different ways of resolving this problem, but none of them appears to be entirely satisfactory.

One way of attempting to solve the problem was to accept Descartes' view that the mind or soul makes some sort of corrective judgments, and try to clarify their nature and explain why it is that we are not conscious of making them. Perhaps the mind does really make judgments, but we do not notice that we are doing so because these judgments have become so quick and habitual.<sup>42</sup> But this is subject to serious objections. For one thing, there is the problem of animal perception discussed above. But even in the human case, some of the judgments Descartes postulates involve things of which we cannot be aware. We thus could never have made such judgments consciously in the first place, so they could not have become habitual.

Or we could drop the notion of judgment and replace it with mere association of ideas. The perception of certain ideas, then, simply causes our minds to perceive also other ideas that have been experienced in close conjunction with them. A thorough examination of this line of thought cannot be undertaken here, although, on the face of it at least, this sort of explanation seems not to explain, but merely to state that as a matter of brute fact certain ideas tend to be aroused by other ideas commonly associated with them. Some reason should at least be given for why certain ideas bring others to mind (memory traces in the brain?, the action of God?, etc.).<sup>43</sup>

A third and more radical way to resolve the problems with the special status of the retinal image (and its pineal correlate) and the nature of the perceptual judgments involved in visual spatial perception is the hyper-theologising route chosen by Malebranche. Realizing the enormous complexity of the judgments involved in correctly perceiving the size, shape, motion and distance of objects (he calls these 'natural judgments'), and noting the speed with which such judgments occur, Malebranche concludes that such judgments are performed not by the soul but by God, who excites them in us on the occasion of certain changes in our nerves and brains. God, he says,

fashions them in and for us in such a way that we could form them ourselves if we knew optics and geometry as God does, if we knew everything that occurs in our eyes and our brain, and if our soul could act on its own and cause its own sensations. [He] always acts in consequence of the same laws, always according to the rules of geometry and optics, always dependently upon the knowledge of what takes place in our eyes compared with the situation and motion of our bodies, always in consequence of an infinity of instantaneous inferences which tend to preserve our life and which vary with each movement of our eyes.<sup>44</sup>

Natural judgments thus appear to us to be mere sensations, but in fact they can be considered in relation to God as a kind of judgment.

A fourth possibility is eliminating the homunculus and becoming more consistently mechanistic than Descartes himself was. We would then limit ourselves to describing the changes that occur in our nerves and brain when we perceive certain things visually. If these may be of any degree of complexity, then one could just say that whenever a certain complex set of changes in the nervous system and brain occurs, we have a perception of the situation, distance, size, and shape of objects – all this as a result of the institution of Nature.

Both the hyper-theologising route or the mechanistic route threaten to make God responsible for our errors – either directly in the case of Malebranche's solution, or indirectly in the mechanistic case, since the institution of Nature is God's doing. This may be one reason why Descartes did not choose either route.

Finally, we could cut the Gordian Knot and say that because the eye does not function like a camera, the retinal images are not merged in the way Descartes thought they were, and Descartes' hypotheses about the animal spirits and the pineal gland were incorrect; there is therefore no reason to suppose that, in the absence of corrective judgments, we would see things as they are represented in the retinal image. Many of Descartes' problems were, then, pseudo-problems. On the whole, this seems the best route to take.

This, however, leads to one last question. What is it that we are looking for, in seeking an explanation of our ability to visually perceive the situation, distance, size and shape of objects? One can, of course, under laboratory conditions, discover that binocular disparity is important for depth perception by presenting slightly differing images to the two eyes and observing how this affects the subject's perception of the third dimension. One can determine which parts of the brain are involved in vision by monitoring electrical activity in certain regions and correlating this with the presentation of varying stimuli or with the subject's introspective reports. One can even artificially stimulate parts of the visual cortex and either observe the subject's behaviour or (in the case of human subjects) have the subject describe his or her visual experience.

But there is something unsatisfying about invoking these sorts of things as explanations of our visual capacities. This happens, and then that happens, . . . and then we see. There is an abrupt jump from some sort of complex description of the condition of our nerves and brain to our conscious experience. An explanation should, after all, make the phenomenon explained more intelligible.

What constitutes an explanation, and why, is one of the most difficult questions in philosophy. But, minimally, an explanation is called for when some phenomenon cannot readily be accounted for on the basis of a given background theory or world picture. And what counts as an explana-

tion has something to do with the purposes of the person seeking it. Descartes thought he had a pretty clear handle on what the world was like and, on the basis of his hypotheses about the structure and function of the visual system, our capacity to perceive the situation, distance, size and shape of objects by sight, required further explanation. He also had a well articulated purpose in mind – namely, to develop a coherent philosophical system that would facilitate the development of mechanistic physics while leaving room for an immaterial soul so that the truths of the Catholic faith would not be compromised.

We, I think, are less clear than Descartes about our underlying picture of the world, and have become overloaded and confused by the mass of data we now have about the visual system. Consequently, we are less clear about why visual spatial perception is particularly problematic – if indeed it is. Moreover, the purposes with which philosophers and scientists enter discussion of these issues vary enormously and indeed are sometimes in open conflict. Neither belief in a mechanistic world picture nor a desire to protect traditional religious beliefs can be taken for granted in contemporary discussions, and few, if any current researchers are committed to both. It is no wonder then that we sometimes find ourselves unsure at what points explanations are needed and what would count as an adequate explanation.<sup>45</sup>

## Notes

- 1 AT, vi. 85.
- 2 Sixth Replies, AT vii.:435.
- 3 He makes this point explicitly in the Sixth Replies: 'I have promised that I will explain these facts minutely with reference to each sense in my Physics. Not that I wish that any of my opinions should be taken on trust, but that I thought that those who have judged correctly in the matter of those accidents which I have already explained in the case of vision in my *Dioptrique* will easily guess what I am able to make good in the case of the others.' (AT vii. 435).
- 4 See, e.g., Sixth Replies, AT vii. 435; *Météors*, AT vi. 331; *Passions de l'Âme*, AT, xi. 337–38; *L'Homme*, AT xi. 153; *Principia*, IV art. 189, AT ixB. 310; author's letters to translator of *Principles*, AT ixB. 15; *Notae in programma*, AT viiiB. 359.
- 5 For a fuller discussion of Descartes' theory of vision, see my *Descartes on Seeing: Epistemology and Visual Perception* (Carbondale, 1993). In it I develop the contrast with the Aristotelean view in more depth, say a great deal more about light and colour, connect the *Dioptrique* account with the *Regulae*, and bring out the tensions and inconsistencies between the role he assigns to judgment in the optical writings on the one hand and his discussion of the levels of sense in the Sixth Replies. The present essay distills material from several chapters of the monograph bearing on visual spatial perception, especially ch. 4. It also amplifies the monograph at several points, especially at the end of Part 3 and in Part 4.
- 6 See *Descartes on Seeing*, ch 2, of for a discussion of these.
- 7 For example, when the spin greatly exceeds the forward motion they generate our sensations of red, or yellow if the spin is a bit less. If it is less than the forward motion we see blue, or green if it is much less.
- 8 *Dioptrique*, AT vi. 123–4.

- 9 *Dioptrique*, AT vi. 114.
- 10 *Dioptrique*, AT vi. 130. The referent of 'it' here is ambiguous. It could refer to either the picture or the resemblance.
- 11 The diagram appended to *L'Homme* was added after his death.
- 12 It might seem that the mind is purely passive in the *Dioptrique* because it is the motions transmitted by the nerves that cause our sensations (by the institution of nature), and that it is more active in *L'Homme* since it is the pattern traced by the departing animal spirits in the surface of the pineal gland that gives rise to our visual sensations. But the animal spirits are material in nature, and their outflowing would not seem therefore to be indicative of any sort of *mental* activity – such as directing one's attention, etc. The crucial determinant of the content of our visual experience in both cases is a pattern of motions that is structurally isomorphic with the retinal image.
- 13 AT vi. 130.
- 14 In fact, the colour we perceive objects to be is not merely a function of the light reaching us from them. Objects perceived under unusual lighting are often perceived to have their normal colours, and, as Land showed, one can see familiar objects as having their usual colours (albeit a bit washed out) when all the light reaching the eyes is in the yellow part of the spectrum. Thus a purely mechanistic explanation fails even here.
- 15 Descartes thinks of these as 'common sensibles' (in Aristotelean parlance), describing them almost exactly as Aristotle does the common sensibles – as not belonging to a single sense only, but being 'common to touch and vision and even in some manner to other senses'. AT xi. 159.
- 16 AT xi. 183.
- 17 AT vi. 137.
- 18 *Dioptrique*, AT vi. 135.
- 19 AT xi. 159.
- 20 AT vi. 140–41.
- 21 *Dioptrique*, AT vi. 140.
- 22 *Dioptrique*, AT vi. 137.
- 23 In the parallel passage in *L'Homme*, Descartes uses the two verbs in exactly the same way (AT xi. 160).
- 24 *Dioptrique*, AT vi. 138.
- 25 This view is not unchallenged. For example, see John Cottingham, 'A Brute to the Brutes?: Descartes' Treatment of Animals', *Philosophy* vol. 53 (1978), 179–93, and Daisie Radner and Michael Radner, *Animal Consciousness* (Buffalo, NY, 1989), chs. 1–4.
- 26 On this point, see also Margaret Wilson, 'Descartes on the perception of primary qualities', in Stephen Voss, ed., *Essays on the Philosophy and Science of Rene Descartes* (New York, 1993), 172.
- 27 Animals such as eagles or bats may, of course, have very different sorts of organs and thus different ways of perceiving distance. But Descartes at least thought that the visual apparatus of sheep was anatomically similar to ours, so I will discuss the problem for sheep.
- 28 AT i. 378.
- 29 See, for example, Cottingham, in 'A Brute to the Brutes?' where he cites passages in which Descartes attributes feelings like hope, fear, and joy to animals (AT iv. 574).
- 30 See, e.g., Radner and Radner, *Animal Consciousness*, especially chs. 2 and 3.
- 31 Perhaps along the lines suggested by MacKenzie, whose interesting rational reconstruction of the *Dioptrique* in 'Descartes on Sensory Representation', *Canadian Journal of Philosophy* vol. 16 (1990), 127–41, is more consistently mechanistic than Descartes himself.

- 32 I am indebted to John Sutton for his probing questions on this particular point, and wish to thank him for a number of other comments that were helpful to me in revising this manuscript.
- 33 Nor does there appear to be any clear trend toward eliminating judgment from perceptual explanation. In his discussion of the three levels of sense in the Sixth Replies, for example, Descartes actually increases rather than decreases the role of judgment in perception (although his concerns in that work, of course, are different from those in the optical writings).
- 34 It is very clear in *L'Homme*, for example, that although he describes the body as a machine, it is the Aristotelean nutritive and sensitive souls that he is out to eliminate, not the rational soul (see AT xi. 202).
- 35 AT vi. 57.
- 36 AT vi. 109.
- 37 The problem of trying to understand how sense and reason interface with each other was by no means a new one. Descartes' Medieval predecessors had struggled with it as well. Thus Aquinas, for example, distinguished between what he called the 'estimative sense' (in animals) and the 'cogitative sense or discursive power' (in humans) which perform many of the same functions, except that in the human case there is an interplay between reason and sense that enables them to perceive the advantages and dangers of things in a way that goes beyond instinct. The problem of how sense and reason are connected, however, arises in a different way for Descartes than it did for them, since he has eliminated the sensitive soul and the forms or species that had performed a kind of bridge function between the sense faculty and the intellect. See ch. 1 of *Descartes on Seeing* for an extended discussion of this point.
- 38 He virtually admits this in a letter to Mersenne in April 1640, when he says that three years before he had attended the autopsy of a woman and found himself unable even to recognize the pineal gland 'even though I looked very thoroughly, and knew well where it should be, being accustomed to find it without any difficulty in freshly killed animals'. The old professor performing the autopsy, he said, admitted that he had never been able to see it in any human body: AT iii. 49. The fact that he could not see it does not, of course, disprove its existence in human beings. Nor does the invisibility of the animal spirits show that hypothesising them was illegitimate (since Descartes constantly hypothesises various micro-mechanisms analogous to macroscopic ones), or that their behaviour (if they exist) would not be explainable mechanistically. But given how little actual knowledge Descartes had to go on, his physiological hypotheses were particularly strongly influenced by his philosophical presuppositions.
- 39 *Dioptrique*, AT vi. 112.
- 40 See *Descartes on Seeing*, 58–60 for a discussion of the reasons given by each.
- 41 See Maurice Pirenne, *Vision and the Eye*, 2nd edn. (London, 1967), 193–6.
- 42 Descartes himself suggests this view in his Sixth Replies (AT vii. 438). As I have argued in *Descartes on Seeing*, however, his account of perception in the Sixth Replies does not merely recapitulate the theory developed in the *Dioptrique*, but changes it significantly in ways that exacerbate rather than ameliorate his problems.
- 43 The way that association of ideas was used by Berkeley to explain vision is also open to the objection that when we open our eyes and look around, what we are primarily experiencing is tactual ideas (those that have been regularly associated with our ideas of light and colour). This strikes me as extremely odd.
- 44 *La Recherche de la vérité*, Bk I, ch. 9, sect. 3.
- 45 I am indebted to Phil Devine for his comments on a draft of this essay, and especially for his suggestions about the nature of explanation.