Essays on Aristotle's De Anima
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Abstract and Keywords

Modern scholars seldom read chapters 7 and 8 of book 2 of the De Anima with the care and attention they give to other parts of that great work. Consequently, they miss several important details in Aristotle's theory of sight and hearing. Among the important details that are liable to be overlooked if one skips De Anima 2. 7–8, the most important, in my opinion, is the following:

> According to the Aristotelian theory of perception, there is no physiological process which stands to the awareness of a colour or a sound as matter to form.

Aristotle believes that when he sees a colour or hears a sound, nothing happens save that he sees the colour or hears the sound.

For us, formed as we are by modern science, such a thesis is incredible. It would be quite impossible for us to believe that when we see a colour or hear a sound, nothing happens save that we see the colour or hear the sound. Consequently, many scholars find it difficult to believe that Aristotle could have held a view so difficult to believe. But there is nothing original in my claim that he did.

When Friedrich Solmsen in his well-known article ‘Greek Philosophy and the Discovery of the Nerves’, came to Aristotle's account of perception, he observed, ‘ . . . it is doubtful whether the movement or the actualization occurring when the eye sees or the ear hears has any physical or physiological aspect’. [1] I cite this article not only because Solmsen is

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a scholar with whom it is always better to find oneself agreeing than disagreeing, but also because of the context in which he made his observation.

(p. 422) After extensive research on Hippocratic and Hellenistic doctors, on Plato, on Galen, and other ancient thinkers who maintained a lively interest in what happens inside the body at the moment of perception, Solmsen faced up to the fact that he had nothing to say about Aristotle. He had found nothing in Aristotle to match the stories about the physiological side of perception that prevail from the Hippocratics at one end of his period of study to Galen at the other, and then on into modern psychology labs. [2]

That finding, in that context, has weight. At the very least, the precedent of Solmsen can serve to encourage us, when we read these two chapters, not to exclude in advance the possibility that Aristotle truly did believe something we could not believe.

Let us then pose the question, What are the material conditions—in the technical Aristotelian sense of the word 'material'—which are necessary for the occurrence of an act of perception? By the technical sense of the word 'material' I mean the sense which indicates the Aristotelian contrast between matter and form, not the modern sense in which 'material' is often synonymous with 'physical' in contrast to 'mental'.

In principle, there are three headings under which they should be found:

> (a) the material conditions which are necessary for the perceiving subject to have the relevant perceptual capacity (sight, hearing, etc.);
> (b) the material conditions which are necessary for the object perceived to be present at a suitable distance and in a state apt to stimulate perception;
> (c) the material conditions which are necessary for the stimulus to awaken the capacity into activity.

Under heading (a) Aristotle gives us a list of receptive stuffs: transparent jelly in the eye (Sens. 2. 438^{b}5–8), still air walled up in the ear (DA 2. 8, 420^{a}9–10), the organ of touch at a mean of temperature and hardness (2. 11, 424^{a}4–10). He insists that the sense-organs are composed either of one simple, homogeneous element or, in the case of touch, of a homogeneous mixture (PA 2. 1, 647^{a}5–24; cf. Sens. 2, 437^{a}20 ff.; DA 3. 13, 435^{b}1–3).

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‘Homogeneous’ here is to be taken in the strict sense of ‘homoiomerous’: every part, however small, is exactly like the whole. It is true that Aristotle distinguishes certain observable parts within the eye. But he emphasizes that the sensitive part, the part that sees (tou men ommatos to oratikon), [3] is the interior of the eye which consists entirely of water; and he describes the other organs in similar terms (Sens. 2, 438ᵇ18–22 with 9–11). [4] It seems plain that (p. 423) Aristotelian sense-organs lack internal structure. A fortiori they lack entirely a microstructure comparable to that which modern science invokes when it speaks of nerves, for example, or retinal cells. [5]

A lack of internal structure is not the same as a lack of qualitative differentiation. In De Generatione Animalium 5. 1–2 Aristotle gives a lengthy account of the material causes of differences among animals in the keenness of their sight and hearing: the causes are such things as the colour of the eyes, the consistency of the water composing them, and factors to do with the external protection of the organ (cf. also DA 2. 9, 421ᵃ7–16; PA 2. 13). But these are all static material conditions. They facilitate or impede accuracy of perception without adding to the processes that take place at the moment of perceiving.

Besides the sense-organs properly so called, the capacity for perception requires a system of passages (poroi) linking the sense organs to the central place where a unitary consciousness of all the objects of perception is located. [6] But what happens in these passages is always a continuation or likeness of what happens in the sense-organs, [7] and it is what happens in the sense-organs that interests me here.

Under heading (b) are found the varied material conditions necessary for a thing to have colour, to make a sound, to be hard or soft. I shall be dealing later with some of the requirements for sound.

The locus of controversy is heading (c). The only condition I find here is a medium in a suitable state. Nothing more. Aristotle insists that the medium of perception, like the organ, lacks microstructure (GC 1. 8). If you ask why an animal with eyes open in clear daylight sees the coloured object in front of it, Aristotle's reply, I maintain, is just this: such is the nature of sight and of colour. (His reply to the question ‘Why does fire warm a cold room?’ follows the same pattern: such is the nature of the hot and the cold—GC 1. 7.) Once you understand what sight is and what colour is, you will appreciate that nothing more by way of explanation need or can be said.

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That, in sum, is what I find in the two chapters before us. My task now is to help you find it too.

I begin with a central thesis of 2. 7:

> Every colour is capable of setting in motion (kinētikon) that which is actually transparent, and this is its nature. (418ᵃ31–ᵇ1; tr. Hamlyn)

Two points call for comment.

The first point is that we must not ask why, in virtue of what, colour is capable of setting the transparent in motion. That is the nature of colour. Compare 419ᵃ9–11: 'this is just what it is to be colour, to be capable of setting in motion that which (p. 424) is actually transparent' (tr. Hamlyn). We are at a terminus of explanation. For Aristotle, a nature or an essence is something that explains other things without needing to be explained itself. [8] That, presumably, is why Aristotle says at 418ᵃ30–1 that a visible object has within itself the cause of its visibility. The cause of the object's visibility is its colour. The colour is the cause of the object's visibility because the colour is by its very nature capable of setting in motion the actually transparent. End of explanation.

The second point is that the translation just quoted from Hamlyn is deeply misleading. As Hicks rightly remarks, [9] we must not understand 'motion' as 'locomotion'. Kinēsis in Aristotle's usage is the generic term for all kinds of change, including alteration. Kinētikon just means 'productive of a change', not 'productive of spatial movement'. All we have learned so far is that the colour by its own nature produces a certain effect on the medium (air or water), provided this medium is actually transparent.

The actuality of the transparent, we discover a bit later at 418ᵇ9, is light. Light is not fire, nor is it any kind of body or emanation from bodies (418ᵇ14–15); that is to say, it is not anything that moves (Empedocles is criticized for saying that light travels—418ᵇ20 ff.). And it is not a movement either (Sens. 6, 446ᵇ30–1). Rather, light is a state or disposition (hexis, 418ᵇ19; 3. 5, 430ᵃ15), the transparency of the medium, its being actually transparent.

Thus the condition laid down for a colour to produce its effect on a medium is not an event or process, but a static condition, a state of affairs. And the condition for this condition is static too: in order for the medium to be in the state of actual transparency which is light, it suffices (a) that it has a nature or capacity to be transparent (418ᵇ6–11, 31; Sens. 3, 439ᵃ24–7), and (b) that

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there is fire present (418ᵇ11–20; Sens. 3, 439ᵃ21–2). It is not necessary for the fire to do anything. It just has to be there and the transparent nature of the medium realizes itself.

If you find this incredible, I can only say that I do too, but it is what the texts contain. The great commentator Alexander of Aphrodisias puts light in the category of relation (in Sens. 134. 11–19; cf. 132. 2–16). When the sun rises or a lamp is lit, for the air around us this is a mere change of relation. [10] The statement 'When fire comes to be present in the air, the air is illuminated' is just like the statement 'When I move to the left of my desk, the desk comes to be on my right'. [11] As usual, Alexander understands Aristotle very well.

But light is not only the condition for the colour to produce its effect on the medium. In a way it is also the condition for the colour itself to be present in actuality (3. 5, 430ᵃ15–17). I conclude that the colour produces its effect all the time it is actually present; all the time the coloured object is visible. There is no (p. 425) event of production. The effect is continually produced, thanks to the presence of the colour in the light, which means, as already explained, thanks to the very nature of colour.

Next, I propose that Aristotle specifies the effect of colour on the illuminated medium at 418ᵇ4–6:

> I call transparent that which is visible not, strictly speaking, in itself but because of the colour of something else.

This text does, without doubt, specify an effect of colour on the medium, and I have not found another text that does as much. The effect is this: colour makes the transparent visible. Now we already know that the visible is colour. [12] So it is no surprise to read later at 418ᵇ11 that light is a sort of colour (hoion chrōma) of the transparent, a text to which De Sensu 3, 439ᵃ19–21 refers when it says that light is the colour of the transparent per accidens. [13] The transparent does not have within itself the cause of its visibility. That is to say, it has no colour of its own; it is not coloured in the way the visible object is. When it is illuminated, it is visible and coloured in a derivative way, thanks to the presence of a colour which belongs to a body.

But what is the meaning of 'coloured in a derivative way'? Here is a very simple reply. The transparent is coloured in a derivative way when the colour of a body appears through it.

When the medium is actually transparent (diaphanēs), i.e. when the medium is such that colours can appear through it (phainesthai dia), they do appear

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through it. [14] At the same time, the transparent itself, the light, becomes visible in a way and coloured in a way—without being really coloured and, in consequence, without undergoing a real alteration. This non-real alteration—a quasi-alteration I shall call it—of the transparent consists in the fact that colours appear through it.

Here is a little experiment to help you to understand the idea of quasi-alteration. [15] Fill a transparent glass with water and put it on a table. Hold a red object a short distance away from the glass and look at it through the water. The water in the glass is now serving as a medium within another medium (the surrounding air). You will see a red coloration in the water. But unlike the coloration that ensues if you pour red ink into the water, this coloration is not visible to other observers from other angles of vision. Now let the glass expand in your imagination to meet your eye, on one side, and the red object on the other. The water will become the sole medium and you will see the red object directly through it.

(p. 426) Such is the effect of a colour on a medium which is actually transparent: the colour appears through it. It is visible through the medium. No more, no less.

It is evident, I hope, that this appearance or visibility of the colour through the transparent is a static condition, a state of affairs, not an event or process. Nothing happens. Nothing moves from the coloured object. There is not even a real alteration, only the quasi-alteration which consists in the fact that the colour is visible through the transparent.

You may think there is an objection to be mounted on the basis of 419ª18–19, where Aristotle argues that it is impossible for the affection which is seeing to be produced by the colour seen itself. The only remaining possibility is that it is produced by something in between the colour and the subject seeing it. Hence it is necessary that there be something in between—the medium.

It is dangerously easy for us to suppose that the impossibility of direct action by colour on sight is to be explained by the fact that the colour is situated at a distance. The function of the medium is to join the object perceived to the subject perceiving it. The medium is needed to transmit the colour, or information about it, to the sight of the perceiver. Nowadays we do indeed understand the medium as a medium of communication. And there were ancients who share our view. [16] But let us look at the context in 2. 7.

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Aristotle has just repeated the point I began from, that ‘this is just what it is to be colour, to be capable of changing that which is actually transparent’ (419ᵃ9–10, tr. now revised). At 419ᵃ11 he offers to confirm this definition: if one places the coloured object directly on the organ of sight, it will not be seen. What Aristotle excludes thereby is a definition of colour as what has a capacity to change the organ of sight. Colour must be defined as what has a capacity to change a transparent medium—for example, air—and it is the air which changes the organ of sight (14–15). This implies that the function of the medium is primarily to separate the object perceived from the perceiving subject. Everyone knows that the necessity of such a separation is the premiss on which Aristotle bases his proof that the organ of touch is not the flesh but the heart. [17] And it is the same, I suspect, with what Democritus had to say on this point. [18]

Democritus suggested that, ideally, vision would work best without a medium: if there was a void or vacuum between the perceiving subject and the object perceived, there would be nothing to interfere with perception, which is effected on his theory by the transmission of something material from the object to the (p. 427) subject. [19] But from Aristotle's point of view, if per impossibile there was a void, i.e. nothing, between subject and object, then so far as explanation goes the situation would be just like the case where an object is put directly on the eye.

Let us go back for a moment to the affection which is seeing and which is such that the colour itself cannot produce it. At the beginning of 2. 12 Aristotle will finally announce that this affection consists in the reception of sensible form without matter. But it is obvious that when a coloured object is placed directly on the eye, it affects it, if at all, as a composite of form with matter. From this I conclude that, if my suggestion is correct that the function of the medium is primarily to separate rather than to join, it is above all the sensible form and the matter of the object perceived that need to be separated. The separation is an aspect of the quasi-alteration I spoke of earlier. If the transparent is coloured in a derivative way, without being really coloured, we can say that the sensible form, the colour, is present in the transparent by itself, without the material base with which it is united in the object perceived. The need for separation can be seen as the reason why colours are seen only in the light (419ᵃ22–3; cf. 7–9), i.e. in the actually transparent. The visible form can only appear to the eye through a medium which separates it from the coloured object.

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So much for the question, What is the immediate effect of a colour on the medium? The next question is: What is the mediate effect of a colour on the eye?

According to Aristotle, the interior of the eye must consist of water or of air, because (1) for the eye to see there must be light within as well as without, (2) the (potentially) transparent elements are water and air, but (3) water is easier to confine (Sens. 2, 438^{a}13–17; ^{b}6–12; PA 2. 10, 656^{a}37–^{b}2). In sum, the eye consists of water because one does not see if the eye is not actually transparent. [20] Given our earlier discussion about the transparent medium being coloured in a derivative way, it will come as no surprise to learn that, when we see, the eye is coloured in a way (3. 2, 425^{b}22–3). All this implies that the effect on the eye is the same as the effect on the medium, as one could already infer from lines 419^{a}13–15 in 2. 7. [21] The colour appears to the eye of the subject who perceives it. The effect on the eye is a quasi-alteration just like the quasi-alteration in the transparent, because the eye too is actually transparent.

(p. 428) Now the key doctrinal passage at 3. 2, 425^{b}26–426^{a}26, states that the effect of the colour on the eye is identical with seeing. The passage applies to all modes of perception the celebrated model of action and passion that Aristotle elaborated in De Generatione et Corruptione 1. 7 and Physics 3. 1–3. [22] Just as one and the same road is differently described as ‘the road from Athens to Thebes’ and ‘the road from Thebes to Athens’, and one and the same achievement is differently described as ‘A learning grammar from B’ and ‘B teaching grammar to A’, so it is one and the same state of affairs that is differently described by the following two statements:

(1) The colour appears to me at my eye through the medium.
(2) I see the colour by my eye through the medium.

The sole difference between the effect on the medium and the effect on the eye is the difference adverted to (for the case of smell) in the very last sentence of 2. 12, 424^{b}16–18: at the eye the effect is seeing, in the medium it is not, because the eye has the capacity to see and the air does not. End of explanation. [23]

To be sure, one can give a more or less extended description of this capacity for seeing which the medium does not possess. In speaking of a capacity to receive sensible forms, Aristotle has in mind not only the appearance of colours to the eye, but also the retention of these appearances, which continue to guide the behaviour of animals after the perception itself is over

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(3. 3, 429ᵃ1–8). But such a description gives us information about the role of sight in animal life. It adds nothing to what happens in the eye at the moment of seeing.

We are now in a position to understand what Aristotle means when he speaks, from 2. 5 onwards, of the alteration or assimilation by which the sense organ becomes that which the object perceived already is in actuality. At the end of 2. 5 (418ᵃ1–3) he had declared that we are not to understand 'being affected' and 'being altered' in the proper (kurios) sense fixed for them in De Generatione et Corruptione 1. 7 and Physics 3. 1–3. [24] In the case of sight we have now verified that it is not a real coloration or a real assimilation, but only a quasi-alteration/assimilation/ coloration. A matter of appearances alone.

According to Richard Sorabji in his deservedly influential paper 'Body and Soul in Aristotle', if scientists had some device which enabled them to see into the interior of my eye when I look at a red object, they would see red in my eye-jelly. [25] According to me, they would see no such thing. The transparent in my eye would behave just like the glass of water in our little experiment. Provided the observations were made from behind my head, the scientists would see the red object (p. 429) itself—through my eye! From other angles they would see nothing but the neighbouring parts of my body.

It is in this sense that there is no material or physiological process in the Aristotelian theory of vision. The mediate effect of a colour on the perceiver is simply that the perceiver sees the colour. The alteration of the eye by a sensible quality is (i) a quasi-alteration only and (ii) identical with the perceiving of the sensible quality in question. And if x is identical with y, neither can stand to the other in the technical Aristotelian relation of matter to form. [26]

I pass now to 2. 8 on sound and hearing. There is no denying that it is written throughout in the language of spatial movement. Sound is a sort of movement of the air (420ᵇ11; cf. 420ᵃ9–11; 21–3). But what sort?

According to 419ᵇ34–5 the air produces hearing when it is moved in a continuous unitary mass. (The air has to be a continuous unitary mass for vision too—419ᵃ14; 3. 12, 435ᵃ5–8.) The contrast, I take it, is with a wind. A wind is moving air, or perhaps better: the travelling of air from one place to another (Top. 4. 5, 127ᵃ3–12). Nothing of that sort happens in the case of sound. The air between me and the place of the blow stays put (hupomenēi, 419ᵇ21). It rebounds and vibrates as a single whole (athroun aphallesthai

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kai seiesthai, 420ᵃ25–6) without being dispersed (mē diachuthēi, 419ᵇ21–2). And we will see that in the De Sensu Aristotle agrees that sound takes time to reach the ear. But if a sound moves from one place to another, while the air does not, we have to side with the ancient commentators who maintained that Aristotle conceives sound as moving along the air between the place of the blow and the ear just like a wave or vibration. [27]

So much for a first account of the immediate effect on the medium. According to 420ᵃ4–5 the air without and the air within the ear have a common nature, and when the air without is moved, the air within is moved likewise. In this sense the movement which is the sound is transmitted from outside to inside. That is why the air inside the ear must also be immobile (akinētos, 420ᵃ10), kept still within, so that it can receive (= perceive) a variety of movements from the air outside. [28] Precisely as in the case of perceiving colour, the mediate effect on the organ is the same as the immediate effect on the medium. But here the effect is a movement.

Yes, but unfortunately for the advocates of material processes, this movement, this kinēsis tis is not a kind of movement but only a movement of a kind; it is (p. 430) movement only in a derivative way, a quasi-movement. Aristotelian physics does not recognize the movement of a wave or a vibration as movement properly so called. Movement properly so called is the passage of a body (a substance) from one place to another (Ph. 3. 1, 200ᵇ32–201ᵃ3; 5. 2, 226ᵃ32–ᵇ1). But unlike a wind, a wave or vibration is not (the passage of) a body or a substance. [29]

The problem is not peculiar to sound. At De Sensu 6, 446ᵇ27, Aristotle remarks that sensible forms are not bodies but pathos kai kinēsis tis: affection and a sort of change. [30] How then to explain the fact that, save in the case of visible forms, this affection or this change can take time to reach the subject who perceives it? For the case of smell Aristotle develops an analogy with ice moving across a pond (447ᵃ3–7). The ice does not really move. This is a façon de parler to describe the fact that the water freezes first here, then there. Freezing is real alteration. But the analogy can be applied without difficulty to a quasi-alteration: the smell manifests itself first here, then there.

The same goes for sound. Like the ice, a sound does not really move. Rather, the air resounds (gegōnei, 420ᵃ1) first here, then there. And for that it is vital, apparently, that the air is prevented from moving in any direction (419ᵇ18–420ᵃ2). Sound, therefore, is a travelling of form alone, a quasi-movement.

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There is a nice illustration of this idea in the example Aristotle gives at De Sensu 6, 446ᵇ7–10, to prove the point that the ‘passage’ of sound takes time. It can happen that you do not hear quite the words I uttered, because they get distorted somewhere in the medium between me and you. This distortion Aristotle describes as a reshaping of the phonemes (metaschēmatisis tōn grammatōn), and, more significantly, as a reshaping of the air that moves (metaschēmatizesthai pheromenon ton aera; cf. 446ᵇ33–447ᵃ1). But the air does not really move. It is not a wind. What Aristotle must mean, therefore, is that the grammata, which are the sounds themselves, i.e. the audible forms, are different in different portions of the air between me and you. There has been a change of forms between me and you. Democritus could have used the same or similar words. [31] But he would not have meant, as Aristotle does, a change solely of forms, a reshaping (metaschēmatisis) without any movement or change of matter. The Aristotelian physics of sound is a physics of form alone, without material processes.

We should give this result its full generality, as Aristotle does at the beginning of 2. 12. Here for the first time in the treatise we meet the celebrated formula ‘receiving sensible forms without matter’, which Aristotle introduces only after he has shown, for each of the five senses, that the stimulus which awakens it to activity is the appearance of a sensible quality. Chapters 7–8, which I have examined (p. 431) here, are only one portion of the larger discussion of 2. 7–11, and the results of Aristotle's summing-up at the beginning of 2. 12 ought to hold for all five senses:

> The generalization we should make about all perception is that a sense is what is capable of receiving sensible forms without matter, as wax receives the marking of the ring without the iron or the gold; it takes on the golden or brazen marking, but not insofar as it is gold or insofar as it is bronze. Likewise, the individual sense is affected by some thing that has colour or taste or sound, but not by these insofar as each is said to be such and such a thing; it is affected by them insofar as each is of a certain quality and according to its form. (424ᵃ17–24)

When I read these words, the message coming over is that with each of the five senses we have to do with a physics of form alone, without material processes.

Back finally to the mediate effect of sound at the ear. The vibration, resonance, or movement passes from the air outside to the air inside the ear. According to the key doctrinal passage of 3. 2, the vibration or resonance

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in the ear (psophēsis) is identical with the hearing (akousis) of the sound. It is one single event that admits of two descriptions. But it is an event on the level of form alone. For us, a vibration or movement is a physical event, hearing a mental event. The fact that for Aristotle ‘movement’ and ‘hearing’ are two descriptions of one and the same event demonstrates how badly our categories, which emanate from Descartes, fit his philosophy. [32]

It is no good responding that, if this discussion has shown anything, it is that Aristotle can be classified alongside modern advocates of the view that mental events or states can be type-identified with physical ones. For we have seen that the exterior movement is just like the interior one. But the exterior movement is not a mental event. The explanation of the difference that we found in 2. 12 is very simple: the air of the environment, like the plants at 424[a]32–[b]3, does not have the capacity to hear.

This may not sound much like a reason to us; it cites an explanandum rather than an explanans. Hence the temptation to read a more congenial moral into the last sentence of 2. 12. [33] But that tells us less about Aristotle than about our own predicament as heirs of Descartes and modern science. For Aristotle, reference to the faculty or power of hearing is a paradigm of satisfactory explanation. Indeed, it is a terminus of explanation, and a very good place for me to stop. Accordingly, I shall close by simply mentioning two non-Aristotelian texts which may help modern readers come to terms with the non-material physics of De Anima 2. 7–8.

The first is Plato's Timaeus 48e–53c, which I take to be Aristotle's inspiration for the idea of quasi-alteration. [34] Like Aristotelian sense-organs, the Receptacle must (p. 432) be formless itself if it is receive all the elemental forms. Contrary qualities like hot and cold, light and dark, will appear in it and make it appear different at different times (allote alloion, 50c), so that the Receptacle as medium can be described in the language of assimilation as moistened here, made fiery there (51b, 52d). But this language must not be taken to mean that the coming and going of sensible qualities (forms) brings real change for the medium. The forms appear there, without ever affecting the formless nature of the thing that receives them (50be). And since these quasi-alterations occur at the very lowest level of Plato's universe, prior to the introduction of geometrical atomism at 53c, of necessity there are no underlying processes to point to when the question is pressed, But how are the warmings and moistenings effected?

The second text, from one of the great masterpieces of ancient science, is Ptolemy's Optics 2. 23–4. [35] To describe colour vision, Ptolemy employs

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language that recalls the Aristotelian description of the same phenomenon. Sight detects colour through undergoing an accidental coloration: it recognizes white, for example, because it goes white. None the less, sight itself must remain pure and colourless in order to be able to perceive the colours outside. [36] In a work of mathematical optics there is no need to give a physiological meaning to such language. Optics is the study of visual appearances. If colour appearances are to be included (in Euclid they are not), Aristotelian quasi-alteration—suggestively developed by Ptolemy to make colour a form of luminosity, and modified to let light travel (2. 16)—is quite a good starting-point.

This helps to explain why Solmsen found nothing to say about Aristotle. He was looking for a physiology of vision and hearing. But Aristotle's methodology gives priority to the scientific study of the objects of vision and hearing (2. 4, 415^{a}20–2). Let it not be said, therefore, that on my account chapters 7 and 8 of book 2 of the De Anima contribute nothing to science. Their contribution is to make room within physics for (the application of) two 'intermediate' sciences which in Aristotle's day were both more successful and more prestigious than physiology.

By 'intermediate' I refer to the placing of optics and harmonics in Aristotle's scheme of the sciences midway, somehow, between pure mathematics and full-bodied physics, where definitions must specify the matter of the definiendum. We know from the first chapter of the De Anima itself (403^{b}17–19) that the scientific definition of anger includes an essential material aspect which is omitted, because it is not essential, from the scientific definition of line. But what of the official definiendum of optics, 'line qua physical' (Ph. 2. 2, 194^{a}7–12)? [37] Its intermediate (p. 433) status strikes me as interestingly like the intermediate status of perception in De Anima 1. 1: perception is mentioned in the list of attributes (pathē) of soul that require a body (403^{a}5–7), but not in the list of affections or passions (pathē in some narrower sense [38]) that require a concomitant bodily process.

If you ask why perception and its objects should be singled out for special status, I can only guess. What is special about perception is that it is a low-grade form of knowledge. [39] As knowledge, it must be of forms—sensible forms if they are to be objects of perception. But if, in causing themselves to be perceived, sensible forms cause themselves to be known, they had better do it with the least possible involvement of matter. That much Democritus got right. What he failed to realize is that form is better than nothing. [40]

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Appendix (Cf. N. 29)

(1) I once made what I thought the unquestionable remark to a German mathematician who was also a physicist that only a body could move—so that, for example, the centre of gravity of a body or of a system of bodies, which is a geometrical point, could not move. He, as I rather expected, thought I was just mad. In this case I should certainly have said I was certain that a centre of gravity cannot move, and I think he would have said he was certain that it could. Here I personally should assert he could not possibly have been more than uncertain that it could not, and that, if he had thought a bit more, he would have become certain that it could not; you cannot make a man think, any more than you can make a horse drink.

But (2) I also made the same remark (viz. that only a body could move) to a mathematician here. What was in my mind was that it is mere inaccuracy to say that a wave could move, and that where people talked of a wave as moving, say with the velocity of a foot, or a mile, or 150,000 miles, a second, the real movement consisted of the oscillations of certain particles, each of which took place a little later than a neighbouring oscillation.

He scoffed for quite a different reason. He said that you could illustrate a movement by a noise—that, for example, if an explosion occurred in the middle of Oxford the noise would spread outwards, being heard at different times by people at varying distances from (p. 434) the centre, so that at one moment the noise was at one place and that a little later it was somewhere else, and in the interval it had moved from one place to the other.

Now, of course, it was not in dispute that in the process imagined people in different places each heard a noise at a rather different time. The only question was, ‘Was the succession of noises a movement?’ and I think that on considering the matter you will have to allow that it was not, and that what happened was that he, being certain of the noises, and wanting to limit the term ‘movement’ to something he was certain of, used the term ‘movement’ to designate the succession of noises, implying that this was the real thing of which we were both talking. But if this is what happened, then he was using the term ‘movement’ in a sense of his own, and in saying that in the imagined case he was certain of a movement, he was being certain of something other than the opposite of what I was certain of.

H. A. Prichard, Knowledge and Perception (Oxford, 1950), p. 99.

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Notes:

(1) Museum Helveticum 18 (1961), 150–67 and 187–97, at 170. Substitute ‘material’ for ‘physical’ and Solmsen's observation has wide support among the ancient commentators, well documented by Richard Sorabji, ‘From Aristotle to Brentano: The Development of the Concept of Intentionality’, in Aristotle and the Later Tradition, ed. Henry Blumenthal and Howard Robinson (Oxford Studies in Ancient Philosophy suppl. vol. 1991), 227–59. Where Sorabji credits the commentators with a revisionary programme for ‘dematerializing’ the Aristotelian physics of perception, I credit them with understanding Aristotle pretty well.

(2) To go from Aristotle to Galen's anatomical refutation, in De Placitis Hippocratis et Platonis 1–2, of the Aristotelian/Stoic identification of the heart as the seat of sensation and the source of locomotion is to be transported at once into a different world: our own.

(3) i.e. the part in which and thanks to which the animal sees.

(4) Further references and discussion in G. E. R. Lloyd, ‘The Empirical Basis of the Physiology of the Parva Naturalia’, in Aristotle on Mind and the Senses (Proceedings of the Seventh Symposium Aristotelicum), ed. G. E. R. Lloyd and G. E. L. Owen (Cambridge, 1978), 215–39. Where the eye is concerned, Lloyd concludes (p. 221): ‘There is, in fact, no mention of most of the parts that seem difficult to identify straightforwardly with water’.

(5) Cf. Deborak K. Modrak, Aristotle: The Power of Perception (University of Chicago Press, 1987): ‘The structure and organization of the matter that is enformed by the capacity to see and thus constitute a functional eye would of necessity be very complex’. True in our world, false in Aristotle's.

(6) The texts are pretty vague and do not allow a decisive interpretation. Cf. Lloyd, ‘The Empirical Basis’.

(7) DA 3. 2, 425^{b}24–5; 3, 428^{b}10–14; 429^{a}4–5; Mem. 1, 450^{a}24–^{b}1; Insomn. 1, 459^{a}14–22; 2, 459^{b}3 ff.

(8) Cf. APo 1. 4, 73^{b}16–18; 24, 85^{b}24–5; Metaph. 8. 17, 1041^{b}9–33; DA 1. 1, 402^{a} 7–8; ^{b}25–6.

(9) Hicks ad loc. Unfortunately, he restricts the remark to the case of vision.

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(10) The type of change that P. T. Geach called ‘Cambridge change’, ‘since it keeps on occurring in Cambridge philosophers of the great days like Russell and McTaggart’ (God and the Soul (London 1969) 71–2).

(11) Naturally, the fire's coming to be present has its causes and involves process: see J. Thorp, ‘The Luminousness of the Quintessence’, Phoenix 36 (1982), 104–23.

(12) Let us agree to leave phosphorescence (418^{a}26–8; 419^{a}7) for another day.

(13) Kata sumbebēkos here = ou kath' auto at DA 418^{b}5 in contrast to kath' auto at 418^{a}30, which Hicks ad loc. glosses by to oikeion in contrast to allotrion chrōma at 418^{b}6.

(14) Alex. in Sens. 45. 20–1: di' hou dē tauta phainetai, touto de idiōs kaloumen diaphanes (for the verb diaphainesthai, cf. Mete. 1. 5, 342^{b}6; GA 5. 1, 780^{a}34–5). Analogously, to diosmon, to diēches in the commentators: Ar. Did. Epit. phys. fr. 17 (Diels Dox. 456. 13–17); Alex. in Sens. 88. 19–89. 2; Them. in de An. 62. 31–2; Simp. in de An. 139. 1–6. Philoponus in de An. 354. 12–16 attributes the terminology to Theophrastus.

(15) I am grateful to Tad Brennan for suggesting it to me.

(16) See n. 19 below.

(17) De An. 2. 7, 419^{a}25–31, referring forward at 30–1 to 2. 11, 423^{b}20–6; cf. 2. 9, 421^{b}17–18; PA 2. 8, 653^{b}19–30. We should be taken aback by the confidence with which Aristotle asserts that, for all sense organs (even the ear, or the nose of a dog), an object placed on the organ is not perceived. I am tempted to think that he does not go into the details of the different cases because he knows in advance, as a matter of principle, that it must be so.

(18) Neither Hicks nor Hamlyn translate the touto in line 15.

(19) Contrast the Stoic-inspired view of Cleomedes (8. 20–4 Ziegler) that empty spaces (kenōmata) inside the cosmos would break the sumpatheia of all its parts and would thereby make sight and hearing impossible. As David Sedley has pointed out to me, we do not need to suppose that Democritus really thought, contrary to his own theory of perception, that one could see through a void. He was emphasizing that the medium of vision is one source of its fallibility. Compare ‘In a void a runner could attain a speed of a hundred

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miles an hour'. It would be silly to reply, 'But in a void, without air to breathe, the runner would die'.

(20) Let us not forget that for Aristotle a teleological explanation can take not only the form 'X is necessary for function Y', but also the form 'X facilitates function Y more than the other available means' (PA 2. 1, 640^{a}33–^{b}4; 3. 7, 670^{b}23–7; GA 1. 4, 717^{a}15 ff.; DA 3. 1, 425^{b}4–11).

(21) For confirmation, cf. 3. 12, 434^{b}26–435^{a}10.

(22) 426^{a}2–6 recalls the general model; 2. 5, 417^{a}1–2, has already referred us to GC 1. 7, and 417^{a}16–20 to Ph. 3. 1–3.

(23) For an interpretation in this sense of 2. 12, see my 'Is an Aristotelian Philosophy of Mind still Credible? (A Draft)', in this volume.

(24) See n. 22 above.

(25) Richard Sorabji, 'Body and Soul in Aristotle' (Philosophy 49 [1974], 63–89; cited from the reprint with revisions in Barnes, Schofield, and Sorabji (edd.), Articles on Aristotle vol. 4 (London, 1979), 42–64) at pp. 49–50 with n. 22.

(26) To be sure, matter and form make a unity. But they can do this precisely because they are not identical. Cf. Metaph. 7. 17, 8. 6; DA 2. 2, 415^{a}13–28.

(27) Alex. de An. 50. 12–18; Them. in de An. 65. 31–6; cf. Sorabji, 'From Aristotle to Brentano', 230–1. Compare the analogy with eddies (dinai) or moving forms (schēmata) that Aristotle invokes to explain the distortion of appearances during sleep (Insomn. 3, 461^{a}8–11).

(28) 420^{a}15–18 fits with this, provided it is read sensibly, as saying that an internal movement of the ear's own (a constant ringing in the ears) obstructs hearing—exactly as a previous taste still lingering on the tongue interferes with tasting (2. 10, 422^{b}7–10). The ideas retailed from ancient commentators by Rodier and Hicks ad loc. seem to me sheer fantasy: horns and seashells do not hear, and the second ho in 420^{a}17 is textually insecure. I maintain, then, that to ēchein aei. . .oikeian tina kinēsin is sēmeion tou mē akouein, not sēmeion tou akouein. 420^{a}17–18 implies that hearing sound is to ēchein . . . allotrian tina kinēsin.

(29) Cf. the passage from H. A. Pritchard quoted as an Appendix at the end of this paper. For us an eccentricity from the home of lost causes, it would

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meet with Aristotle's approval. Aristotle need not deny that a wave involves the air or water moving up and down at each place between A and B, for this movement is not the movement from A to B (hearing can take place in water too: 420ᵃ11–13; HA 4. 8, 533ᵇ4 ff.).

(30) I translate ‘change’ rather than ‘movement’ here with an eye to the fact that 446ᵇ31–2 proceeds to separate the case of alloiōsis from that of phora.

(31) For example metarruthmizesthai DK 68 a 132.

(32) For a good corrective to the widespread tendency to equate ‘physical’ vs. ‘mental’ with ‘material’ vs. ‘formal’, see Alan Code, ‘Aristotle, Searle, and the Mind-Body Problem’, in John Searle and his Critics, edited by E. LePore and R. Van Gulick (Oxford, 1991), 105–13, and also Alan Code and Julius Moravcsik, ‘Explaining Various Forms of Living’, in this volume.

(33) See Sorabji, ‘Body and Soul’, 47; cf. pp. 46, 54, 56, 60.

(34) My inspiration for this conjecture is Plotinus, Enneads 3. 6. Entitled ‘On the impassibility of things without body’, it is an extended study of the parallels between the Timaeus on changes in the Receptacle and De Anima 2. 5 on changes in the soul.

(35) See pp. 23–4 in the magnificent edition by Albert Lejeune (Louvain, 1956; reprinted with a French translation, Leiden, 1989).

(36) ‘Oportet enim ut sensus perspicabilis non habeat qualitatem, sed sit purus et suscipiat qualitatem ab illis [sc. lumen et color], quoniam participat eis et in genere . . . visus cognoscit colorem per colorationem accidentem; et cognoscit albedinem, verbi gratia, quia dealbat, et nigridinem quia denigrat.’

(37) It is easy to give the most important references (to Ph. 2. 2 just cited, add APo. 1. 13, 78ᵇ34–79ᵃ16; Metaph. 13. 3, 1078ᵃ14–21), not easy to extract a consistent doctrine. There may be some vacillation between optics as currently practised and optics as Aristotle would wish it to be practised. What is not in doubt is that Aristotle wants to be in a position to apply current optics in his physical works: Mete. 3. 2, 372ᵃ29 ff.; DA 3. 12, 435ᵃ5–10; GA 5. 1, 781ᵃ37.

(38) I prefer ‘passions’ but need only insist on the point that at 403ᵃ3 pathē has the wide sense of sumbebēkota in contrast to to ti estin (402ᵇ25–403ᵃ2 with 402ᵃ7–10), but by 403ᵃ16 these pathē have been divided into erga and pathēmata (403ᵃ10–11; cf. paschein oude poiein, 403ᵃ6–7; erga kai pathē,

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403b12). Hamlyn translates, very sensibly, ‘properties’ at 402a9 and 403a3, and ‘affections' at 403a10 and 16. It follows that the famous affirmation at 403a25 that pathē logoi enuloi eisin does not take an explicit stand on the erga of soul.

(39) So presented from the beginning of the treatise: 1. 2, 404b9 ff.; 5, 409b23 ff.

(40) This is an English translation of a paper first published in French (Revue philosophique de la France et de l’Étranger 118 [1993] and, with corrections, in Études sur le De Anima d'Aristote, edited by Gilbert Romeyer Dherbey (Paris, 1995)), and (the earliest version) in Spanish (Revista latinoamericana de filosofia 20 (1994)). I am grateful for the remarks and friendly criticism offered when I presented the first version at the Centre Léon Robin in Paris, and for the quite different criticisms and observations which enlivened seminars on this topic in Harvard, Oxford, Pittsburgh, Princeton, Rutgers, and Sheffield. I owe thanks to G. E. R. Lloyd and Sarah Broadie for their help and encouragement throughout the preparation of this essay. For a profound study of the idea of a theory of perception without material processes, I recommend to my readers Broadie's article ‘Aristotle's Perceptual Realism’, Southern Journal of Philosophy 31 (1993), suppl. vol.: Spindel Conference 1992: Ancient Minds, edited by John Ellis, 137–59.

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