

## Aristotle on Sounds

Mark A. Johnstone

*De Anima* II.8 contains Aristotle's most detailed treatment of hearing and sounds.<sup>1</sup> In this paper, I consider two related issues raised by this discussion. The first issue concerns the kinds of changes Aristotle takes to occur, in both the sense organs and (especially) the perceptual medium, when a perceiver encounters a sense object under conditions suitable for perception to occur. Aristotle claims that the air (or water) between a sounding object and a perceiver is 'moved' (*kineisthai*) when that object sounds. But precisely what kind of change does it undergo? And what do these changes have to do with hearing as such? The second issue concerns the nature, location and ontological status of the proper objects of auditory perception. What is a sound? How does it relate to the object that makes it? Are the proper objects of hearing things, properties or events? Are they located at a distance from the hearer, or do they permeate the medium separating the hearer from the object heard? These and related questions have generated considerable interest among recent philosophers of mind.<sup>2</sup> I argue that Aristotle's answers to them are not quite what they are often supposed to be; that they do not raise the kinds of problems for his theory of

---

<sup>1</sup> There is no chapter dedicated to sounds (or, for that matter, to the objects of touch) in *De Sensu*, as there are for the objects of sight, smell and taste. Rather, at *DS* 4 440b27-8 Aristotle refers to the discussion in *De Anima* in a way that implies that sound and voice had been dealt with adequately there. This is despite the fact that in the *Generation of Animals* Aristotle refers, twice, to a (non-existent) discussion of voice in *De Sensu* (*GA* V.7 786b23-6, 788a34-b2), and the fact that Aristotle announces in *De Sensu* itself that he *will* discuss (*DS* 439a10-12) and *has* discussed (*DS* 7 449b1-3) the objects of *each* of the five proper senses. It may well be that, as Burnyeat (2004) has suggested, *De Sensu* originally contained a discussion of voice (and at least certain tangible qualities), but that Aristotle eventually elected to remove these chapters and to incorporate the material they contained into *De Anima*, without clearing up and removing all of the original cross-references in other works. This suggestion gains some support from the fact that the chapters on hearing and touch are the longest of the five chapters in *De Anima* dedicated to each of the five proper senses.

<sup>2</sup> See for example Pasnau 1999, O'Callaghan 2007, Kulvicki 2008, O'Callaghan and Nudds (eds.) 2009, Scruton 2009, Nudds 2010, Matthen 2010, Casati and Dokic 2011.

perception more generally that they have sometimes been thought to raise; and that in important respects they compare favorably with leading contemporary accounts.

- I -

Aristotle begins *De Anima* II.8 by distinguishing things that are capable of making a sound (or of ‘sounding,’ *psophein*) from things that are not.<sup>3</sup> Members of the former class ‘sound’ when struck in the appropriate way (Aristotle’s examples are bronze, and any smooth and solid object), while members of the latter class are incapable of sounding even when struck (Aristotle’s examples are sponge and wool, 419b6).<sup>4</sup> The reason for this difference, Aristotle claims, is that only solid and smooth objects can cause the air (or water) surrounding them to move as a ‘single’ and ‘continuous’ mass<sup>5</sup> when struck quickly and forcefully (419b33f.). The organ of hearing (apparently the inner ear)<sup>6</sup> has air walled up inside it that is immobile (*akinétos*, 420a10) but capable of taking on movements from the air outside, with which it shares a common nature (it is *sumphuês*, 420a4).<sup>7</sup> Air itself is ‘soundless’ (*apsophon*, 420a7), since it is easily dispersed, but ‘when it is prevented from dispersing, its movement is sound.’<sup>8</sup> Both striker and thing struck can be said to sound in a way, so long as their impact is able to cause the surrounding air to ‘rebound and vibrate as

---

<sup>3</sup> In what follows, I read Ross’s 1955 Oxford text of *De Sensu* and his 1961 text of *De Anima*, unless otherwise noted. Translations from *De Anima* are based on Hamlyn (1968/1993), although sometimes slightly altered.

<sup>4</sup> Objects with the *potential* to sound are said to ‘have’ sound (*echein psophon*, 419b6).

<sup>5</sup> The air must be moved as something unitary (*heis*) and continuous (*sunechês*) (419b35).

<sup>6</sup> As is well argued by Johansen (1998, 157-8), who shows how Aristotle generally reserves the term ‘*to ous*’ for the outer ear (as for example at *HA* I.II 492a16-29).

<sup>7</sup> Aristotle claims that the air must extend ‘continuously’ all the way from sounding object to sense organ if hearing is to occur, and that the air inside the ear is moved when that outside the ear is moved (420a4-5).

<sup>8</sup> αὐτὸς μὲν δὴ ἄψοφον ὁ ἀήρ διὰ τὸ εὐθρυπτον· ὅταν δὲ κωλυθῆι θρύπτεσθαι, ἢ τούτου κίνησις ψόφος. (420a7-9). Aristotle claims that this account explains why we can hear underwater (since the air inside the ear is able to take on the relevant movements from the water without water penetrating the ear (420a11-4), which would cause loss of hearing), and why we become unable to hear when the tympanic membrane is ruptured (since then the air previously walled up inside the ear is allowed to disperse (420a14-5)).

a mass.’<sup>9</sup> The differing sounds of objects are revealed only when they actually sound (420a26-9). Finally, sounds are called ‘sharp’ or ‘flat’ by a kind of transference, since a sharp sound (like a sharp knife) produces an abrupt change in a short time (420a26-b4).

Aristotle’s language in these passages has suggested to many readers that on his view the air (or water) surrounding a sounding object, and extending between it and the hearer, undergoes spatial movement when acted on by that object. However, this assumption has been forcefully challenged by some recent scholars. In particular, Myles Burnyeat has argued in an influential article<sup>10</sup> that according to Aristotle the air between sounding object and hearer undergoes only an extraordinary ‘quasi-alteration,’ consisting merely in its being perceived through. To illustrate this idea in the case of colour, Burnyeat asks his reader to imagine perceiving a red object through a glass full of water: the redness of the object is ‘in’ the water, he claims, only in the highly qualified sense that it can be perceived *through* the water.<sup>11</sup> Similarly, Burnyeat claims, it was Aristotle’s view that nothing happens to the sense organs or medium when a perceiver encounters a sounding object under suitable conditions, save that the perceiver *hears* the sound *through* the medium – and that neither sense organs nor medium need undergo any ‘material’ change for this to occur.<sup>12</sup>

---

<sup>9</sup> ὥστε τὸν ἀέρα ἀθροῦν ἀφάλλεσθαι καὶ σειέσθαι (420a25-6).

<sup>10</sup> Burnyeat, ‘How Much Happens When Aristotle Sees Red or Hears Middle C? Remarks on *De Anima* 2.7-8,’ first published as a supplementary essay in the 1995 reissue of Nussbaum and Rorty (1992/1995).

<sup>11</sup> Burnyeat 1995, 425.

<sup>12</sup> In speaking of ‘material’ changes I adopt Burnyeat’s own preferred terminology (esp. Burnyeat 2001, 146, 149). The relevant contrast is with ‘formal’ changes. One of Burnyeat’s main claims is that in his theory of perception Aristotle countenanced ‘purely formal’ changes without any ‘material’ correlates. Burnyeat also sometimes calls the purely formal change that is the rise to perceptual awareness an ‘extraordinary’ change, in contrast to ‘ordinary’ changes (esp. in Burnyeat 2002). It is ‘extraordinary’ because, unlike changes of, say, colour or location, it involve no *replacement* of one quality by another (in this, Burnyeat argues, drawing especially on *DA* II.5, it is like the change involved in exercising knowledge one already possesses).

Burnyeat's central goal in his discussion of *DA* II.8 was to show that Aristotle's views on hearing can be interpreted along 'spiritualist' lines;<sup>13</sup> for him, this more general view is motivated primarily by other texts.<sup>14</sup> Nevertheless, it is surely fair to ask whether Aristotle's discussion of hearing and sound, considered in its own right, can reasonably be thought to bear such an interpretation. I begin with the verb '*kineisthai*.' Burnyeat insists that Aristotle's use of this word should not lead us to conclude that the medium of hearing undergoes local movement. In this he is surely right: although '*kinēsis*' is often translated into English as 'movement,' it was also for Aristotle a general word for change, and hence needn't denote spatial movement in particular. Nevertheless, much of the surrounding language at least suggests movement with respect to place. For example, the air that has been moved is said to 'reverberate' inside a hollow object, to 'bounce' back, to 'rebound,' to be capable of 'dispersing,' to 'vibrate.' As Burnyeat himself acknowledges, the whole of *DA* II.8 is 'written in the language of spatial movement.'<sup>15</sup> Given this language, and in the absence of evidence that it is being used in some special way,<sup>16</sup> we should surely at least begin with the presumption that ordinary spatial movement is involved.

---

<sup>13</sup> The label 'spiritualist' was originally coined by Everson (1997) in a book critical of Burnyeat's view, but was subsequently embraced by Burnyeat himself. The core commitment of spiritualism is perhaps best expressed negatively: it is the view that nothing happens when a perceiver encounters a sensible object under suitable conditions, save that the perceiver becomes perceptually aware of the object. Since the spiritualist regards becoming perceptually aware of the object as an 'extraordinary', 'purely formal' change, spiritualism can also be characterized as the view that no 'ordinary' or 'material' changes are part of perception *per se* (see also previous note). While it is not always easy to get clear on precisely what kinds of changes the spiritualist wishes to exclude, spatial motion undoubtedly counts among them.

Burnyeat defends his spiritualist interpretation of Aristotle's theory of perception in Burnyeat 1992, 1995, 2001, 2002. Further arguments in favour of this view can be found in Broadie 1993, Johansen 1998 and Murphy 2005, although none of these authors embrace spiritualism explicitly and outright. For a clear yet critical overview of the main arguments for spiritualism offered by these authors, see Caston 2007.

<sup>14</sup> Especially on the basis of the text of *DA* II.5 (see in particular Burnyeat 2002).

<sup>15</sup> Burnyeat 1995, 429.

<sup>16</sup> Burnyeat does note that Aristotle describes sound as '*a kind of movement of the air*' (ἀέρος κίνησις τίς ἔστιν ὁ ψόφος, 420b11), commenting as follows: 'unfortunately for the advocates of material processes, this movement [in the medium of hearing], this *kinēsis tis*, is not a kind of movement but only movement of a kind; it is movement only in a derivative way, a quasi-movement' (1995, 429-30). However, the occurrence of the phrase '*kinēsis tis*' does not alone support Burnyeat's claim that the change is of an extraordinary kind;

How, then, does Burnyeat argue that Aristotle's account of hearing in *DA* II.8 should be understood along spiritualist lines? In effect, he constructs his basic case by presenting the following dichotomy: either (i) the transmission of sounds involves air crossing the distance between the sounding object and the perceiver, much like a wind, or (ii) the spiritualist account is correct for the case of hearing. Burnyeat then argues by elimination: on Aristotle's view, hearing does *not* involve portions of air crossing the distance between the sounding object and the ear of the perceiver; hence the spiritualist interpretation should be accepted. Burnyeat supports his rejection of (i) in two main ways. First, he points to textual evidence, most notably Aristotle's claim that the air in question 'stays put' (*hupomenéi*, *DA* 419b21).<sup>17</sup> Second, he offers comparisons with Aristotle's discussion of the mediation of odour in *De Sensu* 6. There, Aristotle compares the effects wrought in the medium by an odorous object to what happens to the water of a lake as it gradually freezes over (*DS* 6, 447a3-7). Although the analogy is imperfect, Burnyeat claims, since freezing is an ordinary change, its point is to show that no portion of water need move *from* one location *to* another in order for freezing to spread.<sup>18</sup> In much the same way, Burnyeat concludes, no portion of air needs to travel anywhere in order for a sound (or odour) to become perceptible at a distance from a sounding (or odorous) object.

The basic problem with this argument is that it rests on a false dichotomy. On the one hand, Burnyeat is surely right to deny that for Aristotle hearing involves portions of air

---

in and of itself, this phrase is perfectly innocuous, and is in fact clearly used by Aristotle elsewhere in *De Anima* simply to denote a 'kind' of (ordinary) change (e.g. in *DA* II.6 at 418a19; cf. *DA* I.1 403a26).

<sup>17</sup> Burnyeat 1995, 429.

<sup>18</sup> Burnyeat 1995, 430.

crossing the gap between the sounding object and the ear of the perceiver.<sup>19</sup> However, it does not follow from this that the spiritualist account of perceptual mediation must be correct. There is an alternative, namely that each part of the intervening medium is affected sequentially in some ‘ordinary’ (i.e. ‘physical’ or ‘material’) way, while remaining in its original place.<sup>20</sup> What kind of change might it undergo? In fact, Aristotle is explicit on the point: on his account, the intervening air is caused to ‘vibrate’ (*seiesthai*, *DA* 420a26) by the action of the sounding object. This suggests the following picture: the sounding object ‘moves’ the surrounding air (or water) by causing it to vibrate; this vibration is then transmitted sequentially from one portion of air (or water) to the next; and this movement is ultimately conveyed to the air walled up inside the ear of the hearer. Crucially, no single portion of the air (or water) needs to travel across the gap between sounding object and hearer for this to occur.

Interestingly, Burnyeat accepts that for Aristotle the medium of hearing is caused to vibrate by the activity of a sounding object. He even compares what happens to the medium when

---

<sup>19</sup> Why is Burnyeat right about this? First, as noted, there is textual evidence: Aristotle remarks that a sound occurs only when the air surrounding the impact ‘remains’ (*hupomenēi*, *DA* II.8 419b21) and is not dispersed upon being struck, and claims that the air that produces hearing must be moved as a single, continuous mass (419b35) – single because continuous right up to the hearer (420a1-2). It is difficult to square these claims with the view that the transmission of sound involves a portion of air travelling from sounding object to hearer. Second, there is a phenomenological objection: Aristotle was surely aware that there doesn’t *seem* to be a rush of wind accompanying every noise (note that given the speed at which sound travels, this air would have to move very rapidly indeed). Finally, on this interpretation Aristotle’s account would bear a striking resemblance to effluence theories of perception, a kind of theory he strongly criticizes elsewhere.

For a defence of the alternative interpretation, on which it was Aristotle’s view that a “packet” of air crosses the gap between sounding object and hearer, see Towey (1991). Against Towey, I note only that the two pieces of textual evidence he adduces in support of his interpretation (the discussion of echoes at *DA* 419b25-7 and the remarks about the mishearing of spoken words at *DS* 446b6-9), while they may raise problems for the spiritualist, are both perfectly compatible with the view I propose below, on which sounding objects cause a succession of local movements to ripple through the medium in the manner of a wave: for such a wave can also be thought of as “bouncing back” when its progress is blocked (indeed, this was essentially Alexander’s take on the passage, which Towey cites with approval (p.14)) and as being “transformed” (*metaskēmatizesthai*, *DS* 446b8) by intervening local motions in the medium.

<sup>20</sup> Aristotle’s example of the lake freezing over provides a vivid example of just such a change, given that for Aristotle freezing is an ordinary qualitative alteration.

a sound is heard through it to the movement of a wave.<sup>21</sup> In order to sustain a spiritualist interpretation, he therefore needs to argue that Aristotle did not regard vibration as any kind of ‘ordinary’ (i.e. ‘material’ or ‘physical’) change. Indeed, this is exactly what he seeks to establish. First, he argues that if vibration were such a change, then on Aristotle’s official classification of the different kinds of *kinēsis* it would have to be either a qualitative alteration (*alloiōsis*) or a local movement (*phora*). Since it is not a qualitative alteration, it must be an instance of local movement if it is to count as a regular *kinēsis*. However, Burnyeat argues, vibration does *not* qualify as local movement for Aristotle, since on his account local motion requires change of place, while the vibrating air does not *travel* anywhere.<sup>22</sup> Therefore, Burnyeat concludes, it was Aristotle’s view that vibrating air does not undergo *any* ordinary kind of *kinēsis*. If it is ‘moved’ without undergoing any ordinary *kinēsis*, it must undergo only an ‘extraordinary’ change – by which, to be clear, Burnyeat means a ‘quasi-alteration’ of the kind a spiritualist can admit, namely a ‘change’ that consists merely in being perceived through.

However, if the medium of hearing is caused to vibrate by the action of a sounding object, *something* happens to it besides merely being heard through. The medium certainly undergoes more than a ‘travelling of form alone ... without material processes’<sup>23</sup> (think

---

<sup>21</sup> Burnyeat 1995, 429 and following.

<sup>22</sup> ‘Aristotelian physics does not recognize the movement of a wave or vibration as a movement properly so called. Movement properly so called is the passage of a body (a substance) from one place to another (*Phys.* 3. 1, 200b3 2–201a3; 5. 2, 226a32–b1). But unlike a wind, a wave or vibration is not (the passage of) a body or a substance.’ (Burnyeat 1995, 430). Yet while it is true that the passage of a wave is not the passage of a body, it remains the case (as I argue) that vibration necessarily involves local movement, and that the wave progresses through the medium only as a result of such movement occurring (and being conveyed from one portion of air to the next). Thus the fact that no portion of air passes from A (the location of the sounding object) to B (the location of the hearer) is beside the point: the question at issue is not this, but rather whether any local motions (and hence ‘material’ changes) are necessarily involved in the perception of sound.

<sup>23</sup> Burnyeat 1995, 430.

again of what happens to the water in the glass when a coloured object is seen through it).<sup>24</sup> What kind of change does it undergo? I take it that vibration just is rapid backwards and forwards movement with respect to place (it is difficult to see what else it could be). That the particular portions of air (or water) involved ultimately end up where they began is beside the point. To claim that the air that vibrates undergoes no local movement at all, on Aristotle's theory of local movement, is no more plausible than to claim that I do not move on that theory if I walk to the other side of the room and back again, ending up back where I started. If the air undergoes a rapid sequence of backwards and forwards movements with respect to place, it undergoes local movement; and if it undergoes local movement, it undergoes a 'material' change. In sum, the spiritualist cannot consistently claim *both* that a sounding object causes the medium of hearing to vibrate *and* that nothing happens to the medium save that it is heard through, as Burnyeat wishes to maintain.

My suggestion, then, is that for Aristotle a sound is transmitted through the medium only because each successive portion of the medium undergoes local movement. On this interpretation, Aristotle held that a sounding object 'moves' the surrounding air (or water) by causing it to vibrate. This movement is transmitted sequentially through the medium from one portion of air to the next in the manner of a wave, and is eventually conveyed to the air walled up inside the perceiver's ear. There is no need for any portion of the air to

---

<sup>24</sup> Note that for the spiritualist the *only* thing that happens to the medium in perception is that it is perceived through. This implies that *nothing* happens to the medium *at all* (not even a 'quasi-alteration') in the absence of an actual perceiver. This consequence is embraced by Johansen, a prominent defender of a broadly spiritualist account of Aristotle on perception, who writes that 'the medium changes only insofar as the sense-object becomes apparent to a perceiver through it' (Johansen 1998, 124); 'we cannot describe the change in the medium of perception without also describing the change in a perceiver, namely, that the sense object becomes apparent to him.' (127); 'the transparent could not be changed by the colour unless there was a perceiver at the other end of it to whom the colour appeared through the transparent' (135). But these claims are simply incompatible with Aristotle's explicitly stated view that a sounding object causes the medium to vibrate, since vibrations clearly can occur in the absence of an actual perceiver.



travel across the intervening gap for this to occur. Vibration is (or at least involves) a rapid sequence of local movements. It does not consist in a ‘travelling of form alone’ without underlying material changes or processes, any more than does the movement of a wave along a piece of rope that had been flicked. If this is right, then in admitting that the medium of hearing vibrates, the spiritualist has already conceded the main point at issue concerning the kinds of changes the medium of hearing (and, presumably, the air walled up in the hearer’s ear) undergoes.

Besides fitting the text, this interpretation has several further advantages. First, it readily accommodates the language of spatial movement that permeates the relevant passages, language that would be difficult to explain on the assumption that the medium undergoes no ‘material’ change. Second, it offers a way of explaining Aristotle’s claim that an excess in a sense object can destroy the sense organs (*DA* II.12, 424a28f.). In the case of hearing, Aristotle’s idea was apparently that especially loud or sharp sounds can cause (temporary or lasting) damage to the (inner) ear. Such claims about damage to the sense organs are easy to explain if a loud or sharp sound causes the air inside the ear to vibrate rapidly or vigorously; by contrast, they become extremely difficult to accommodate on a view on which a sounding object’s sounding causes the medium and sense organ to undergo no ‘material’ change at all. Third, this interpretation easily accounts for Aristotle’s view that a sounding object affects the intervening medium between it and the hearer progressively, beginning with the portion of the medium closest to the object and arriving at the portion adjacent to the ear of the perceiver only after a temporal delay.<sup>25</sup> By contrast, it is simply

---

<sup>25</sup> In *DS* 6, Aristotle wonders whether the objects of sense perception – or at least the movements proceeding from them – always arrive first at a middle point, ‘as odour and sound seem to do’ (446a23). He observes that ‘he who is nearer perceives the odour sooner, and the sound of a stroke reaches us some time after it

not plausible, I maintain, to think that such a temporally extended process should fail even to get underway in the absence of an actual perceiver, or that nothing happens *to* the medium as it progresses, as the spiritualist must maintain.<sup>26</sup> Finally, the present interpretation is more charitable to Aristotle. In this connection, we should recall that the spiritualist interpretation is self-consciously *un*charitable: it saddles Aristotle with the view that perception occurs through purely formal changes without any material correlates, leading even its own proponents conclude that if their interpretation is correct, Aristotle's whole theory of perception (and indeed his whole theory of mind) should be 'junked.'<sup>27</sup>

To this point, I have argued against a spiritualist interpretation of Aristotle's theory of hearing. Before proceeding, I should stress that in rejecting spiritualism I do not mean to endorse the view commonly known as 'literalism.'<sup>28</sup> Although they are sometimes presented as the only options, spiritualism and literalism do not exhaust the possibilities for understanding Aristotle's theory of sense perception more generally. To see this, we need only note that the key claim of spiritualism is best expressed negatively: nothing happens when a perceiver encounters a sense object under suitable conditions, save that the perceiver becomes perceptually aware of the object. By contrast, literalism represents one possible positive alternative: the perceiver's sense organs – and perhaps also the

---

has been struck' (446a24–5). He concludes that this is true of odours and sounds, but not of colours, which affect the whole of the intervening medium simultaneously: thus 'the parts of media between a sensory organ and its object are not affected all at once, except in the case of light' (447a8–10).

<sup>26</sup> The spiritualist might argue that the medium is affected just insofar as the sound becomes audible to a suitably constituted hearer at each point successively. However, if nothing whatsoever happens to the medium of perception besides being perceived through, it becomes difficult to see what could distinguish a portion of air in which the object is audible from one in which it is not.

<sup>27</sup> E.g. Burnyeat (1992) argues that Aristotle's whole philosophy of mind is no longer credible and should be 'junked,' since (on his spiritualist interpretation) it rests on assumptions about the possibility of purely formal changes without any material correlates that we can no longer accept, or even seriously entertain.

<sup>28</sup> Prominent advocates for literalism include Sorabji (1974, 1992, 2001) and Everson (1997). The literalists' view of perceptual assimilation, on which the sense organ literally takes on the same sensible quality as the object perceived, is also defended by Slakey (1961).

intervening medium – literally take on the very sensible quality the sense object already possesses (for example, the eye jelly turns red when one sees a red object). This leaves room for an alternative view, on which the medium and sense organs undergo *some* ordinary change, without literally taking on the sensible qualities of the object perceived.<sup>29</sup> The view I am attributing to Aristotle suggests such an alternative. On this view, the medium of hearing is caused to vibrate by a sounding object, a movement that is eventually conveyed to the air walled up inside the perceiver’s ears. But vibrating, on Aristotle’s account, is not the same as sounding; indeed, Aristotle is clear that on his view air does not usually sound.<sup>30</sup> Thus while the medium and organs of hearing vibrate, they do not themselves become noisy, as literalism would lead us to expect.

So what is the relationship between vibrations in the medium and the twin activities of sounding and hearing? I have argued that on Aristotle’s account vibrations in the medium and sense organs are *necessary* for hearing to occur. If this is right, Aristotle’s physics of hearing was not the spiritualist’s ‘physics of form alone.’ However, to be clear, it is not my intention to argue that Aristotle was some kind of reductive materialist about hearing and sound, for whom hearing *just is* being caused to vibrate by a sounding object.<sup>31</sup> Rather, on Aristotle’s account as I understand it, hearing occurs only when these vibrations are conveyed to the appropriately functioning auditory organs of a creature with the *capacity* to hear. The activation of this capacity to hear, considered merely as such, represents the *formal* aspect of perception. This formal aspect of hearing could be understood in various

---

<sup>29</sup> Several interpreters of Aristotle have favoured alternatives to *both* literalism *and* spiritualism, as I do here. The following authors could be placed in this class, although their accounts differ in various details: Lear 1988, Modrak 1988, Silverman 1989, Bradshaw 1997, Caston 2007, Lorenz 2007, Polansky 2007.

<sup>30</sup> For example at *DA* II.8, 420a7.

<sup>31</sup> For one thing, inanimate objects and plants can be caused to vibrate, but cannot hear.

ways, depending (among other things) on one's interpretation of Aristotle's difficult discussion of perception in general in *De Anima* II.5.<sup>32</sup> The important point for present purposes is that however it is understood, there is *also* an essential material aspect to hearing, consisting in the transmission of vibrations from a sounding object through the medium to the ears of a perceiver. Why are these material changes required at all, in order for hearing to occur? I submit that on Aristotle's view *information* about the sounding object is transmitted *through* the medium *to* the hearer by means of them. Different sounding objects produce differing determinate movements in the medium, depending on their constitution and the manner in which they are struck; and the sense organs of hearing are then affected in corresponding ways, allowing the hearer to discern these differences. In this way, the medium transmits – and the sense organs receive – determinate information about the sounding of the sounding object by means of 'material' changes, all without reducing hearing to the occurrence of these changes.

- II -

In the preceding section, I sketched an interpretation of Aristotle's theory of hearing on which information is conveyed from the sounding object to the hearer by means of

---

<sup>32</sup> For all I have said here, spiritualists such as Burnyeat could be perfectly right when they insist, on the basis of *DA* II.5, that for Aristotle the activation of the capacity to perceive (considered merely as such) is an 'extraordinary' change, involving no *replacement* of one quality by another (see esp. Burnyeat, 2002). In that case, the present account would differ from theirs only in its insistence that hearing necessarily and centrally involves, *in addition to* this purely formal change, a material change occurring in the sense organs and medium. On this interpretation, understanding hearing will be much like understanding other psychological phenomena such as anger, which according to Aristotle (*DA* I.1 403a24f.) can rightly be described *both* as a boiling of blood around the heart (material aspect) *and* as a desire for retribution (formal aspect). A true student of nature should learn about both its material and formal aspects, in order to arrive at a satisfactory understanding. Burnyeat in fact acknowledges that his interpretation of *DA* II.5 leaves 'logical space' for underlying material changes in Aristotle's theory of perception, but denies that Aristotle allows any 'textual space' for them (Burnyeat 2002, 82-3). On the contrary, I hope to have shown that there is ample 'textual space' for admitting material changes into Aristotle's theory of hearing and sound. For a fuller defence of such a 'hylomorphic' view of Aristotle's theory of perception, see Johnstone 2012.

‘material’ changes in the medium and sense organs. In order to develop this view further, a clearer account of the proper objects of hearing is required. In fact, questions about the nature and ontological status of the objects of auditory perception have aroused considerable interest among recent philosophers of mind. In this literature, possible theories are sometimes usefully divided into three main kinds, based on where they take the proper objects of hearing to be located: (i) where the hearer is (‘proximal’ theories); (ii) where the medium is (‘medial’ theories); or (iii) where the object/event heard is (‘distal’ theories).<sup>33</sup> For example, a proximal theory might identify sounds with sensations, which can exist only in the mind of a perceiver;<sup>34</sup> a medial theory might identify sounds with waves, which fill the space between the object making the sound and the perceiver;<sup>35</sup> and a distal theory might identify sounds with enduring properties of objects, or with events or processes occurring in or near the object that is said to ‘make’ the sound.<sup>36</sup>

Where might Aristotle’s views on the nature of sounds fit into this contemporary scheme of classification? It seems clear that Aristotle did not hold a proximal theory, on which sounds are sensations (or perhaps ‘sense data’), existing only in the mind of the perceiver. For one thing, he understood sense perception within the framework of his more general theory of change, on which there is always an interaction between a distinctly specifiable agent and patient.<sup>37</sup> In the case of the five proper senses, the agent is the particular colour,

---

<sup>33</sup> For a more comprehensive discussion and division of various contemporary accounts according to the criteria of spatial location, see Casati and Dokic (2011).

<sup>34</sup> For a contemporary defense of a proximal theory, see Maclachlin 1989.

<sup>35</sup> In scientific contexts, the truth of medial/wave theories of sounds is frequently assumed.

<sup>36</sup> Most recent philosophical accounts of the nature of sounds have defended some kind of distal view. See for example Pasnau 1999, O’Callaghan 2007, Kulvicki 2008, Nudds 2010, Matthen 2010.

<sup>37</sup> A doctor healing herself (and similar cases) present no exception to this claim, since on Aristotle’s account the agent and patient in the causal transaction are still distinctly specifiable: one and the same person is healing *qua* doctor and being healed *qua* patient.

sound, or odour that is seen, heard or smelled. If sounds, colours and the like existed only in the mind of the perceiver, they would not be the kinds of things that could plausibly be thought to play the role of the agent in such a transaction. Furthermore, Aristotle claims that proper sensibles always act on a perceiver *through a medium*: an external medium of air or water in the case colours, sounds and odours, and an internal medium of flesh in the case of the contact senses of touch and taste.<sup>38</sup> Again, this view is incompatible with a proximal theory, on which sounds, colours and the like exist only in the perceiver's mind.

Rather, it is commonly thought that Aristotle maintained some version of a medial theory, on which a sound is something like a wave in the medium. This interpretation has clear support in Aristotle's text. For example, in *DA* II.8 Aristotle claims that 'actual sound' (*psophon energeia*) comes into being 'between' (*metaxu*) the sounding object and the hearer (419b8-9), and that the movement of the air (when it is prevented from dispersing) *is* sound (420a8-9). On the basis of such passages, Aristotle was widely held throughout the medieval period to have identified sounds with movements in the medium. However, as Robert Pasnau has usefully documented,<sup>39</sup> the reception of this doctrine was complicated by the fact that it appears to raise acute problems for an Aristotelian theory of perception more generally. One problem is that Aristotle distinguishes the five proper senses on the basis of their differing objects: each sense is suited to perceive exactly one kind of proper sensible, and each of these proper sensibles can be perceived only by its one proper sense (*DA* II.6, 418a11f.). However, there seems to be no good reason why a movement in the air could not be perceived by other senses as well, such as by sight or touch. Indeed,

---

<sup>38</sup> On Aristotle's view, some kind of medium is essential to the perception of *all* proper sensibles, including even the objects of touch. Thus in *DA* II.11 we learn that the contact senses too operate through a medium, since the flesh serves as an internal medium with the true organ of touch lying further within (423b17-26).

<sup>39</sup> Pasnau 2000.

Aristotle explicitly classifies movement (*kinêsis*) and rest (*êremia*) as *common* sensibles (*DA* II.6 418a17); identifying sounds with movements in the medium therefore also threatens to undermine the key Aristotelian distinction between ‘proper’ and ‘common’ sensibles.<sup>40</sup>

However, there are good reasons to doubt whether Aristotle really wished to identify the proper objects of auditory perception with waves in the air (or water) between sounding object and perceiver. In particular, such a view would undermine the role Aristotle consistently assigns to the *medium* of perception. Aristotle held that the proper objects of hearing, like those of sight and smell, are perceived at a distance through an external medium.<sup>41</sup> However, a wave fills the medium, extending right up to the sense organs of the perceiver. If the proper objects of hearing were wave-like motions *in* the medium, they could not also be perceived *through* the medium, contrary to Aristotle’s clearly stated intent. In this way, any medial view will effectively undermine Aristotle’s distinction between sense object and medium, and with it his distinction between “distance senses” (sight, hearing and smell) and “contact senses” (taste and touch).

Aristotle wished to maintain that the proper objects of auditory perception, like those of visual or olfactory perception, are perceived at a distance through a medium. If we take this commitment seriously, it appears that Aristotle needed to hold some kind of *distal* theory, on which the proper objects of auditory perception are located at a distance from the

---

<sup>40</sup> The basic problem is that a movement can be perceived by more than one sense, whereas proper sensibles (by definition) can be perceived only by one of the five proper senses. Thus the identification of sounds with movements threatens to undermine their status as proper sensibles, and hearing’s status as one of the five proper senses. This prospect greatly worried medieval philosophers such as Avicenna and Albert the Great, who both argued at length against the identification of sounds with movements. See for example Avicenna, *Liber de anima* II.5 (157); Albert, *Summa de homine* 24.1 (200-1); Pasnau 2000, 32f. for discussion.

<sup>41</sup> He makes this claim repeatedly at *DA* 423b4 and following; cf. e.g. 419a25f., 422a8-17.

perceiver. In fact, there is excellent reason to think that a view of this kind is exactly what he had in mind. To see this, it will be useful to begin by recalling Aristotle's general theory of agency and change, as presented for example in *Physics* III.3. On this view, every change involves an agent acting on a patient by making the patient in some way what the agent already is. In the simplest cases, this involves the patient taking on, in a straightforward way, some feature that the agent already possesses – as for example when the hot element in a kettle heats the water the kettle contains. Furthermore, on Aristotle's view the agent's acting on the patient and the patient's being acted on by the agent occur simultaneously and are in fact numerically a single change,<sup>42</sup> occurring *in* the patient. Thus, for Aristotle, the teacher's teaching and the learner's learning are a single change, occurring *in* the learner; while the builder's building and the house's being built are one and the same change, occurring *in* the building materials of the future house.<sup>43</sup>

In *DA* III.2 Aristotle applies this general account of agency and change from the *Physics* to the specific case of sense perception. There he claims that 'the activity (*energeia*) of the object of perception and of the sense is one and the same, although what it is to be is not the same' (*DA* 425b26-7).<sup>44</sup> He chooses to illustrate this point with the case of sounding and hearing: the sounding of the sounding object and the hearing of the hearer are numerically one and the same activity, occurring *in* the hearer (*DA* 425b28-426a7). On this view the object that is capable of sounding and the animal that is capable of hearing begin

---

<sup>42</sup> Although the two 'sides' of this single change (e.g. the teaching and the learning) are said to differ in account (*logos*), that is, with respect to the account which states their essence, much as the road from Athens to Thebes and that from Thebes to Athens are numerically the same but can have different features (e.g. one is harder to travel because it goes uphill) (*Phy.* 202b10-16).

<sup>43</sup> On Aristotle's views on agency and change in *Physics* III.3, see Coope 2004.

<sup>44</sup> Aristotle's idea that a change occurs only *in* the patient while the agent is left unchanged works well for sense perception. For example, for Aristotle a colour acts on the eye of the perceiver in order to make itself seen – and it would indeed be strange to say that the *colour* is changed when this occurs.



with a matching pair of capacities: to sound and to hear, respectively. When an object sounds, due to the impact of some blow, its capacity to sound is realized, and the same goes for the hearer's capacity to hear. In this way, sounding and hearing are for Aristotle a single activity, strictly speaking, occurring *in* the hearer: the patient of the activity is the hearer hearing, while the agent is the sounding object sounding.<sup>45</sup>

This, I suggest, provides the key to understanding Aristotle's account of the proper objects of auditory perception. For Aristotle, the sounding object sounding is the agent of the change that takes place in the hearer when he or she hears. If the agent of the hearing is the thing heard,<sup>46</sup> then on Aristotle's account the proper objects of auditory perception – the things we hear, strictly speaking – are sounding objects sounding (e.g. bells tolling, birds chirping, etc.). Since the sounding object (e.g. the tolling bell) is located at a distance from the hearer, this secures what Aristotle needs in the context of his overall theory: the view that the proper objects of auditory perception are located at a distance from the perceiver, and perceived by him or her through an external medium.

---

<sup>45</sup> This seems an opportune moment to express my disagreement with the view of Towey (1991). On Towey's interpretation, Aristotle wished to maintain that hearing (like other forms of perceiving) is an *energeia* (i.e. an activity that is complete at any moment), but also that sounding is a *kinēsis* (i.e. an end-directed, temporally extended change that is always incomplete while it is in progress). Towey then infers that Aristotle's theory of hearing faces a 'dilemma,' since in treating hearing and sounding as a single change he needs to identify an *energeia* with a *kinēsis*. However, I see no good reason to suppose that Aristotle regarded sounding as a *kinēsis*, or that on his view sounding need be any less complete at any moment than hearing. Where Towey seems to go wrong is in supposing that for Aristotle 'sounding' denotes the whole process leading up to hearing, including the transmission of movement through the medium to the ear of the perceiver and even movement within the ear itself (e.g. on p.12, where he calls the movement transmitted through the medium to the ear 'the sounding which occurs in the ear'). However, it seems clear that Aristotle denotes by 'sounding' not this whole process, but rather what e.g. the bell does when it sets the process in motion. Thus while Towey is right to note that for Aristotle there is a delay between sounding and hearing, he is wrong to suppose that it follows from this that sounding must be a *kinēsis*, and hence that Aristotle, in treating sounding and hearing as numerically a single change, must identify a *kinēsis* with an *energeia*. This is not to deny that Aristotle faces the related challenge of explaining how two *energeiai* can be numerically identical when they occur at different times (given temporal delays in the transmission of sounds). But this strikes me as potentially surmountable (after all, a learner can continue learning from the lesson after the teacher has finished teaching) – and is in any case distinct from the 'dilemma' Towey thinks Aristotle must confront.

<sup>46</sup> Just as for Aristotle the agent of seeing is the colour that is seen.

At this point, it might be objected that Aristotle explicitly identifies *sounds* as the proper objects of hearing.<sup>47</sup> Since (as noted) he sometimes claims that sounds are ‘movements’ in the medium that exist ‘between’ the sounding object and the perceiver, it might seem that he was firmly committed to a ‘medial’ view about the proper objects of hearing, regardless of any difficulties this conclusion might cause for his theory of perception more generally. However, Aristotle actually commits himself to all of the following *three* seemingly inconsistent claims: (i) the things we hear are sounds; (ii) sounds are movements *in* the medium; and (iii) the things we hear exist at a distance from us and are perceived *through* the medium. Should we therefore conclude that his whole position was inconsistent? I believe not. The key, I suggest, is to recognize that Aristotle uses the word for sound (*psophos*) imprecisely, denoting by it at times both (i) the setting in motion of the medium (i.e. ‘sounding’), and also (ii) the motion in the medium that results.<sup>48</sup> This explains why we find Aristotle claiming *both* that we hear sounds at a distance through a medium *and* that a sound is a movement *in* the medium.<sup>49</sup> Nevertheless, his considered view, as I argue it should be understood, was that it is the setting in motion of the medium by the sounding object (i.e. the ‘sounding’) that we hear, strictly speaking, and *not* the movement in the medium that results. This interpretation has the virtue of making Aristotle’s inconsistency

---

<sup>47</sup> For example in *DA* II.6 418a13, *DS* 439a6-12.

<sup>48</sup> An especially clear example of this occurs in *DA* III.2 425b26-426a8. Throughout this passage, Aristotle identifies ‘actual sound’ with ‘sounding’, and hence with the activity of setting the medium in motion, not with the movement in the medium that results. Furthermore, at *DA* 426a6-7 he remarks that ‘the activity of that which can sound is sound or sounding’ (ἡ μὲν οὖν τοῦ ψοφητικοῦ ἐνέργειά ἐστι ψόφος ἢ ψόφησις), thus using ‘sound’ and ‘sounding’ interchangeably and denoting by both the activity of that which sounds.

<sup>49</sup> Incidentally, I suspect this very same ambiguity, between the setting in motion of the medium of hearing (which occurs at a distance from the hearer) and the wave-like motion that results and that propagates through the medium, exists also in the ordinary English use of the word ‘sound.’ (Thus we say both that a sound ‘fills the air’ and that it is ‘over there’ at some specific location.) My claim then is that Aristotle had a consistent and interesting account – his only failing was a certain imprecision in his use of the term ‘sound’, one that probably reflected ordinary Greek usage and remains commonplace even to this day.

purely terminological, while preserving the consistency of his philosophical view. Indeed, it leaves this view free from the kinds of problems identified above, since on it the movements in the medium are not themselves *what* we hear, strictly speaking, but rather that *by means of which* we hear the sounding of the sounding object that produced them, an activity which will always occur at a distance from the perceiver.<sup>50</sup>

In fact Aristotle's view, when so understood, is not only broadly consistent, but actually compares favorably in many ways with leading contemporary accounts. First, from a contemporary perspective Aristotle was on the right track in claiming that hearing involves the transmission of movements through the medium to the hearer in the manner of a wave. Second, Aristotle plausibly regards the proper objects of auditory perception as occupying a specific location at a distance from the perceiver (many recent philosophers of mind have emphasized the fact that we ordinarily take the things we hear to be located at a distance from us in this way).<sup>51</sup> Finally, Aristotle's view, on which what we hear is a sounding object's sounding (e.g. a person's talking, a bird's singing, a bell's tolling),<sup>52</sup> dovetails nicely with those (increasingly common) contemporary accounts that identify sounds with temporally extended processes or events.<sup>53</sup> Thus Aristotle's theory captures

---

<sup>50</sup> As Johansen (1998, 119 n.2) notes, even listening to music through in-ear headphones need represent no exception to this claim, since for Aristotle the organ of hearing is located *inside* the ear. Aristotle often expresses the view that a sense object placed in direct contact with the sense organ could not be perceived (e.g. at *DA* 423b17f., 419a22f.).

<sup>51</sup> E.g. Pasnau 1999, O'Callaghan 2007. O'Callaghan identifies sounds with event-like individuals, while Pasnau argues that they should be understood as *qualities* of the objects that have them, by close analogy with colours.

<sup>52</sup> In ordinary language I can describe the thing I am hearing interchangeably as 'the bird,' 'the bird chirping' or 'the sound of the bird chirping.' On Aristotle's account, as I have argued it should be understood, while all of these would be perfectly acceptable ways of describing the object of my auditory perception the clearest and most accurate way of speaking about the case is the second: I hear the bird chirping, the thing sounding: a temporally extended activity ('sounding') performed *by* a thing.

<sup>53</sup> For arguments for this view, see especially O'Callaghan 2007, Ch. 5; 2009. Other theorists who identify sounds with event-like individuals include Casati and Dokic 1994, 2005, Scruton 1997, and Matthen 2010.

several of our ordinary, pre-theoretical views about the objects of auditory perception better than many contemporary accounts (e.g. those that *identify* sounds with waves), while still retaining a central role for movements in the medium in the transmission of sounds.

I conclude that Aristotle's theory of hearing and its proper objects should be understood roughly as follows. Some things have the potential to sound, since, due to their solidity and smoothness, they have the power to move air as a single continuous mass when they are struck an abrupt blow. A sounding thing moves the air (or water) around it, and between it and the perceiver, by causing it to vibrate. This vibration is a rapid backwards and forwards movement with respect to place, and hence a 'material' change. The movements in question are transmitted successively from one portion of the medium to the next in the manner of a wave; no portion of the air needs to *travel* for this to occur. The vibrating air, in both medium and ear, does not itself sound. Rather, information about the sounding thing and its activity is transmitted *through* the medium *to* the perceiver *by means of* these ordinary, material changes. Aristotle sometimes calls these movements in the air (or water) 'sounds.' However, this does not lead to the collapse of his distinction between proper and common sensibles, or between distance and contact senses, nor does it obliterate the distinction between sense object and medium. The reason is that, for Aristotle, strictly speaking, these movements in the medium are not *what* we hear, but rather that *by means of which* we hear the sounding of the thing that produced them. What we hear – that is, proper object of auditory perception – is a sounding thing sounding, the agent of the change that

is the hearer hearing. This sounding thing (e.g. a tolling bell) exists at a distance from the perceiver and is perceived through the intervening medium, in the manner described.<sup>54</sup>

## Bibliography

Bradshaw, D., 'Aristotle on Perception: The Dual-Logos Theory', *Apeiron* 30 (1997): 143–61.

Broadie, S., 'Aristotle's Perceptual Realism', in J. Ellis (ed.), *Ancient Minds (Southern Journal of Philosophy* 31, suppl.; Memphis, 1993), 137–59.

Burnyeat, M., 'Is an Aristotelian Philosophy of Mind Still Credible? A Draft', in Nussbaum and Rorty (eds.), *Essays on Aristotle's De Anima* (1992/1995), 15–26.

--- 'How Much Happens when Aristotle Sees Red and Hears Middle C? Remarks on *De Anima* 2. 7–8', in Nussbaum and Rorty (eds.), *Essays on Aristotle's De Anima* (1995 edn.), 421–34.

--- 'Aquinas on 'Spiritual Change' in Perception', in D. Perler (ed.), *Ancient and Medieval Theories of Intentionality* (Leiden/Boston/Köln: Brill, 2001), 129–53.

--- 'De Anima II 5', *Phronesis* 47 (2002): 28–90.

Casati, R. and Dokic, J., *La Philosophie du Son* (Nîmes: Chambon, 1994).

---

<sup>54</sup> Earlier versions of this paper were presented at 35th Annual Workshop in Ancient Philosophy, University of Texas at Austin, in March 2012, and at the Canadian Colloquium for Ancient Philosophy, University of Alberta, in May 2012. I am grateful to the participants at these sessions for their comments and questions.

- ‘Sounds’, *The Stanford Encyclopedia of Philosophy (Summer 2011)*, Edward N. Zalta (ed.),  
 <<http://plato.stanford.edu/archives/sum2011/entries/sounds/>>.
- Caston, V., ‘The Spirit and the Letter: Aristotle on Perception’, in R. Salles (ed.),  
*Metaphysics, Soul and Ethics in Ancient Thought: Themes from the Work of Richard Sorabji*  
 (Oxford: Clarendon Press, 2007), 245–320.
- Coope, U. ‘Aristotle’s Account of Agency in *Physics* III.3’, in *Proceedings of the Boston Area  
 Colloquium in Ancient Philosophy* 20 (2004): 201-21.
- Everson, S., *Aristotle on Perception* (Oxford: Clarendon Press, 1997).
- Hicks, R. D., *Aristotle, De Anima* (Cambridge: Cambridge University Press, 1907).
- Hamlyn, D. W., *Aristotle De Anima: Books II and III (With Passages from Book I)* (Oxford:  
 Clarendon Press, 1968; rev. ed. 1993).
- Johansen T. K., *Aristotle on the Sense Organs* (Cambridge: Cambridge University Press, 1998).
- Johnstone, M. A. ‘Aristotle on Odour and Smell’, *Oxford Studies in Ancient Philosophy* 43  
 (Winter 2012), 143-83.
- Kulvicki, J., ‘The Nature of Noise’, *Philosophers’ Imprint* 8 (2008) No. 11: 1–16.
- Lear, J., *Aristotle: The Desire to Understand* (Cambridge: Cambridge University Press, 1988).
- Lorenz, H., ‘The Assimilation of Sense to Sense-Object in Aristotle’, *Oxford Studies in  
 Ancient Philosophy* 33 (2007): 179–220.
- Maclachlan, D. L. C., *Philosophy of Perception* (Englewood Cliffs, NJ: Prentice Hall, 1989).
- Matthen, M., ‘On the Diversity of Auditory Objects’, *Review of Philosophy and Psychology* 1  
 (2010) No. 1: 63–89.

- Modrak, D., *Aristotle: The Power of Perception* (Chicago: University of Chicago Press, 1987).
- Murphy, D. 'Aristotle on Why Plants Can't Perceive', *Oxford Studies in Ancient Philosophy* 29 (2005): 295-339.
- Nudds, Matthew 'What are Auditory Objects?' *Review of Philosophy and Psychology* 1 (2010) No. 1: 105–22.
- Nussbaum, M. and A. O. Rorty (eds.), *Essays on Aristotle's De Anima*, (Oxford: Clarendon Press, 1992; paperback edn. 1995).
- O'Callaghan, C., *Sounds: A Philosophical Theory* (Oxford: Oxford University Press, 2007).
- O'Callaghan, C., 'Auditory Perception', *The Stanford Encyclopedia of Philosophy* (Summer 2009 Edition), Edward N. Zalta (ed.), URL = <<http://plato.stanford.edu/archives/sum2009/entries/perception-auditory/>>.
- O'Callaghan, C. and M. Nudds, 'Introduction: The Philosophy of Sounds and Auditory Perception', in C. O'Callaghan and M. Nudds (eds.), *Sounds and Perception: New Philosophical Essays* (Oxford: Oxford University Press, 2009).
- Pasnau, R., 'What Is Sound?' *The Philosophical Quarterly* 49 (1999) No. 196: 309–24.
- 'Sensible Qualities: The Case of Sound', *Journal of the History of Philosophy*, Volume 38, Number 1, January 2000, pp. 27-40.
- Polansky, R., *Aristotle's De Anima* (Cambridge: Cambridge University Press, 2007).
- Ross, W. D., *Aristotle: De Anima: with Introduction and Commentary* (Oxford: Clarendon Press, 1961).
- *Aristotle: Parva Naturalia: A Revised Text with Introduction and Commentary* (Oxford: Clarendon Press, 1955).

- Scruton, R. 'Sounds as Secondary Objects and Pure Events,' in C. O'Callaghan and M. Nudds (eds.), *Sounds and Perception: New Philosophical Essays* (Oxford: Oxford University Press, 2009), 50–68.
- Silverman, A., 'Colour and Colour-Perception in Aristotle's *De Anima*', *Ancient Philosophy* 9 (1989): 271–92.
- Slakey, T., 'Aristotle on Sense Perception', *Philosophical Review* 70 (1961): 470–84.
- Sorabji, R., 'Body and Soul in Aristotle', *Philosophy* 49 (1974): 63–89.
- 'Intentionality and Physiological Processes: Aristotle's Theory of Sense-Perception', in M. Nussbaum and A.O. Rorty (eds.), *Essays on Aristotle's De Anima*, 195–226.
- 'Aristotle on Sensory Processes and Intentionality: A Reply to Myles Burnyeat', in D. Perler (ed.), *Ancient and Medieval Theories of Intentionality* (Leiden/Boston/Köln: Brill, 2001), 49–61.
- Towey, A., 'Aristotle and Alexander on Hearing and Instantaneous Change: A Dilemma in Aristotle's Account of Hearing', in C. Burnett, M. Fend and P. Gouk (eds.), *The Second Sense: Studies in Hearing and Musical Judgement from Antiquity to the Seventeenth Century* (London: The Warburg Institute, 1991).