Aristotle and Alexander on Hearing and Instantaneous Change: A Dilemma in Aristotle's Account of Hearing

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Aristotle's account of hearing,[1] despite its considerable influence on subsequent thought,[2] has usually been discussed only as part of a wider treatment of some other subject in the context either of ancient music[3] or of Aristotle's general psychology.[4] Yet there is much to be said for a study that concentrates specifically on hearing. Such an approach accords well with Aristotle's own advice that accounts seeking to embrace different psychological capacities in a general survey are less informative than ones which are focused on the peculiar differences of each.[5] More significantly, despite this apparent emphasis on autonomous explanations for each sense modality, it is clear that Aristotle himself took hearing to be in certain important respects paradigmatic of sense perception generally.[6]

Thus a study of Aristotle's theory of hearing can be expected to shed light upon Aristotle's general treatment of perception. Unlike modern philosophers Aristotle is more concerned with the physics involved in perception than with epistemological concerns. It is true that, in Aristotle's view, hearing makes a greater contribution to the acquisition of knowledge than any other sense.[7] But, despite this, a study of his account of hearing will not bear directly upon the question of how the evidence of the senses is thought to form the basis of human knowledge. This is rather something which he takes for granted[8] in his principal discussion of perception in the *De anima*, where he assumes that what we see,

[1] I shall concentrate on Aristotle himself, in particular his discussions of hearing in the *De anima*, edited with introduction and commentary by W. D. Ross (Oxford, 1961), and the *De sensu et sensibili* from Aristotle, *Parva naturalia*, edited by W. D. Ross (Oxford, 1955); also the commentary on the latter by the Aristotelian commentator, Alexander of Aphrodisias (floruit 205 AD), *In librum De sensu commentarium*, edited P. Wendland, Commentaria in Aristotelem graeca, 3.1 (Berlin, 1901), and Alexander's own treatise *De anima*, edited by I. Bruns in Alexander, *Praeter commentaria scripta minora*, Supplementum Aristotelicum, 2.1 (Berlin, 1887). I shall not consider the Pseudo-Aristotelian *Problemata*, beyond noting that Book XI contains an account of hearing close in some respects to the account given by Alexander. For a discussion of the *Problemata* see the article by Burnett in this volume. All translations of Aristotle are, except where otherwise stated, from *The Complete Works*, edited by J. Barnes, 2 vols (Princeton, 1984). Translations of Alexander are my own.

[2] See especially the chapters by Burnett and Frangenberg in this volume.

[3] There is a useful treatment in E. A. Lippman, *Musical Thought In Ancient Greece* (Columbia, 1964), pp. 118–20; see also A. Barker, *Greek Musical Writings* (Cambridge, 1984–9), II, pp. 74–80.

[4] The standard account remains J. I. Beare, *Greek Theories of Elementary Cognition* (Oxford, 1906).

[5] *De anima* II.3–4, $414^{b}25$–$415^{a}16$. Aristotle is referring to nutrition, perception and thought, but the same principle will apply to the five senses which constitute perception. See Alexander, *De anima*, p. 40.3–15.

[6] See pp. 8–10 below.

[7] See *De sensu* 1, $437^{a}9$–15: 'Hearing announces only the distinctive qualities of sound, and, to some few animals, those also of voice. Incidentally, however, it is hearing that contributes most to the growth of intelligence. For rational discourse is a cause of instruction in virtue of its being audible, which it is, not in its own right, but incidentally; since it is composed of words, and each word is a symbol.'

[8] Aristotle's most important remarks on the relationship between knowledge and perception occur in *Posterior Analytics* II.19. For a recent discussion see J. Barnes, *Aristotle's Posterior Analytics* (Oxford, 1975), pp. 248–60.

hear, smell, taste or touch falls under some determinate species,[9] and concentrates instead on the different task of explaining the causal mechanisms which underlie perception.

The sense of hearing, and musical hearing in particular, provides the basis for Aristotle's characterization of the various species of perceptibles, notably colours and flavours. Colours can be defined in terms of proportions of black and white which may or may not be expressible in rational numbers.[10] A similar story applies to the various flavours which are made up of different proportions of sweet and bitter.[11]

This view that all perceptibles can be defined as proportions[12] reflects the impact made by the then recent discovery in acoustics that certain pairs of musical notes which mix together to produce a pleasing unity—i.e., a consonance (συμφωνία)—can be expressed as proportions (λόγοι) of simple rational numbers. The consonance known as the diapason, for example, is achieved by plucking two strings whose lengths are in the ratio 2:1. Aristotle takes the idea further. At one point in his explanation of perception he is prepared to describe the sense, as well as the sense object, as a proportion. It is likely that he is thinking of the sort of proportion that yields a consonance from the way he supports the idea by an appeal to a musical phenomenon: too strong a sense object, he says, destroys the sense organ just as the consonance and pitch are destroyed when the strings are struck violently.[13] The phenomenon Aristotle is here attempting to explain is the failure of the sense faculties to perceive sense objects that are excessively strong. A loud and violent sound, he has said earlier in the *De anima*,[14] is in a way inaudible, connecting this with the fact that something excessively bright is invisible (but in a different way from darkness) and an excessively strong flavour destroys the sense of taste. The theory he offers in explanation is based on the idea that any sense faculty, i.e., the faculty a perceiver possesses which enables him to receive the forms of sense objects, is itself a proportion or blend in the way that two mixed musical notes are blended to make a third note.

This theory has other uses. Aristotle also employs it to explain why plants cannot perceive despite their being endowed with souls just like animals. The explanation which Aristotle gives, that plants lack a mean which can receive the

[9] *De anima* II.6 gives the special objects of the first four as colour, sound, taste and flavour respectively (touch is ascribed a variety of objects) but no proof is attempted, the intention being instead to suggest a way of defining the different senses: see R. Sorabji, 'Aristotle on Demarcating the Five Senses' in *Articles on Aristotle: 4. Pyschology and Aesthetics*, edited by J. Barnes, M. Schofield and R. Sorabji (London, 1979), p. 76. Aristotle does try in *De sensu* 6, 445^{b}20–446^{a}20, to prove that there is only a determinate range of species for the objects of each sense. But he assumes without question that such qualities must be regarded as species: see 445^{b}29.

[10] See especially *De sensu* 3, 439^{b}19–440^{a}6.

[11] Ibid., 4, 442^{a}12–25.

[12] That is, all the proper or special perceptibles (τὰ ἴδια αἰσθητά), defined by Aristotle at *De anima* II.6, 418^{a}11–12, as those objects of sense perceptible to a sense which cannot be perceived by another sense and about which deception is impossible.

[13] Ibid., II.12, 424^{a}26–32. What he probably has in mind is the fact that when the two strings in the right proportion to produce a consonance are struck too violently they no longer produce notes of the exact pitch required.

[14] Ibid., II.10, 422^{a}20–34.

forms of perceptible objects, is obscure,[15] but clearly related to the doctrine that the sense faculty is a proportion. Obscure too is the argument on which his proportion theory rests, which generalizes from hearing musical notes of varying pitch to hearing in general, and then from hearing in general to all the other senses.[16] Although the argument is less than compelling, Aristotle's strategy of treating hearing as a paradigm of sense perception generally is clear. One particularly difficult notion—the idea that the sense, as well as the sense object, is a proportion—is justified by the doctrine that the sense and its object are one and the same thing. Thus if sound—the object of hearing—is a consonance and hence a proportion, the sense of hearing too must be a proportion.

This identification of a sense with its object, on which the proportion theory depends, is explained in a passage which again draws upon the paradigmatic status of the sense of hearing:

> The activity of the sensible object and that of the sense is one and the same activity, and yet the distinction between their being remains. Take as an illustration actual sound and actual hearing: A man may have hearing and yet not be hearing, and that which has a sound is not always sounding. But when that which can hear is actively hearing and that which can sound is sounding, then the actual hearing and the actual sound come about at the same time (these one might call respectively hearkening and sounding).[17]

It is no accident that Aristotle chooses to explain what might be called the single activity doctrine by reference to the example of hearing. Such an explanation is more persuasive than it would have been if vision had been the example. For, even though Aristotle undoubtedly intends this doctrine to apply to all the senses, and thus to vision no less than to hearing, there is something strange about this doctrine as applied to the case of seeing colour, as is marked by the fact that there is no natural expression in either Greek or English for the activity of a coloured object that corresponds to our seeing it, in the way that sounding corresponds to hearing.

There are of course countless problems of interpretation associated with the various doctrines I have adumbrated here. My present purpose is not to attempt to resolve these, but rather to underline the theoretical richness which Aristotle achieves by taking hearing as the paradigm of sense perception.[18] Clearly, however, by making so much of his account of perception depend upon the paradigm of hearing, Aristotle commits himself to supplying an account of hearing itself which is satisfying and coherent as it stands. If other things are to

[15] Ibid., II.12, 424^{a}32–424^{b}3. There is a good discussion in D. K. W. Modrak, *Aristotle, the Power of Perception* (Chicago, 1987), p. 58.

[16] A. Barker, 'Aristotle on Perception and Ratios', *Phronesis*, 26 (1981), pp. 248–66, questions the view that there is a generalization from hearing vocal sounds to hearing sounds in general and from there to sensing in general. Modrak, *Aristotle* (n. 15 above), pp. 60–1, criticizes this attempt to save Aristotle from an apparently invalid deductive argument and suggests charitably that Aristotle intends a 'not very persuasive' argument from induction.

[17] *De anima* III.2, 425^{b}26–426^{a}1. The single activity doctrine has a second important use as a means of answering those of Aristotle's predecessors who espoused the subjectivism of denying that colours can exist in the absence of seeing. Aristotle accuses them of over-simplification. What they said was true of actual colour but not potential colour: see *De anima* III.2, 426^{a}22–5.

[18] For further benefits of the theory that senses are proportions see Modrak, *Aristotle* (n. 15 above), pp. 61–2.

be understood by reference to hearing, hearing must be explicable without further reference to anything else.

This is problematic for Aristotle. One obvious question he has raised for himself is what exactly it is that sounding objects do, when they are active, that causes our hearing to be a hearing of sounds of determinate pitch. There is a major difficulty here. In the account of hearing which he gives in *De anima* II.8, Aristotle is working within the Platonic tradition that the particular pitch of any sound we hear is a function of a disturbance or movement in the air around us, which generates a similar movement within us.[19] Although he rejects Plato's view that high and low pitch are caused respectively by fast and slow movements, he nevertheless retains the notion that hearing a sound is to be accounted for by a movement within the ear. In other contexts, Aristotle classifies acts of perceiving, including hearing, as activities complete at any moment, in which respect they are to be distinguished from movements.[20]

It will be useful first to bring some of these concepts into sharper focus. The notion of movement or change, for example, is diffuse. Movement is a natural expression in English for what Aristotle, in the *De anima* and the *De sensu*, takes the process of causing sound to be. For it typically conveys the sense of something (in this case a sound) passing from one location (the sounding object) to another (the ear). But, for Aristotle, this is just one type of change: locomotion or change of place, for which he reserves the Greek word φορά. For change in general, any emergence of new states of affairs, including as well as locations such properties as qualities and sizes, he has two expressions, κίνησις and μεταβολή. The difference between κίνησις and μεταβολή is that the latter captures all the cases that would be covered by our concept of change, including the emergence itself, whereas the former is restricted to cases where there is a discernible process leading up to the emergence.[21]

Aristotle uses the term κίνησις rather than μεταβολή in his account of hearing. He elsewhere defines κίνησις as 'the actuality (ἐντελέχεια) of what potentially (δύναμει) is, as such',[22] a definition which seems designed to capture the distinctive feature of a process that is on-going, rather than the end-result of that process. The distinction between potentiality and actuality can be understood by considering, as Aristotle does, the case of a sculptor producing a bronze statue.[23] The lump of bronze, which serves as his raw material, has the potentiality to be a statue. The actuality of that potentiality is the finished product, the statue itself. The phrase 'as such' is intended to emphasize that Aristotle does not mean by ἐντελέχεια the actuality of the bronze as a lump of bronze (which would catch the κίνησις before it had started), nor the actuality of the statue as a statue (which would capture only its end-result), but the actuality

[19] See *Timaeus* 67A-C.

[20] The distinction is drawn at *Metaphysics* 1048^{b}18–35. See also *Nicomachean Ethics* 1174^{a}14–29, and *De sensu* 6, 446^{b}2 (which refers specifically to hearing).

[21] For a fuller discussion see S. Waterlow, *Nature, Change, and Agency in Aristotle's Physics* (Oxford, 1982), pp. 93–6.

[22] *Physics* III.1, 201^{a}11. In preferring the term 'actuality' to 'actualization' as a translation of ἐντελέχεια, I am following the explanation given in L. A. Kosman, 'Aristotle's Definition of Motion', *Phronesis*, 14 (1969), pp. 40–62, in preference to that suggested by, e.g., W. D. Ross, *Aristotle's Physics* (Oxford, 1936), pp. 44–8.

[23] See *Physics* III.1, 201^{a}29–^{b}15.

of the bronze as a statue, which captures it whilst the sculptor is busy at work on it, as it is in process. For it is still bronze and hence not yet a statue; but it is something more than inert bronze since, in the sculptor's hands, it is actively expressing its potential to be a statue.[24]

Aristotle's example of the bronze becoming a statue is an artificial κίνησις, but in his view natural processes occur for the realization of an end just as artificial processes do. What holds true of both the bronze turning into a statue and the seed growing into a tree is that the activity can be represented as a movement towards a goal. In expressing its potential to reach that goal or intended terminus, the subject of κίνησις is necessarily engaged in an activity (ἐνεργεία) that is incomplete, as Aristotle emphasizes when he says, 'κίνησις does seem to be a type of ἐνεργεία but an incomplete one (ἀτελής), and the reason is that the potential subject which is active is incomplete'.[25]

The Greek word I have translated as 'incomplete'—ἀτελής—means literally 'without a terminus'. Aristotle does not mean that the change has no terminus but that the terminus has not yet been reached and will not be reached so long as that ἐνεργεία which κίνησις is by definition continues. In saying that it is a *type* of ἐνεργεία he has in mind a contrast with other ἐνεργείαι which are not incomplete. That is to say that they *do* have a terminus, just as a κίνησις does, but, unlike a κίνησις, their terminus is attained as they are enacted. It is these ἐνεργείαι which Aristotle has in mind when he contrasts ἐνεργείαι with κινήσεις, reserving the generic term ἐνεργεία for that type of activity which is not incomplete. In what follows I will do the same.

Ἐνεργείαι such as hearing are to be distinguished from κινήσεις such as being cured. One way of making the distinction—the so-called tense test—is to note that, with verbs expressing ἐνεργείαι, use of the present tense entails use of the perfect tense of the same verb ('Everything at the same time is hearing and has heard'), whereas with κινήσεις use of the present tense precludes simultaneous use of the perfect ('It is not true that at the same time one is being cured and has been cured'). This is related to the contrast drawn in the *Physics* between complete and incomplete activities. One cannot use present and perfect tenses simultaneously of a κίνησις-verb because, while a κίνησις is going on, its completion or terminus must be in the future. In contrast, with an ἐνεργεία-verb the perfect tense is applicable as soon as the present tense is. Hearing is complete at the moment when it happens, and it does not require any further moves for that to be so.

Another aspect of the same distinction has to do with coming to be.[26] The point is made for ἐνεργείαι like seeing and hearing that there is no coming to be (γένεσις) of them, but that they exist without coming to be (γίγνεσθαι). In this they differ from κινήσεις, not because there is a process by which a κίνησις comes into being,[27] but because there is a process by which the τέλος—the

[24] For a defence of this interpretation see Kosman, 'Aristotle's Definition' (n. 22 above), p. 50.

[25] *Physics* III.1, 201^{b}31–3. My own translation.

[26] The tense test is introduced at *Metaphysics* 1048^{b}18–35, the claim about coming to be at *De sensu* 6, 446^{b}2 and *Nicomachean Ethics* 1174^{b}12–13. For a fuller discussion of the philosophical issues see T. Penner, 'Verbs and the Identity of Actions—A Philosophical Exercise in the Interpretation of Aristotle' in *Ryle*, edited by O. P. Wood and G. Pitcher (London, 1971), pp. 393–460 (436).

[27] Something which would breed an infinite regress of κινήσεις, as Aristotle shows in *Physics* V.2, 225^{b}15.

terminus or completion—of a κίνησις comes into being. The completion of a κίνησις is approached step by step. But this is not true of the completion of an ἐνεργεία, precisely because its completion is realized as soon as it happens. To put it another way, these ἐνεργείαι cannot be intercepted at a half-way stage in the way that being cured or learning something could be.

How can Aristotle classify hearing as an ἐνεργεία whilst explaining it as a κίνησις? Aristotle attempts an answer to this question in chapter six of the *De sensu* where he asks whether the perception of light and colour like that of sound and smell involves any time-lapse. This is relevant to our problem because a time-lapse between commencement and completion is something characteristic of a κίνησις but not an ἐνεργεία. Thus Aristotle argues initially that the perception of colour and light must involve a time-lapse because it involves a κίνησις and all κίνησις involves a time-lapse.[28] He adds that, even if hearing and perceiving generally are ἐνεργείαι, this does not rule out there being a time-lapse involved in them. Aristotle shows that hearing does indeed involve a time-lapse by appealing to ordinary experience. The sound still has not reached the ear even after the blow which produced it is over.[29] It looks then as if Aristotle's proposed solution is to retain the account of hearing in the *De anima* as a κίνησις involving time-lapse and simply stipulate that the existence of a time-lapse between the blow which produces the sound and the hearing of it, i.e., a time-lapse within the sounding process, is compatible with the fact that the hearing itself is an ἐνεργεία involving no time-lapse.

But there is a problem with this. For, as has already been pointed out,[30] it is a key doctrine with Aristotle that, when perception takes place, the ἐνεργεία of the object of perception is one and the same as the ἐνεργεία of the sense. Moreover, it was noted that his chosen illustration for this doctrine was the sense of hearing. It is a matter of paradigmatic importance for Aristotle that the sounding and the hearing are a single activity. Thus, if Aristotle is not to abandon his single activity doctrine, he is committed to the view that the sounding which occurs in the ear is an ἐνεργεία identical with the ἐνεργεία which constitutes the hearing and thus, like the hearing, complete at any moment. Yet the account of hearing given in *De anima* II.8 is clear in representing the sounding within the ear as a κίνησις.[31]

Aristotle perhaps recognizes this problem when, at the start of the discussion in *De sensu* 6, he is careful to avoid committing himself on the question of whether it is a κίνησις which arrives at the ear.[32] By talking of the *sound* arriving at the ear, he can, given his view that an actual sense is identical with its actual object, suggest that actual hearing, like actual sound, is an ἐνεργεία rather than a

[28] *De sensu* 6, 446^{a}29–446^{b}2.

[29] Ibid., 6, 446^{b}5–6.

[30] See my comments on the 'single activity' doctrine on p. 9 above.

[31] *De anima* II.8, 420^{a}4–5. I do not think one should make anything of the tenses here (κινου-μένου... κινεῖται). Aristotle does not wish to suggest that the change in the ear is simultaneous with the change in the air outside, an idea which would contradict his own view that the process that causes hearing involves a time-lapse; see *De sensu* 6, 446^{b}5–6.

[32] See *De sensu* 6, 446^{a}20–3: 'One might ask: do the objects of sense perception, or the movements (κινήσεις) proceeding from them (in whichever of the two ways sense perception takes place), when these are actualized for perception, always arrive first at a middle-point, as odour evidently does, and also sound?'

κίνησις. But he does not point out the difficulties in rendering this view compatible with the *De anima* account of hearing.[33]

Hearing and Instantaneous Change

Aristotle in fact goes on in this same chapter of the *De sensu* to introduce a concept which can resolve the difficulties, although he himself never spells out how. For he says that a change of quality (ἀλλοίωσις), unlike a change of place (φορά), need not involve a time-lapse at all. Over a large area it must proceed a part at a time, but the parts themselves could change without a time-lapse. That is to say that although an overall change of quality (a lake freezing over, say) takes time, it can be broken down into a series of changes none of which by itself takes time to happen, the overall time-lapse being the product of the time-lapses between each of the component changes. These changes are instantaneous.[34]

Alexander takes up this suggestion that some changes are instantaneous in the account of hearing in his *De anima*. It is evident that, although Alexander accepts much of the account given in *De anima* II.8, including the assumption that hearing involves a κίνησις, he is prepared to make radical departures from Aristotle's theory. This emerges particularly clearly in his explanation of echo. Aristotle had said merely that echo came about 'when, a mass of air having been unified, bounded, and prevented from dissipation by the containing walls of a vessel, the air rebounds from this mass of air like a ball from a wall'.[35] The image of the rebounding ball suggests a packet of air moving like a ball through the aural medium. On the evidence of his explanation of echo, then, Aristotle seems to be saying that hearing occurs because of packets of air, generated by colliding solid bodies, which fly earwards to cause hearing, and the remainder of his *De anima* account contains nothing to contradict this theory.[36]

The remarks about hearing which Aristotle makes in *De sensu* 6 confirm that he holds a locomotion theory of hearing. It will be recalled that Aristotle was asking whether the perception of light and colour involves a time-lapse as it does for sound, appealing to the accepted fact that hearing involved a time-lapse between the production of the blow and the arrival of the sound at the ear. Aristotle goes on to say: 'This is made clear by the change in shape (μετασχήμασις) of letters because the locomotion comes about in the medium. For people clearly fail to have heard what was said because the air undergoes change of shape (μετασχηματίζεσθαι) while in locomotion.'[37]

[33] In particular the *De anima* account states that sound itself is a κίνησις at 420^{a}8–9.

[34] *De sensu* 6, 447^{a}1–6. I use the term 'instantaneous' to translate the Greek adjective ἀθρόος as applied to change. By an instantaneous change I mean one that occurs without time-lapse.

[35] *De anima* II.8, 419^{b}25–7.

[36] Thus although some commentators (e.g., R. D. Hicks, in Aristotle, *De anima*, edited, translated and introduced by R. D. Hicks [Cambridge, 1907], p. 377) regard the air that is struck before it can disperse at 419^{b}21–5 as referring to the exceptional case where air itself is one of the bodies struck, others (e.g., Ross, in Aristotle, *De anima* [n. 1 above], p. 248) take it to be a packet of air that is struck whenever solid bodies collide. This is quite compatible with the idea that a packet of air is always sent earwards. Again at 419^{b}34–5 Aristotle says that air produces hearing when it is moved as something continuous and one, adding at 420^{a}3–4 that it is moved as far as the hearing. Aristotle's remarks in *De sensu* 6, 446^{b}6–9, suggest that this air which is continuous and one must be construed as a self-contained packet of air, and the movement of the air as far as the hearing as a locomotion.

[37] *De sensu* 6, 446^{b}6–9. My own translation.

He must be thinking of cases where one mishears what is said by someone at some distance away, not failing to hear altogether (which would be caused by absence of any σχῆμα at all).[38] Such mishearing in a language like ancient Greek with its heavy reliance on pitch accent would in part be attributable to a hearer's misregistering variations in pitch of the syllables spoken. Interpreted in this way, this 'shape' theory of pitch is consistent with Aristotle's explanation of variations in pitch in the *De anima* in terms of the idea of sharp and blunt sounds, the guiding metaphor being tangible shape.[39] The fact that there is this single conception of what sounds are—namely different shaped packets of air—in both the *De anima* and the *De sensu*, taken together with the fact that the *De sensu* is explicit in stating that these shapes travel to the ear, tends to confirm the idea that the implications of a locomotion theory in the *De anima* are to be taken seriously.[40]

Alexander begins by recapitulating the Aristotelian account of echo in terms of the locomotion of air.[41] 'But', he then adds, 'it can also be maintained that the air which is struck to begin with does *not* undergo locomotion to the hollow body and the air confined in it, and is *not* then bounced back from these to the place it started at.'[42] He then offers the following alternative theory:

> Instead, the air which is struck to begin with might remain continuous and indivisible because of the speed of the blow. It would use the same sort of blow to impose a shape on the air next to it. This air might do the same to the air next to it, and in this way, because there is continuous air as far as the vessel, the sound would move forward by being passed on (κατὰ διάδοσιν). The air adjacent to the vessel is the last air to be struck and receive the shape. Prevented from passing the blow any further because the vessel is in the way, it would be pushed back by the resistance of the solid body, just as a ball bounces off a solid body, and would strike the air behind it and re-impose the shape. This air would do the same to the air next to it, and in this way the passing on of the blow and the sound would reach its starting point, just like seeing people in mirrors.[43]

The idea of διάδοσις—one packet of air passing on an imprint to the next—is a clear repudiation of Aristotle's locomotion theory, and it is no doubt for this

[38] See Aristotle, *De sensu et De memoria*, edited and translated by G. R. T. Ross (Cambridge, 1906), p. 206.

[39] *De anima* II.8, 420^{a}26–420^{b}4.

[40] It is true that elsewhere Aristotle creates difficulties for his locomotion theory. In *De sensu* 6, 446^{b}17–26, he explains how several people hear the same thing by saying that the perceptual change for each person has a single common source but different termini, one for each person. Since the standard case of locomotion involves the same body being in a succession of locations at a succession of times, the locomotion being terminated when that body has reached the final location, if he is now prepared to allow the change involved in hearing to terminate in a number of different locations, he cannot have straightforward locomotion in mind. Moreover, he denies that it is a body at all which is at these different locations. It is an affection and change of some sort, although, 'not without body' (*De sensu* 6, 446^{b}25–6). These difficulties must have given Alexander further motivation to develop his own theory of transmitted shape, if only to restore clarity.

[41] Alexander, *De anima*, pp. 47.25–48.7.

[42] Ibid., p. 48.7–12, giving as the reason against locomotion the fact that it would involve a twofold reciprocal replacement of the intervening air.

[43] Ibid., p. 48.12–21. This account is quoted verbatim by Simplicius as an original theory of Alexander's (see M. Hayduck's edition of Simplicius, *Commentaria in libros Aristotelis De anima*, Commentaria in Aristotelem graeca, 11 [Berlin, 1882], p. 141.15–32). Simplicius praises it for meeting the point that locomotion of air could not take place quickly enough (p. 141.19–20) and for complying with the Aristotelian principle that mover needs to be next to mover (p. 141.20–1; cf. p. 141.27–8), but is less happy with the absence of any explanation of how shape is transmitted from one packet of air to the next (p. 141.34–8).

reason that Alexander introduces it so tentatively. It is not of course restricted merely to the special case of echo. There are not going to be two accounts of how the air behaves in hearing, one for echo and the other for all other auditory perception. The διάδοσις theory offers an explanation of all cases where sound appears to travel, an explanation which dispenses with the need to postulate locomotion at all. In place of locomotion Alexander hypothesizes a series of changes of shape. As Aristotle had made clear in *De sensu* 6, such changes, if regarded as changes of quality, need not involve time-lapse—unlike locomotions. Over a large area a change of quality takes time because it has to proceed a part at a time, but the parts themselves, Aristotle had said, could undergo instantaneous changes. It may be difficult to see how exactly they are to be reconciled with Aristotle's general insistence that all κίνησις necessarily involves a time-lapse. But this very problem itself points to their possible use to explain how a κίνησις can be identified with an ἐνεργεία. For an instantaneous κίνησις is complete at any moment just because there is no lapse of time between its inception and its completion, and this is exactly the problematic characteristic of ἐνεργείαι such as hearing.

Alexander makes it clear in his account of hearing that the change of quality which his διάδοσις theory envisages does not involve time-lapse. He describes hearing as occurring in the following way: the air which is enclosed in the ears undergoes a change which is produced by the air which assails the ear from outside, air which has been given a shape in some way by the original blow. The air in the ear persists undispersed because it is enclosed and for this reason its reception of the shapes is accurate. By passing these on to the primary sense organ it causes the apprehension and judgement of sounds in the perceptive soul.[44] It is clear that the series of changes which begins at the blow and ends in the primary sense organ is a repetition of the same type of change throughout, a passing on of shape. This suggests that the description of the first change in the series will apply to all the subsequent ones. If one looks back to Alexander's description of the original change which occurred at the place of the blow, one can see that it already has built into it a clear indication that it is an instantaneous change. He says that it is air which is isolated instantaneously (ἀθρόος) which produces sound and adds that it produces sound because it is cut off instantaneously.[45] The air adjacent to the collision must be temporarily a solid body, and this means that it must be immune from air's natural tendency to disperse for as long as it takes to receive the change. But the idea that it acquires solid body status instantaneously has no counterpart in Aristotle's account.

To acquire temporary solidity is, I suggest, not a preliminary to acquiring 'shape'. It is much more likely, since some sort of shape is essential for any solid body, that the air in question acquires its 'shape' at the same time as it acquires its solidity. Thus Alexander's instantaneous acquisition of solidity is an instantaneous change of shape. Alexander is clearly signalling the fact that the physical and physiological process of hearing is made up of a series of instantaneous changes.

[44] Alexander, *De anima*, pp. 50.12–18.
[45] Ibid., p. 47.7–11.

Alexander's motive for this innovation becomes clear when one compares his account of the ear with that of Aristotle. Alexander shares Aristotle's view of the ear as essentially a box of enclosed air, and like Aristotle he connects the design of the ear with the need to ensure that perceptions are accurate. Where they differ is in their explanations of how that need is met. Alexander says that the ear's reception of *shapes* is accurate because the air in the ear is enclosed.[46] Aristotle on the other hand talks in terms of the ear's reception of a standard non-instantaneous κίνησις. Where Aristotle had linked accuracy to the fact that the enclosed air did not itself undergo κίνησις (meaning not that there was no movement but that the enclosed air was immunized, as it moved, from the accidental movements that the external air was prone to),[47] Alexander associates it with the relative permanence of the enclosed air's shape in comparison with the instability of the shapes in the external air. Thus Alexander's specification that aural shape is received instantaneously has an important function within his account of hearing. He accepts Aristotle's idea that, in hearing, there is a κίνησις in the ear. But in his view perceptual accuracy resides in the persisting nature of the completion of that κίνησις rather than in the distinctive nature of the κίνησις as it develops. Precisely because there is no time-lapse between the commencement and the completion of an instantaneous κίνησις, Alexander can guarantee that hearing will at any moment have as its object a static and hence determinate shape. The object of hearing needs to retain a determinate pitch for just long enough for this pitch to be registered by the hearer. Alexander is taking the view that, whatever else may be true of the physical story that explains our perception of sound, that story will need to contain some assurance that we will perceive the determinate sounds which he assumes, as does Aristotle,[48] we do in fact perceive. The physical process involved in hearing has an essentially static nature, a nature predetermined by the peculiarly determinate character of perception itself.

Alexander on the Distinction between κίνησις and ἐνεργεία

If my analysis of Alexander's reasons for describing hearing as an instantaneous change is correct, his response to the problem facing Aristotle's account of hearing is clear. The dilemma of having to decide whether hearing is an ἐνεργεία or a κίνησις does not arise. The κίνησις involved in hearing will have its character predetermined by the nature of the experience of hearing. Since hearing has been identified as an ἐνεργεία complete at all stages of its existence, the same will be true of the κίνησις involved in hearing. Thus it will be an instantaneous change. But it has already been characterized as such in order to ensure perceptual accuracy.

It is of course a matter of speculation to decide what Alexander's overall strategy is and how this is related to the tactical manoeuvres employed in individual passages. But I feel some confidence in suggesting that Alexander

[46] Ibid., p. 50.12–16.

[47] *De anima* II.8, 420ᵃ7–11: 'Air in itself is, owing to its friability, quite soundless; only when its dissipation is prevented is its movement sound. The air in the ear is built into a chamber just to prevent this dissipating movement, in order that the animal may accurately apprehend all varieties of the movements of the air outside.'

[48] See n. 9 above.

introduced instantaneous change into his account of hearing in the *De anima* to guarantee perceptual accuracy rather than to solve Aristotle's ἐνεργεία/κίνησις dilemma, since this is an interpretation which sticks closely to what Alexander says in the passage concerned. By contrast, nowhere in his explanation of hearing does Alexander state that the introduction of the idea of instantaneous change enables hearing to be regarded as an ἐνεργεία.

None the less I think that it is no coincidence that the incorporation of instantaneous change into the *De anima* account of hearing avoids the Aristotelian dilemma highlighted in *De sensu* 6. There is an important connection between the two in Alexander's mind, which is indicated by the fact that in distinguishing a κίνησις from an ἐνεργεία he describes the latter as instantaneous, using the same Greek adjective ἀθρόος which marks a change out as instantaneous. This emerges in Alexander's commentary on Aristotle's distinction between κίνησις and ἐνεργεία in *De sensu* 6. Alexander chooses to express this as a distinction between two different types of temporary entity. Natural and artificial products like horses and shoes come into being in stages. But a perception comes into being fully formed and cannot be described at any stage as being on the way to completion. It is complete from the very start of its existence: '*For everything hears and has heard* [*De anima* 446^{b}2]: for every ἐνεργεία and every part of it is a hearing. Hence that which hears has heard immediately it hears. The same applies to the other ἐνεργείαι in respect of the senses. For their ἐνεργείαι and their apprehensions are instantaneous (ἀθρόαι) and do not need a period of time in order to be complete.'[49]

It is noticeable that Alexander's distinction is open-ended in the sense that he offers examples of the two types of temporary entity under consideration rather than exhaustive lists. This raises the question whether he would include the product of an instantaneous change in his second category. After all, although such a change is a κίνησις, it is ἀθρόα. The product of an instantaneous change does not emerge in stages. It is true that he cites ἐνεργείαι under the second category. But this does not rule out the inclusion of things other than ἐνεργείαι. I feel sure that, although he does not mention them, Alexander would wish to include the products of instantaneous changes alongside perceptual ἐνεργείαι.

For while the first category is clearly marked out by his examples as covering the end products of κίνησις generally, this would not prevent him from including in the other category the special sort of κίνησις which an instantaneous change is. For he draws an explicit distinction between κίνησις proper and ἀθρόα κίνησις. This is made clear a few pages later in a second passage where Alexander is explaining why Aristotle should have introduced the topic of instantaneous change into a discussion of the behaviour of light. Alexander thinks that the implication of this discussion is that the instantaneous spread of light through a transparent medium does not occur by κίνησις at all. Why then introduce the concept of instantaneous κίνησις? Its relevance according to Alexander is to demonstrate that even within the realm of κίνησις such instantaneous occurrences can happen. When Aristotle says that a lake freezes over in stages but that the first part freezes all at once,[50] Alexander comments:

[49] Alexander, *In librum De sensu*, pp. 125.24–126.1.
[50] *De sensu* 6, 447^{a}3–6.

> He gave this illustration, not to make the point that being illuminated is an alteration (for he does not think that it is), but because he wanted to establish that certain things can change as a whole instantaneously (ἀθρόα) and that if something is divisible it need not in all respects be changed a part at a time. Therefore, if in the case of alteration—which is a κίνησις and takes time to occur—there is none the less no reason why a part cannot undergo instantaneous change, since illumination does not occur by means of κίνησις, there is nothing strange in saying that what is illuminated can receive light all at once.[51]

Alexander's argument is *a fortiori*. All κίνησις is time-taking. Yet even within a time-taking κίνησις there can be instantaneously realized stages. All the more reason then to accept that illumination which is not even a κίνησις can be instantaneously realized. Alexander's reliance here upon the idea that *all* κίνησις takes time is significant. For it clearly implies that an instantaneous change is not a κίνησις proper at all. It is simply a *stage* in a genuine κίνησις. Thus Alexander can contrast illumination with the processes involved in hearing and smelling. These, he says, resemble locomotion in that they involve a time-lapse.[52] This is no contradiction of the claim in the *De anima* that hearing involves an instantaneous change. For the instantaneous changes involved in hearing are simply the perceptible stages into which the overall time-taking κίνησις can be broken down.

Alexander's distinction between entities that do and entities that do not exist complete at every stage achieves all that is encompassed by Aristotle's distinction between κίνησις and ἐνεργεία. But, by leaving room for instantaneous changes alongside ἐνεργείαι, Alexander can avoid Aristotle's dilemma of having to decide whether hearing is a κίνησις or an ἐνεργεία. He can say that hearing is both. The hearing process overall is a true κίνησις, but it breaks down into a succession of instantaneous changes. These are not themselves ἐνεργείαι. But they can be temporally co-terminous with ἐνεργείαι in a way that Aristotle's κίνησις within the ear could not have been. The schema which Alexander achieves by widening the Aristotelian distinction between κίνησις and ἐνεργεία into a distinction between entities that are instantaneously realized and those that are not enables him to classify the instantaneous stages of a κίνησις alongside perceptual ἐνεργείαι, thus reconciling the roles of κίνησις and ἐνεργεία within his account of hearing. To the extent that this resolves the dilemma which Aristotle had himself raised in *De sensu* 6 of how hearing could be an ἐνεργεία if sounding is a κίνησις,[53] Alexander can be seen as making an important contribution to the continuing vitality of the Aristotelian theory of hearing.

[51] Alexander, *In librum De sensu*, p. 133.12–19.
[52] Ibid., pp. 132.22–133.1.
[53] See p. 12 above.