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The Physiology of Vision in Alexander's Commentary on the *De sensu*

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I consider how far the commentary of Alexander of Aphrodisias on Aristotle's *De sensu* (henceforth IDS) presents a coherent account of the workings of the eye while at the same time assessing the extent to which Alexander was aware of the work of Galen in this area. These two questions are linked. Galen's account of the workings of the eye in *De methodo medendi* (MM), *De usu partium* (UP), and above all *De placitis Hippocratis et Platonis* (PHP), is characterised by its anatomical detail. The account presented in IDS is in contrast devoid of anatomical detail. And yet in other areas various studies have argued the case for seeing Alexander as responding to Galen.[1] If Alexander when he wrote IDS was mindful of Galen's contribution to the subject of visual physiology, his apparent disregard for the fruits of Galen's dissections of the human eye requires explanation.[2]

The IDS is a commentary on a work of Aristotle's. This means that in writing it Alexander was primarily engaged in the task of interpreting the text for a contemporary audience. One could contrast the commentary with his own treatise *De anima* where his goal is the exposition of a systematic psychology (cf. Caston 2012, 3). Is he not more concerned in the commentary to expound and defend on a piecemeal basis the Aristotelian doctrines contained in successive passages of text? There is certainly something in this view, but the contrast between treatise and commentary can be overstated. Alexander's treatise *De anima* was most probably written after the IDS and in several chapters utilises the outcomes of the commentary (cf. Moraux 2001, 340). Given that Alexander was in the commentary elucidating a treatise of Aristotle, which he presents at the outset as an integral step in the gradual unfolding of a systematic psychology, there can be no objection to using his commentary alongside his other works to clarify Alexander's own understanding in this area. Indeed Sharples 2005, to which this article is meant as a belated postscript, attempted to do just this.

I. Alexander's philosophical method in the IDS

Alexander's readers are assumed to be aware of the difference between the rival schools and also to be broadly familiar with the Aristotelian corpus and

[1] Donini 1974 argued that Alexander in his treatise *De anima was* deliberately engaging with the views of Galen; Tieleman 1996, 265-281 argued that in the same work Alexander inverted Galen's own arguments to defend cardiocentrism against Galenic attack.

[2] Obviously no such explanation is required if Alexander was totally oblivious to the work of Galen, although in that case the immunity from Galen's influence might equally require explanation.

willing to submit to the authority of these works. Since they will therefore be looking to Alexander to demonstrate the relative superiority of Aristotelian doctrine, it is no surprise to find him adopting a methodology in the IDS and other commentaries that is dialectical in character. For dialectic is a method for resolving the problems that arise from considering the reputable opinions within any field in which conflicts arise, and hence it is well suited to achieving an adjustment between Aristotle himself, those predecessors whom he criticises, and those successors who criticise him—all three of these categories being examples of authorities with a public reputation. With its concern for the opinions of the reputable, it is a mode of proceeding particularly well suited to the deferential context in which Alexander operates.

But as a method it is open to the criticism that it falls short of a rigorous approach to the truth that the serious-minded student has a right to expect. The dialectical syllogism is not conclusive in the way that the demonstrative syllogism is intended to be.[3] Alexander wishes to defend the Aristotelian stance against alternative views rather than to establish such a stance from first principles that even a sceptical opponent would be forced to accept. Thus the inconclusive nature of dialectical argument is not a weakness in his eyes. For the standard of proof that he has in mind is judicial rather than mathematical. He accepts that dialectic cannot establish which plausible views are true or false. The value of dialectic lies rather in the good judgment that those adept at it acquire by practice. Such judgment somehow enables its possessor to decide between truth and falsity in cases where there are convincing cases to be made on both sides.[4] The parallel with law court procedure is evident: the jury decide what a just outcome is after listening to the case for the prosecution and for the defence. In the same way a philosopher can decide the truth after considering the arguments for and against a particular philosophical hypothesis. In cases where there are different opinions the truth is to be located in the opinion that has greater credibility.[5] Of

[3] Yet the demonstrative syllogism, based as it is on true and primary premisses, represents a theoretical ideal that the warring schools of Alexander and his rivals are unlikely to achieve.

[4] As such it is the method appropriate to those seeking to advance in physics, ethics, logic, and metaphysics (*in Top.* 28,25-26). It is because philosophers are able to distinguish the various plausible arguments that contribute to both sides of an issue, and thus argue convincingly for both sides, that they are well placed to discover on which side the truth lies (*in Top.* 28,26-30).

[5] Within the *De sensu* commentary, for example, the debate between Aristotle's theory of vision and other theories that postulate an efflux coming from the visible object and entering the eye is to be resolved by just such a method: 'Aristotle now opposes an opinion presupposed by the ancients concerning seeing, that seeing comes about in accordance with the efflux from the bodies seen… He reminds us that the opinion is not sound and that it is not possible that seeing comes about in this way but in the way he himself showed by showing in general that it is not possible that seeing comes about by virtue of effluxes from the objects seen… But he did not add the absurdity which follows' (IDS 56,10-22; all translations from IDS are based on Towey). Where Aristotle had argued against an efflux theory on the grounds that it reduces vision to touch, Alexander supplements Aristotle's own objection with a battery of his own arguments. By introducing a series of objections in the manner of a forensic orator, he suggests that the sheer quantity of the difficulties is a relevant factor in undermining the credibility of the efflux theory.

course to the sceptic the fact that contrary views on any matter are held by eminent thinkers is a good reason for suspending judgment altogether. But Alexander assumes that such a course will be unacceptable.[6]

Does Alexander make this dialectical procedure explicit in the *De sensu* commentary? His frequent use of the verb 'to demonstrate' (*apodeiknunai*) when describing what he takes Aristotle to be doing may be taken to imply that far from following a dialectical procedure he assumes that the arguments of the *De sensu* are in fact demonstrations. But in practice he does not show much interest in exhibiting Aristotle's arguments as categorical syllogisms, and he does make it clear that as far as this particular commentary goes there is no clear distinction between dialectic and demonstration. At the outset he stresses that the doctrines of Aristotle's *De anima* are to be taken as the principles (*arkhai*) or suppositions (*hypotheseis*) of the *De sensu*. In Alexander's mind a supposition could refer to an indemonstrable axiom (the very thing that dialectic can lead us to). But it could equally well describe things that are demonstrable but which people 'take as agreed and suppose without the demonstration that is proper to them because they will demonstrate them later but will use them now as principles for other purposes' (IDS 4,20-23). This effectively kicks into touch the difficult question of whether any claims defended in the forthcoming commentary are strictly speaking demonstrations. Thus Alexander can talk in terms of demonstration while engaging in the looser dialectical procedure I have described. The task of reformulating in a demonstrative mode can be indefinitely postponed.

II. The divergence from Galen

There are two important passages in IDS where Alexander's views on the physiology of vision can be gleaned: the commentary on *De sensu* 438b8 and the commentary on *De sensu* 436a22, and I shall consider both of these in turn. But it is important to make clear at the outset that Alexander's method emphasises the dialectical assessment of opposing views where aporiae have arisen. It is therefore not surprising if the presentation of a coherent physiological picture is hard to come by. For the dialectical procedure is not easily harmonised with the sort of approach followed by Galen that is based on sensitivity to anatomical detail as revealed by dissection. The question of the anatomical structure of the eye and its periphery is not an area where the competing authorities within Alexander's philosophical tradition can be located. Thus even though there is a contrast between Alexander's position and that of Galen (cf. Sharples 2005, 354-355),

[6] The importance of making a decision receives Aristotelian authority from *De caelo* ii 12.291b24ff., which suggests that the philosopher who seeks to make modest progress is displaying the appropriate degree of commitment (*prothumia*) when faced with difficulties. Cf. Alexander's comment in *On the Cosmos* p. 125: 'As for the cause of the divergence and opposition of opinions it is bound to be due to one of the following reasons: either to a desire to rule and dominate which diverts from discerning the truth and following it, or to the difficulty, subtlety, and obscurity of the matters under discussion, or to the weakness of our nature and our incapacity to attain realities. But we should not for all that reject what we have come to believe and think by way of reflection and philosophizing.'

this is not something that we should expect Alexander to address given his mode of proceeding.

I have presented at Figure One an approximate picture of the eye as Galen understood it, and it is clearly one that would be recognisable today.[7] It will become apparent in what follows that no attempt can be made for purposes of comparison to present a picture of the eye as Alexander understood it.

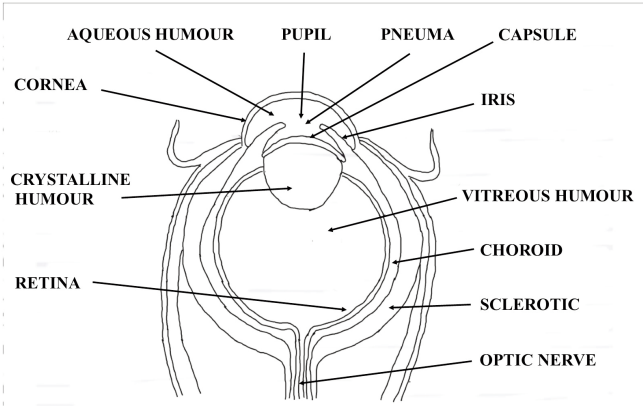

FIGURE 1—GALEN'S EYE

Whereas Galen regarded the lens of the eye (shown in Figure One as the crystalline humour), as the location of vision, in Alexander's view it was the heart, the site of the organ of the common sense, where vision was located. But this contrast is not quite as definitive as this bald way of stating it might imply. Galen's position on the question is clear: it is explicitly stated in three separate treatises by Galen that the crystalline humour is the principal instrument of vision (UP 10.1 = iii 760 K, lines 13-14; PHP 7.5 = v 623-624K; MM 1.6 = x 48K, lines 16-17). Alexander's views on this question are in contrast never set out explicitly but have to be inferred from various passages because the question of the location of vision is not as such a central dialectical issue between the Aristotelian and the alternative reputable opinions.

Those philosophy students who are drawn to the *De sensu* of Aristotle must have had a significant overlap of interest with the medical students. Alexander shows awareness elsewhere in the commentary of areas of scientific research where the interests of philosophers and doctors overlap (IDS 107,3-5: the relation of nutrition to smell) and compares the close connection of physics to medicine with the relationship between geometry and optics, arithmetic and musicology, astronomy and navigation. In each case the latter practice is subordinated to the former in the sense that it depends upon the former to supply the principles that it requires (IDS 7,2-6).

[7] This is adapted from Galen's anatomy of the eye according to Magnus, *Die Augenheilkunde der Alten*, as depicted in Crombie 1990, 186. I am indebted to Edward Towey for the line drawing.

Moreover Alexander's extensive discussion of the anatomy of the eye in his commentary is exactly what he has led the reader to expect to find. In broad terms he presents the treatise *De sensu* as addressing the material basis for perception. Indeed he summarises it (IDS 1,11-18) as a discussion of the sense organs and the perceptibles. So convinced is he of this that when earlier commentators dismissed the topic of sense organs as an unplanned diversion from Aristotle's stated theme of inquiring into animal activities, he leaps to Aristotle's defence: 'it is reasonable that, having taken it as obvious that perception and the activity in respect of it is common to body and soul he begins to discuss the sense organs. For he has already discussed the perceptive soul [*sc.* in Aristotle's *De anima*], and perception and the activity in respect of it are common to soul and body, and it was necessary for the person discussing the common activities to discuss perception first. For this is the commonest to all animals and most evident of the activities in respect of soul.' (IDS 2,19-24)

Sharples is certainly correct to think that Alexander's discussions of the eye in the IDS provide the best source of evidence for working out in detail Alexander's own understanding of the anatomy of the eye and the physiological mechanism involved in the visual process. But these discussions must not be understood as a systematic physiology in the manner of Galen. The tensions between his role as a commentator sympathetic to the Aristotelian tradition and his receptivity to advances in medical anatomy outside that tradition are evident. We know from his treatise *De anima* that he appreciated the discovery that the nerves were vehicles of motor functions (*De anima* 24,9; 76,16; 98,12-15; 100,16). But this level of anatomical interest is absent from the IDS.

If Alexander is aware of Galen's research on the eye and chooses to ignore it, the likely reason is that the dialectical dispute between competing authorities on whether the eye is fiery or watery is the only significant point at issue. The practice of medicine must operate within principles laid down by philosophy, and it is not any part of Alexander's task as a philosopher to descend to the level of detail at which Galen operates. Galen's own ophthalmology can indeed be integrated into the debate over principles that Alexander is adjudicating, but this is because he can be subsumed under the *Timaeus* theory of the eye, which receives extensive coverage. For, as noted above, Galen is clear that the principal instrument of vision is the crystalline humour, a homoiomerous body of watery composition, and to this extent can be seen as endorsing the Aristotelian position. At the same time he makes the process of vision require the emission from the crystalline humour into the external air of visual *pneuma*, a body with some affinity to the 'pure fire' that Plato in the *Timaeus* 45b7 imagines being emitted from the eye to coalesce with the external air. Galen's idea that the visual *pneuma* assimilates the external air to its own nature (PHP v = 625K) is a restatement of this theory. Thus when Alexander criticises Plato's theory and others who follow him, he can be presumed to have Galen specifically in mind: 'Others say that light that is sent out from the eyes proceeds as far as a certain point and then comes to be commingled with the light outside and seeing comes about when this light which is

established from both and fused together impinges at its boundary on the eyes and announces the affection to the eye, as seems to be the case to Plato' (IDS 28, 7-11).[8] If Galen is one of the theorists Alexander has in mind here, the lengthy section of the commentary (IDS 28,16-34,21) that raises a series of objections to the coalescence theory, could be regarded as a major riposte by Alexander to Galen's theory of vision.

III. The evidence of the commentary on *De sensu* 438b8-16 (Aristotle's claim that the organ of sight is not on the surface of the eye)

It is a consequence of the commentary genre that philosophical discussion has to emerge from the task of interpreting the text in question. This does not mean that such discussion has to be incidental or by way of digression. If an Aristotelian text warrants a commentary, there will be good reasons. In particular Aristotle's structuring of the subject-matter will be defensible as the best way of presenting that material. The evidence in the IDS for attributing to Alexander the view that vision is located in the heart does not emerge from a detailed account of the anatomy of the eye and other parts of the body's perceptual system. Aristotle is discussing the sense-organs, but not at the detailed level of anatomy. This will become clear from considering the passage that Sharples relies on to establish that Alexander located vision in the heart. The passage in question occurs in Alexander's commentary on Aristotle's claim at *De sensu* 438b8-16 that the organ of sight is not on the surface of the eye.

Alexander says: 'After saying "But as things outside are not seen without light, so too is it with what is inside" he adds the reason for what is inside too needing to be transparent, namely that the soul and the faculty of sight are not in the eye' (IDS 36,7-9). Thus where Aristotle had said merely that the faculty of sight was not on the surface of the eye, Alexander says that it is not in the eye at all (cf. Sharples, 2005, 353).

A little later Alexander says: 'And there is also evidence from certain observed facts that the seeing soul is not on the surface of the eye, and that what extends up to that faculty is transparent and that sight occurs through it when it is illuminated: for, he says, when people have been wounded, he says, "on the temple in battle in such a way that the *poroi* of the eye were cut off", (i.e. the *poroi* in which the transparent is located) darkness seemed to come upon them suddenly as if a light had been put out, since the *korê* had been cut off from the transparent behind the *korê*, which it illuminates like a lamp; through it everything inside right up to the faculty of sight was illuminated by the light outside. The blow, destroying this continuity and preventing it from being illuminated extinguished the light in it so to speak.' (IDS 36,20-37,3)

This short excursus on the anatomy of the eye is a case where Alexander is relying very much on Aristotle rather than taking the initiative himself. In particular two key anatomical concepts, which are deployed here as if their signifi-

[8] Certainly it is *pneuma* rather than light that coalesces in Galen's account, but equally it is fire rather than light in Plato's.

cance could be taken for granted, the *korê* and the *poroi*, are terms that Alexander is using simply because they have been introduced into the discussion by Aristotle. He makes no attempt to identify which parts of the anatomy he means. This has the consequence that a high degree of interpretation is required to establish that Alexander locates vision in the heart. Sharples 2005, 354 notes that it is unclear from the context where exactly the *poroi* are situated, saying: 'the conclusion that Alexander does not locate sight in the eye could be avoided if we suppose that the *poroi* are located in the eye itself rather than behind it'. He also comments, 'Alexander…imposes upon us the alternative of either interpreting the *poros* as a structure within the eye or else supposing that vision itself takes place in the heart' (350) and concludes 'the possibility remains that Alexander may not himself have had a very clear conception of exactly how the *poroi* function' (357).

In view of my conclusions above concerning Alexander's preferred philosophical method, it seems at least possible that his lack of coherence on the precise nature of the *poroi* is because his attention is directed elsewhere. Because the goal is to interpret and defend the doctrines of Aristotle as expressed in the *De sensu*, the presentation of a coherent anatomy of the eye is not in itself an overriding priority. Indeed, to continue the judicial metaphor already employed, remarks that we are tempted to regard as having a precise physiological bearing will at best be *obiter dicta* from Alexander's perspective as he defends and assesses whichever Aristotelian doctrine is in play.

Aristotle is discussing the sense organs but *not in anatomical detail*. The immediate context of the passage Alexander is commenting upon is a comparison of differing reputable opinions. Aristotle's disagreement with Empedocles, Plato's *Timaeus*, and Democritus, the historic authorities who have different views on how one can correlate four elements to five senses: the four sublunary elements, earth, air, fire, and water, with the organs of the five special senses, sight, hearing, smell, touch, and taste. It is an unbalanced discussion because Aristotle refers only briefly to the other four senses and concentrates on the issue of whether the eye is fire or water. It is also, as Alexander sees it, a wild goose chase since he is at pains to distinguish at IDS 38,12-16 Aristotle's own views from the programme of matching elements to senses. It is only redeemed in Alexander's view from being an exercise in futility because it gives him a chance to defend what is a genuinely Aristotelian position, namely, the identification of the eye (or the functionally relevant part thereof, identified as the *korê*) with one of the elements, namely, water. This for Aristotle and Alexander reveals an important truth about the underlying mechanism of vision: the importance of the role of light and in consequence the need for transparency in the visual apparatus. However, it is debatable how necessary Alexander felt it was to fill out the detail beyond the point of confirming that the physiologically relevant actors in the story, that is to say the *korê* and the *poroi* (but not the primary sense organ) have the capacity to be illuminated in the way that Aristotle's account requires.[9]

[9] It is in particular striking that no reference is made here to the primary sense organ located in

IV. The evidence of the commentary on *De sensu* 436a22-437b10 (Aristotle's claim that the phosphene effect is not indicative of a fiery composition for the eye)

Alexander's reluctance to enter into anatomical commitments emerges even more strongly in the second passage under consideration. Sharples 2005, 355 supports his interpretation of Alexander as locating the *poroi* outside the eye by referring to IDS 19,17-18 and uses this same passage to support the idea that visual sensation proper occurs in the heart (352): '[the eye] can still see because it lies in a straight line with the *phlebia* through which it came about that the movement which comes about in relation to seeing transmits to the primary sense organ the glitter which comes about in the part which has been pushed aside'.

The other details of this I will return to shortly. The important point for Sharples is that the *phlebia* are clearly outside and distinct from the eye and can move relative to the position of the eye. Vision takes place only if the eye is in a straight line with these *phlebia*. In view of their role as a purveyor of transparency, i.e., illuminability, as far as the location of vision, now clearly identified as the primary sense organ, the question arises as to whether they can be identified with the *poroi* of Aristotle mentioned at IDS 36,24.

Alexander is vague as an anatomical authority when judged by the standard of Galen's precise terminology. Alexander uses the terms *poroi* and *phlebia* indifferently, and it is unclear that he means the same part of the anatomy. The contrast is all the more awkward because this is recognisably the same topic under discussion by both authors, namely, the physiology of the eye.

However, the significant point of the discussion is the dialectical issue of deciding between two reputable opinions, the view that the eye is fiery and the view that it is watery. This is the key to understanding *De sensu* 436a22-437b10 and the underwhelming grasp of anatomy shown in Alexander's commentary on it.

Alexander's rejection of the idea of a fiery emission from the eye is established in a characteristically dialectical manner. A series of objections are raised so that the alternative view that the eye is watery is victorious by default. In the words of Tieleman 1996, 278: 'those of two positions which appears more vulnerable…and hence more complicated or muddled is the one to be discarded in favour of the other'. But the main argument that supports the idea that the eye is of fiery composition is quite independent of a belief in emission as the mechanism for how seeing occurs. It is based on the so-called deformation phosphene effect: fiery sparks, so-called phosphenes, are seen when pressure of deformation is exerted on the eyeball in total darkness.[10]

The view that the eye is of fiery composition originates according to Aristotle

the heart as described in Alexander's own *De anima* 99,19-30. Indeed it is Alexander's refusal to go into anatomical detail that enabled Sharples to conclude that if the *poroi* are located in the eye, there is no need to locate vision in the heart.

[10] The importance of this effect in determining the nature and the development of Presocratic ophthalmology has been well documented in Grüsser and Hagner 1990.

from a misinterpretation of the phosphene phenomenon (*De sensu* 437a23-24). His solution is based on the notion that the iris (the 'part of the eye called black and middle', 437b1) is 'smooth', i.e., phosphorescent.[11] What a person sees when undergoing a deformation phosphene experience is not the emission of bits of fire from within the eye but the natural flashing in the dark of the eye's iris because of its smooth and hence phosphorescent nature. The eye is seeing itself. According to Aristotle the phosphene phenomenon occurs only when the eye is moved since it is only then that what is one becomes as it were two (437b1-3). The movement is so fast that what sees and what is seen appear to be distinct (437b3-4), i.e., they are not really two distinct things but just appear so.

Alexander with his characteristic disregard for anatomical detail eliminates the iris from his commentary and treats the eye as simply a watery body: 'Perhaps it will seem to some people hard to accept that the eye comes to be both seeing and seen because it comes to be two things because of a rapid displacement. For if the glittering effect which occurs in the course of the displacement could persist even for a little time occurring in another part away from the *korê*, there being transparency elsewhere when the glittering effect occurs, it was plausible that the eye when it comes to be in its proper place still apprehends and sees the effect generated in it in the place to which it had been displaced. But this is impossible (for no such thing occurs in the case of other glittering things. The glitter from them ceases simultaneously with the removal of the glittering thing. This applies not only to glittering things but also to all things that are seen. This is because the transparent medium receives within itself no colour in a manner that involves its being modified (*pathêtikôs*). This in turn is because it does not receive light in this way. For when light is removed from the transparent medium it ceases together with the removal of that which naturally illuminates.) If this is so in all cases how could the *korê* when it comes to be in its natural place even if it had moved there quickly be able to apprehend the glitter which is in it and which travels with it?' (IDS 18,17-19,10).

Alexander finds 'hard to accept' (IDS 18,18: *dusparadekton*) the suggestion that the eye can come to be two things, both seeing eye and seen object, because of the rapidity with which the eye is pushed aside (IDS 18,17-19) and he does so because of his belief that the transparent medium receives colour or phosphorescence without being affected (unlike a standard case of qualitative change (*alloiôsis*) in which the agent imparts a modification or *pathos* to the patient). In the physiological change underlying vision, there is no standard qualitative change since the removal of the agent leads immediately to the absence of whatever effect that agent was having. This idea relies on the principle that light itself, and thus by analogy colours and phosphorescent effects, departs instantaneously when the source of light is removed and is diffused instantaneously when the source is applied. The propagation of light takes no time at all.[12]

[11] 'It is in the nature of smooth objects to flash in the dark without however creating light', *De sensu* 437a31-32.

[12] In regarding the physiological change underlying vision as a non-standard *alloiôsis*, Alexan-

Alexander's preferred solution is that when the eye is pushed aside one part of the eye sees the glittering from the other part as if it were coming about from a distinct object of vision (IDS 19,16-20). For the eye has magnitude and hence can be divided into two parts (IDS 20,1-2). To the possible objection that if this were the case the eye should also see its own phosphorescence without any displacement, he makes the point that 'it does not see it because it is one and is itself that through which we see but not what we see' (IDS 17,18-19). The intuition to which he appeals is that you cannot see what you are looking through. For example, if you are using a telescope you are normally not seeing the telescope itself.

Having embarked on this solution, Alexander is faced with a problem that did not arise for Aristotle. The eye (the *korê* at 18,21 and 19,8) is now conceived of as two distinct portions of watery stuff. But the theory being defended is that one of these portions sees the other rather than that the combined portions see themselves. A reason is therefore required to explain why only one portion sees. Alexander resolves this by relying on the conception of the eye's own or proper place (IDS 17,19-20 and 18,22). Alexander suggests that the displacement that creates two parts of the eye does so because one part of the eye is no longer in its proper place; the part that remains in its proper place can see because it lies in a straight line with the *phlebia* we met earlier (IDS 19,17-18). These little veins were outside the eye and it was only by being in a straight line with these veins that vision could take place at all.

Unlike the part of the eye that is in correct alignment with the *phlebia*, the part that has been displaced, i.e., moved out of alignment with the *phlebia*, is in a place that is contrary to nature and for this reason it becomes the object seen and not any longer a seeing eye (IDS 19,21-22). The conception of a proper place is not something present in Aristotle's text. But it would be familiar to readers of Aristotle's *De caelo* where a geocentric universe allocates the centre as the proper place for earth, proper places for water and air above that, and above them the proper place for fire at the periphery (cf. *De caelo* i 8.276b24, 9.278b32). Alexander thinks of the proper place for the eye as in a straight line with the *phlebia* that lead to the central sense organ at the heart: it is only when the eye is so situated that the 'movement that comes about in accordance with seeing' (IDS 19,18) can be transmitted to the central sense organ (19,19). This confirms the

der is following the authority of Aristotle, *De anima* ii 5. Polansky 2007, 238 brings out well the way in which the idea of a non-standard *alloiôsis* highlights serious tensions within that text between physics and psychology, and these are tensions that Alexander inherits. His criticism of Aristotle at IDS 18,18 can be viewed as part of his attempt to harmonise discrepancies between different Aristotelian texts. In fact Alexander is keen to highlight the connection between the instantaneous natures of both illumination and vision, and the absence of standard time-taking *alloiôsis*. He presents this as a consistent doctrine throughout the *De sensu* commentary (IDS 31,11-18;42,26-43,1; 133,23-27; 134,11). Alexander will even go on to say (IDS 125,12-15 and 23) that the actualization of sense perception is precisely the sort of thing that requires no time to occur. This doctrine was influential on Philoponus (cf. De Groot 1983, 177-182) who went even further and declared that the appearance of light in a medium is no kind of *kinêsis* at all, not even an *alloiôsis*, thus taking Alexander's view to its logical conclusion in a way that Alexander himself, as a loyal defender of Aristotle, was not prepared to do.

bedrock of Alexander's theory of vision highlighted by Sharples, its location in the heart: for the mysterious movement involved clearly transmits the perception of the glitter to the central sense organ. Alexander has removed from the Aristotelian theory any possibility that a process of change occurs in the eye. Although he talks about the eye seeing, as indeed he must if he is to be faithful to the demands of the Aristotelian text, the eye is not a place where seeing is carried on but is at best a conduit for vision that takes place in the heart.

This whole discussion encapsulates the problem of how to read Alexander as a physiologist. The anatomical detail is vague and is limited in terminology to the *korê* and the *phlebia*, neither of which correspond to anything identified by Galen in his dissections. Alexander serves the needs of Aristotle's argument rather than engaging with the results of Galen's observations. The eye itself is simply a transparent watery body linked to the heart by some sort of transparent passages. No reference is made to the parts identified by Galen, the retina, the aqueous or vitreous humours, the lens, the cornea or the iris (see Figure One).

It is possible that the *korê* might be identified with the aqueous or vitreous humours or indeed the crystalline humour; but because Alexander treats it as identical with the eye as a whole, it is difficult to attribute such an intention to Alexander. The detail of Galen's anatomy is of course integrated into his own theory that vision occurs because visual *pneuma* reaches the crystalline humour from the brain and then forms a unity with the external air. As we have seen, this type of theory is rejected by Alexander a little later in the commentary. Nevertheless, the omission of all reference to the parts of the eye familiar to his contemporaries is remarkable.

On closer inspection however it is possible to detect a resemblance between Alexander and Galen in their physiological vocabulary. When Galen describes the coalescence of visual *pneuma* with the external air, he draws a parallel between the work carried out by the external air and the operation of the optic nerve in the body that delivers the *pneuma* to the lens: 'It seems that the effect produced on the air around us by the emission of the *pneuma* is of the same sort as the effect produced on it by the light of the sun. For sunlight, touching the upper limit of the air, transmits its power to the whole; and the vision that is carried through the optic nerves has a substance of the nature of *pneuma* and when it strikes the surrounding air it produces by its first impact a qualitative change that is transmitted to the furthest distance, the surrounding air being of course a continuum so that in a moment of time it spreads [*diapempein*] the qualitative change to the whole of it' (PHP 7.5 = de Lacy page 454 = v 619K, lines 4-13).[13]

Galen shares with Aristotle the Platonic idea that the external air when considered as a medium for vision forms a continuum with the visual organ. The difference here is that for Galen the direction of travel is outward towards the visual object, whereas on the Aristotelian theory the movement is from the outside into the eye and beyond. If we compare the description by Alexander of the moment when the eye sees, it is striking that he uses the same language to describe the

[13] The translation is based on de Lacy p. 455 with minor amendments.

process that underlies vision. It should be recalled that the eye sees because it is in alignment with the *phlebia*. Alexander states that it is through the *phlebia* that the glitter spreads (*diapempein*) the change to the primary sense organ (IDS 19,18-19). Thus whether it is describing the transmission of a movement from outside into the central sense organ (Alexander) or a movement from inside out into the external air (Galen), the process involved is conceptualised as a type of transmission. The only difference is that the Galenic movement is straightforwardly one of qualitative change (*alloiôsis*), whereas Alexander avoids the term *alloiôsis* in favour of the vaguer *kinêsis* because he needs to rule out change in a manner that involves being modified (*pathêtikôs*).

Conclusion

I am now able to summarise the answer to the two questions raised at the outset. There is no systematic physiology of the eye within IDS that would match the work of Galen because Alexander is interested in the principles that (as he sees it) guide the work of medical researchers rather than the messy detail of the work itself. If he was aware of Galen's work in this area, his criticisms of the coalescence theory of vision as set out in the *Timaeus* is a sufficient answer at the level of philosophical principle, and the inadequate anatomical detail in Alexander's own physiology of vision reflects that outlook. Alexander's physiology is not ultimately to be judged against the criterion provided by the model of Galen's dissection-based research.[14]

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