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Some problems in Lucretius' account of vision[1]

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ABSTRACT: Examination of three difficulties in Lucretius' account of vision in book 4 helps to clarify exactly what is involved in the theory that vision takes place by means of a stream of images from the object seen to the eye. The three issues considered are: the apparent conflict in using similar arguments both for the continuity of the stream of visual images and for the rapidity of their travel; the problem of simultaneous awareness of the distance both of closer and more remote objects; and the explanation of why we can see into a lighted room from the dark but not in the reverse direction. It is argued that the difficulties can be resolved if we suppose that the images travel so rapidly that one arrives at our eye before its successor departs from the object we are seeing. The paper concludes with reflections on the implications of this for our general understanding of the atomic theory and for our assessment of Lucretius' portrayal of it.

At 4.143-75 Lucretius argues for the constant flow of visual images (which is the translation I shall throughout use for εἴδωλα/*simulacra*), and at 4.176-215 for their speed.[2] At 4.155-8 he argues for the former point from the fact that images of objects appear in a mirror as soon as they are placed in front of it, and at 4.209-15 for the latter from the fact that the distant stars are immediately visible when water, serving as a mirror, is placed beneath the clear sky. But, as Lackenbacher 1910, 224 observed, the first argument negates the second; if images are constantly streaming down from the stars, the fact that the stars are reflected in the water as soon as it is placed there does not show that images travel quickly from the stars, for they will have been on their way already. Or so it might seem: in fact there is an answer, as we shall see. But first, another problem.

At 4.244-53 Lucretius argues that we are aware of the distance of things because of the amount of air the image forces through our eye before it arrives there itself. There are various difficulties with this theory pointed out by ancient and modern critics alike: for example, the question how images which are fine enough to travel swiftly through the air can yet force before them columns of air which may be many miles long.[3] (I will speak of 'columns' for convenience; these

[1] This is a version of the paper given at the Leeds Lucretius colloquium on 5th May 2000, revised in the light of discussion there. I am particularly grateful for comments and suggestions to Francis Cairns, Hans Gottschalk, Elizabeth Pender, David Sedley and Katherina Volk. The responsibility for any misuse I have made of their suggestions of course remains my own. I am grateful to Gerald Duckworth and Co. Ltd. for permission to reproduce the translation of Alexander of Aphrodisias, *De anima libri mantissa* 136.11-24 from my version forthcoming in the Aristotelian Commentators series edited by Richard Sorabji.

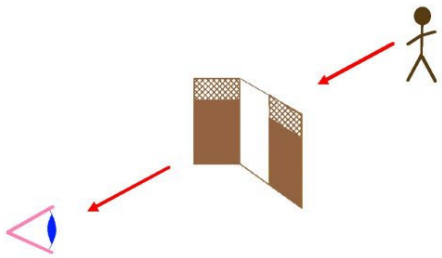
[2] Sedley 1998, 115-16 notes that whereas Epicurus *On Nature* 2 and following him Lucretius discuss first the speed of generation of the images and then the speed with which they travel, Epicurus *Letter to Herodotus* 46-48 reverses the order.

[3] Alexander of Aphrodisias *In De sensu* 57.25; *Mantissa* 136.15; Bailey 1947, 3.1212; Godwin 1986, 108.

columns will be horizontal, at least if we are looking horizontally which we are more often than not.) Here however I want to concentrate on one specific question; how, on this view, do we *continue* to be aware how far away a thing is as we go on looking at it? This could perhaps be explained by our remembering the initial sensation of distance[4]—so long as the thing does not move. But if it does move, we can still see it; there is not an interruption in our vision of it while a fresh amount of air arrives to show us how far away it is now.

Moreover, a similar difficulty can be derived from Lucretius' own account at 4.269-88:

> Now come, grasp why the reflection is seen beyond the mirror; for assuredly it is seen removed deep within. In the same way as things which are seen in reality outside the doors, when the doorway provides an open passage for vision through itself, and causes many things to be seen from the house outside the doors. This seeing too comes about with duplicated air. For first at this time the air on this side of the doorposts is seen, then the doors themselves follow, the left and right-hand ones, then the outside light brushes through[5] the eyes, and another [quantity of] air, and the things which are seen in reality outside the doors. Just so, when the image of the mirror [itself] first sends itself forth, while it is travelling to our sight it drives forward the air which is located between itself and our eyes, and makes us able to sense all this before the mirror [itself]. But when we have sensed the mirror itself too, straight away the image which is carried from us to [the mirror] arrives and, thrown back, returns to our eyes and drives on another [quantity of] air, rolling it before itself, and causes us to see this before itself, and so it seems to be separated from the mirror by so great a distance.



Lucretius is here explaining why it is that an image in a mirror seems to be beyond the mirror; and he compares this case with that of objects which we see through an open door. He describes how there arrive at our eyes, first the air between us and the door, then the two leaves of the door themselves—i.e. their

[4] Disregarding the fact that a single image is not enough to generate sensation: cf. Lucretius 4.89, 105, 256-8, and Alexander *Mantissa* 136.17. Avotins 1980, 445; Rosenmeyer 1999, 26 n.6. (I am grateful to Michael Hendry for drawing my attention to Rosenmeyer's discussion.)

[5] *perterget*. I adopt, as does Godwin 1986, Bailey's translation for this term, which appears first at 249, then at 252 and (here) at 277. Godwin 1986, 108 comments that 'the idea of touching while passing through is prominent, rather than any idea of cleaning', which the word does appear to have as a connotation in other authors. However, in a Mediterranean country the air outside the doors is likely to be considerably brighter than that inside the house; so one may wonder whether there might not be some anticipation here of *purgat* in the argument of 4.341 (below).

atomic images—then the air between the door and the objects outside them, and then the objects outside. Similarly with the mirror; and in each case the two bodies of air, that preceding the door or mirror and that following it, give us the awareness of distance. Once again, however, Lucretius' account seems to fail to allow for the fact that we *go on* both seeing the door and the objects outside it *and* being aware of how far away they are. Nor, again, is it just a matter of memory; for suppose that the left-hand half of the door were subsequently closed but the right-hand half remained open, so that we could still see the object through it. We are aware of the left-hand half becoming closed; so at least at that point a new image of the door must come to us. Does it drive a fresh column of air before it? And how is it that, while this is happening, we continue to be aware of the objects outside? It might seem that if images are, as Lucretius has told us they are, constantly streaming off from every object, we have to suppose *both* that the sequence

air this side of the door — door — air beyond the door — objects outside

is preserved, *and* that every part of it is constantly arriving, or as near constantly as can be the case in an atomic theory. In other words, to speak—as Lucretius appears to do—of the air and the image of the things seen as two *separate* and successive stages in a sequence (or four, in the case of the door and the mirror) would be an oversimplification for the sake of exposition, not the full account of what is going on.

However, the mechanics now become even more complicated. For if a stream of images is constantly arriving, say from an object six feet away from my eye, *each image* has to drive a six-foot column of air through my eye for me to be aware of the distance: a point which is made by Alexander of Aphrodisias.

> Next, if according to them the interval will be seen by the quantity of the air which flows off and impinges on the sight in advance of the image—[for] the [air] itself too impinges on the sight—,[6] first, how will the sight receive so much air (*for with each travelling of an image it will receive as much air as there is between it and the thing seen*)? Next, what[7] strength will the images that flow off have so as to be able to drive this [air] in front of them? (Alexander *In De sensu* 57.21-26)

and similarly

> To say that distance is apprehended by the quantity of air between the thing seen, from which the images come, and the eye (for this is pushed in front of it by the image and enters the pupil before the image) exceeds all absurdity.[8] For how will

[6] The Greek is difficult and, if it is taken in the way I have taken it here (similarly Towey 2000, 61), the parenthetical clause seems redundant. Avotins 1980, 433 translates 'if according to them distance will be perceived by the amount of air which, too, enters the eye—<this air> belongs with the idol which emanates before [the air] and enters the eye—', on the grounds (433 n.13) that only an image or idol, not air, can be said to 'emanate' ('flow off', ἀπορρεῖν). But this cannot be right; the explanation of our awareness of distance involves air which is pushed in front of the image, not air which follows it.

[7] Reading τίνα ἕξει with Thurot (or ἕξει τίνα?) for ἕξει τινὰ.

[8] The text in fact has not 'exceeds all absurdity' but 'exceeds no absurdity'; a logical slip of a familiar sort, rather than an error in transmission of the text.

> the image be able to push the air in front of it, if it is so easily affected? And how does the pupil admit this, *and in addition frequently receive such an amount? For it is not by the entering of one single image that seeing occurs. So each of the (images) that enter in will send the same amount of air into the eye before it, unless indeed the images that travel from the thing seen do not travel when somebody looks, but are (already) adjacent to the eye. For it is not the case that, when the eye sees, (only) then do the images stream off. So how, if they are (already) adjacent, will they still push the intervening air in front of them*? Moreover, if the images are not scattered by the winds because they are below the level of and finer and rarer in nature than the air which is carried by the winds, how at the same time will it be possible for them to push this air in front of them? (Alexander *Mantissa* 136.11-24).

This however means that I must be aware as a separate entity of the column of air which each image drives before it; for if the air were not divided into separate though overlapping six-foot portions, but merged into a continuous stream, all I would be aware of as far as the air is concerned is a single quantity the amount of which would be a function of the distance of the object multiplied by the length of time for which I had been looking at it. One could perhaps calculate distance on that basis, by discounting the length of time, of which one might be independently aware.[9] The alternative, that I can distinguish the six feet of air impelled by image number *x* from the six feet impelled by image *x+1* even when they overlap and portions of both are passing through my eye simultaneously, *before the actual images that serve to individuate them arrive,* certainly seems incredible. But even the view that we calculate the distance unconsciously from a continuous stream of air seems to involve complexities that take us uncomfortably far from Lucretius' account.

Something is clearly wrong with the interpretation so far. And I think that the difficulty points a general moral; the difficulty of taking full account of the smallness and rapidity of atomic movements generally and of the movement of images in particular, for all that Lucretius repeatedly emphasises it (and notably in the very context of the perception of distance, at 4.254-5 where he says that the passage of the air through our eye happens so quickly that we perceive the nature of the object and its distance both together). We must suppose that the movement of the images and the columns of air is discrete rather than overlapping; thus, from the object six feet away, image number *x* arrives, then the six feet of air impelled by image *x+1*, then image *x+1*, then the six feet of air impelled by image *x+2*, and so on, with the images arriving rapidly enough that we are not aware of any interruption in our vision of the distant image.[10] In other words, image *x + 2* does not set out, and so start driving air before it, until image *x + 1* has arrived.

[9] The *first* image, the one that is already present when I first look at the object because it has been on its way beforehand, would presumably have driven no air through my eye (because my eye was turned somewhere else). Those already in the pipeline, as it were—say the one that is three feet away when I start looking at the object—would presumably drive the last part of their column of air through my eye, the first part not; but perhaps my mind is used to discounting this as well.

[10] This is a different point from the general one that, if space is divided into indivisible minima, the movement of the individual atoms of which the images and the air are made up must be in discrete

This will however have to apply not only to an object six feet away, but to every object whose distance we sense. True, it is questionable how far we have a direct sense of the true distance of very remote objects, either in fact or in Epicurean theory. David Sedley has pointed out to me that at Lucretius 5.564-91 the claim that the sun and moon are approximately the size they appear to be (whatever that means) is supported by the fact that the sun's heat reaches us and that the moon's outline is seen clearly, neither of which (we are told) would be the case if they were far enough away for their apparent size to be appreciably diminished by distance.[11] This argument makes no appeal to any direct awareness of the distance of the heavenly bodies. Moreover, Lucretius at 4.404-13 refers to the optical illusion whereby the sun at sunrise seems closer than it actually is.[12] This might suggest that the point at which we cease to have an accurate sense of the distance of remote objects is in fact determined by the distance at which the columns of air take so long to travel that they begin to overlap. Nevertheless, for objects closer at hand of whose relative distances we are simultaneously aware—such as doors and what is outside them—the notion that the images travel so rapidly that the first arrives before the next sets out resolves the difficulty we would otherwise have.

At this point we need to return to the first difficulty, the use of the argument that we can see things as soon as we look at them, or in Lucretius' version as soon as we place a mirror in the appropriate position, in two ways that seemed to negate each other: first to argue that there was a constant flow of images, and second to argue that the images travel very quickly. The conflict between the two arguments arises from the assumption of a continuous stream of images, such that at any given time one is already adjacent to my eye, another has travelled (say) nine-tenths of the distance, another four-fifths, and so on, for in that case it is not clear from *this* argument why the images should not travel slowly. (We could indeed argue for their speed rather from the fact that the whole landscape is illuminated rapidly at sunrise—a point made by Lucretius at 4.200-3—*and* that we are aware of this even when looking towards distant western regions, so that the passage of the light to them *and* back to our eyes of the images showing that they are illuminated does not take appreciably longer than for regions closer at hand.)

Suppose instead that the images that move so fast that the second does not set out till the first has arrived. It may still seem that we cannot infer anything about the speed of travel of the images from the fact that the *first* image is already adjacent to our eye as soon as we look at the object. But the picture we now have, of images separated, in the case of an object six feet away, by six-foot columns of air, makes rather more pressing than did the previous one the question: why should we suppose that, at the moment we first look at the object, what is adjacent to our eye is an image rather than some portion of the column of air? (After all, the odds on it being part of the air, rather than an image, presumably correspond

steps; the question is now concerned with the movement of compound bodies on a larger scale, the air and the images themselves.

[11] Cf. Harry 1970, 58-63.

[12] Cf. Sedley 1998, 90 nn.123 and 130.

to the proportion that a length of six feet has to the minute thickness of an image). So what is needed is not so much that an image should be present already as that, if one is not, one should at any rate arrive so quickly that we do not notice the delay. And for that we need *both* that there should be a continuous flow of images *and* that they should move very rapidly.

The view that atomic images travel so quickly that the first one reaches us before the second sets out, at least in the case of objects up to a considerable distance away, thus agrees with what we need to suppose in order to solve the difficulty concerning the argument for speed as well as for constant flow, and itself solves the problem of our continued and simultaneous awareness of the distance of more and less remote objects. It does moreover give the most natural interpretation to 4.284-8:

> Straight away the image which is carried from us to [the mirror] arrives and, thrown back, returns to our eyes and drives on another [quantity of] air, rolling it before itself, *and causes us to see this before itself, and so it seems to be separated from the mirror by so great a distance*.

For these lines are more easily taken as suggesting that there are just two things we are aware of simultaneously, the air and the image driving it (repeated successively, indeed), rather than in terms of a stream of images overlapping successive columns of air which themselves overlap.

It is perhaps ironical that Bailey (1947, 3.1212) comments, apparently as an objection to the explanation of awareness of distance in terms of the air driven through the eye, that 'if the speed of all the 'idols' is almost absolute, there can be no sensible difference of time in the arrival of "idols" from near and distant objects'. Bailey's observation is irrelevant *as an objection*; nothing in the text suggests that Lucretius' explanation involves awareness of a difference in *time*. But Bailey is right to suggest the speed which I have argued is essential to understanding how the theory is meant to work. Bailey continues 'Robin in an interesting note points out that it is really the number of the intermediate 'idols' of things between us and the object, and not the air lying between them, which gives us this sense of distance. But this is to correct rather than interpret.' Rather it is to miss the point; it is essential, if the intervening air is to give us an awareness of distance, that at any given time there is one and only one image of an object between the object and us. I do not indeed want to suggest that this was formulated by Lucretius or even Epicurus as a conscious principle; only that we can interpret their arguments better if our notion of what their theory presupposes is in these terms rather than in terms of a stream of images of which at any given moment many are each at a different stage on their journey from the thing seen to the eye that sees it.

There is one further complication to consider, before we come to the third problem in Lucretius' text. Avotins and Asmis have argued that we do not in fact see the whole of the object with each image. For there is an obvious objection to this: how does the image from a table, say, become small enough to fit into my eye? Rather, each image represents only a small part of the object, and our

impression of the whole is built up from a succession of such partial images.[13] The implication of this for our present discussion is simply to increase yet further, and to a very considerable extent, the number of images that will be needed to account for our vision of an object, and, if no image sets out till its predecessor has arrived, the speed of travel that will be required. But if this paper has a single overall moral it is that in interpreting ancient atomism one should not be afraid of interpretations that postulate very large numbers, quantities or ratios.

The need for a succession of images to build up the object must be combined with the customary view that the succession is needed to explain continued vision. Avotins indeed argues otherwise (1980, 446), on the grounds that such a double theory is needlessly complex and that it is too much of a coincidence to suppose that Alexander, cited in n.13 above, preserves only one part of it, Lucretius (at 4.259-68) only the other. Nevertheless, the double theory is required. For our awareness of any change or movement in the object has to be explained by our reception of a new image or set of images; and it would be arbitrary to suppose that we receive a new image or set of images from the object *only* when it moves or changes.

Now to the third problem. At 4.337-352 Lucretius uses the same principle, that what is closer arrivies at our eyes first, to explain why we can see from a dark region into a light one but not vice versa. (The problem, we may note, seems to have been a standard one in discussions of vision; it is used against the *Stoic* theory at Alexander *Mantissa* 10.131.30ff.)

We see from the darkness things that are illuminated because, when the dark air of the gloom, which is nearer, enters our eyes first and occupies them, being open, hurriedly the bright and clear air follows and as it were cleans them[14] and scatters the black shadows of the former air. For the latter is much more mobile and has smaller particles and more power. As soon as it fills the passages of our eyes with light and lays open those which the dark air had previously blockaded, straight away there follow the images of the things which are situated in the light, and they provoke us to see. On the other hand we cannot do this in darkness from the light, because the gloomy air, which is thicker, follows after [the illuminated air] and fills up all the apertures and blockades to the passages of the eyes, so that they cannot be roused by the images of any things impinging [on them].

Lucretius' explanation is that when we are located in the dark and look at what is illuminated, the light follows (*insequitur*, 340) the darkness into our eye[15] and drives it out, to be followed (*sequuntur*, 346) by the images of the objects seen in the light; whereas when we are situated in the light and look at what is in darkness the darkness comes second and blocks up the passages in our eyes, so

[13] Cf. Alexander *In De sensu* 58.1-12; *Mantissa* 135.6-22; Galen *De plac. Hippocratis et Platonis* 7.7.8. Avotins 1980, 440; Asmis 1984, 128-137, and 1999, 169 n.12. Cf. also Rosenmeyer 1999, 27-28.

[14] Cf., perhaps, above n.5.

[15] Bailey 1947, 3.1223 suggests rather that, because shadows are outside our eyes, the passages (*vias*, 344) are not in our eyes but outside; this seems difficult to square with the text. The correct explanation at Godwin 1986, 113.

that the images of the actual objects cannot enter. But at first sight this seems to disregard the fact that, if we are in a lighted room and cannot see things outside in the darkness, we *go on* being able to see the lighted room; the darkness does not in fact follow the light in the sense that, as far as we are concerned, one finishes and the other starts, but rather—as with the simultaneous awareness of closer and more remote objects discussed above—we go on being aware of both at once.

One possible answer might be that we are aware of the lighted objects in the room and of the darkness outside the door or window with different parts of our eyes; after all, in the reverse situation, when we are in the dark outside a lighted room, we are still aware that it is dark outside as well as that it is light within. But then the references to light driving darkness out of the passages and to darkness blocking them up seem problematic. The answer may again be that we should regard the processes involved as discrete in time rather than as overlapping. To return to the example of the object seen outside the door; we must suppose not only that the second image from the door does not start its travel towards our eyes before the first image *from the door* has reached our eye, but that the second image from the door does not start its travel until the first image *from the object outside* has reached our eye. For only so can the columns of air remain distinct. And similarly when we look out of the lighted room; the image we should have is not one simply of darkness replacing light, but of a rapid alternation, too fast for us to notice, as first the light within the room enters our eyes, then the darkness outside, and then the whole sequence repeats itself. Just as we receive images of the door and of the object outside alternately, just so we are affected by the light and the dark alternately. The light and the darkness do not, therefore, affect the other half of the cycle in each case; when Lucretius speaks of light driving out darkness and of darkness blocking the passages he is simply explaining why each half of the cycle is different from the one that has preceded it, and the explanation in fact reduces to the general point that we can see what is illuminated but not what is in darkness.[16]

There is however a problem. I have argued that, if we look at an object beyond a doorway, the image from the object must arrive, following the image of the doorway and driving the intervening air before it, before the next doorway-image starts its journey driving its column of air into the eye. The easiest way to make sense of this, it seems to me, is to regard the process as governed as it were by the ticking of a clock:[17] *all* my sensations—and we are here referring not just to the processes that take place within me, but those involved in the outside world

[16] The interpretation requires that dark air is not illuminated when it enters a lighted room. But this must be presupposed on any interpretation of Lucretius' argument. (I am grateful to Elizabeth Pender for raising this point.)

[17] We are already aware of another metaphorical clock in the Epicurean universe ticking much faster: if space and time as well as body are divided into indivisible minima, and all atoms move at the same speed, every atom must move one indivisible minimum of space, in whatever direction, in one indivisible minimum of time. Ticks of the slower clock in the process of perception, which themselves happen so rapidly that we are unaware of them, will only happen when the faster clock has ticked enough times for a visual image—which as a compound presumably moves more slowly than an individual atom—to traverse each of the individual minima of space that together add up to the distance between myself and the furthest object of whose distance I am aware.

as well to bring this about—have to go through one cycle before the next cycle starts.[18] And, since the ticking of this 'clock' must be independent of the images actually reaching my eyes—for otherwise some sort of feedback loop would be required, and it is difficult to see how this could be accommodated in Epicurean theory[19]—the ticking will need to be the same for all observers.

The problem then is this. If the images from the open doorway are given off only infrequently enough for there to be space between them and their columns of air for the images from outside and *their* columns of air, what happens if we close the doorway completely? We can hardly suppose that the doorposts of a closed doorway give off images more frequently than those of an open one. There will therefore be gaps in the sequence reaching my eyes once the doorway has been closed: first will come the air between the doorway and my eyes, then the image of the doorway, and then, when I would have been receiving air and images from outside the doorway, *no* visual images, until the air driven before the next door-image arrives.[20] And this seems rather implausible.[21]

This might suggest a different interpretation from that advanced so far. The Epicurean explanation of awareness of distance is an attempt to capture our *apprehension* of the interval between us and the object seen.[22] We might seek to combine this with the Epicurean notion of ἐπιβολή, 'application', as 'attending to' or 'focussing on' a particular image at a given moment. Perhaps there are after all images of every part of the fourfold sequence air-doorway-air-external object present whenever we want to focus on any of them, and what is in fact going on is not so much a process of passive reception by our eyes of different stages in turn of the sequence, rather a process of active focussing on different stages of it; we look in turn (by focussing on the relevant image) *at* the indoors air, or rather each stage of it, the doorway, the outdoors air and the outdoors object in turn—or indeed the reverse, because if images are given off so frequently that we can focus on any part of the interval whenever we wish to, it does not much matter whether we scan if from near to far or the reverse. It will no longer then be necessary for the columns of air associated with each image to remain distinct; in effect we will be aware of the length of the column not by its passing through our eye but by focussing on different parts of it. Consequently there is now no need for there to be only (at most) one image of the doorway between it and our eye at any given time, and there is no longer the problem of the gap when the doorway is closed.

There are however three problems with this view. First, to appeal to ἐπιβολή in this way may create problems for the distinction between sense-perception and opinion, for opinion may direct which images we focus on. If this is a problem, however, I suspect it is a more general one. Second, this interpretation of our

[18] It might seem that the claim that images are given off in this way involves an un-Epicurean claim that things are organised for our benefit, so that we can apprehend them. (I am grateful to Katherina Volk for raising this point). But I do not think this need be the case; all that is required is that the world as a matter of fact is structured in such a way that we are able to apprehend it.

[19] I am grateful to Hans Gottschalk for pointing this out.

[20] I am grateful to Hans Gottschalk for pointing out that this must be the sequence.

[21] I am grateful to Francis Cairns for emphasising this point.

[22] I am grateful to David Sedley for this suggestion.

awareness of distance is harder to square with Lucretius' (and indeed Alexander's) text, which does attribute it to the air *passing through our eyes*. And that may be for a good reason: for, to move on to the third difficulty, to talk of focussing on different points in the interval between us and an object suggests that those points can themselves be seen. But in Epicurean terms that means that different parts of the *air* give off images of which we can be aware, and moreover that those images can be distinguished in terms of which part of the interval they come from. That either of these could be the case with *visual* images given off by air seems highly unlikely. Perhaps indeed we should rather imagine images apprehensible only by thought, or of some mental construction concerning the interval which does not involve the direct reception of images *of the interval* at all. But this takes us even further from the Lucretian text.

It seems then that we should return to the view that images travel so rapidly that even in the case of (moderately) remote objects the first arrives before its successor starts its journey. In the case of the door that is first open and then closed, we do need to accept an interval in which no image arrives at all. And that is in fact only a special case of a more general point: in an atomist universe, as in any other, a body moving at a given speed will take a longer time to cover a greater distance, and consequently, if two objects emit visual images with the same frequency, and the more distant one does so in such a way that the second is not emitted till the first has reached us, in the case of the closer one there will actually be a delay between the arrival of the first image and the emission of the second. (Distance and closeness will be relative to individual observers.) However, if we suppose that even in the case of the more distant object the rate of emission of images and the speed of travel are such that we can see it as soon as we look at it and are not conscious of any interruption in our vision, our immediate and continued vision of the closer object will not be problematic.

In general we should never, in interpreting ancient atomism, underestimate the extent to which the smallness and speed of atoms exceeds anything in our ordinary experience; ironically enough, even though Lucretius is himself at pains to emphasise this,[23] the very vividness of his analogies from our own sense-experience may make it harder for us to realise the point. Here it is not irrelevant that, in striving to make the atomic system both comprehensible and vivid, Lucretius is doing something different from Epicurus, who emphasises the *distance* between the atomic level and that of our ordinary experience, both by his technical language and by explicitly stressing the limits of analogy (notably in *Letter to Herodotus* 62 and 47).

The difficulty of imagining what Epicurus describes may not in itself be a criticism of Epicurean theory. Those of us trained in the humanities probably tend to imagine the entities and processes studied by contemporary science too as closer in scale to our ordinary experience than they actually are. But the apparent extravagance of Epicurus' theories may also display something of a tendency to postulate one's way out of difficulties which sets ancient natural philosophy apart from modern natural science.

[23] E.g. 2.163, 4.159, 191, 254, 795; cf. Epicurus *Letter to Herodotus* 46.

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