Movement, Direction, and Speed of Atoms - Do Atoms Fall "Down?" Is the "Swerve" Required To Bring Them Together Into Bodies?

Post by “Don” of December 18, 2020 at 10:42 AM

Admin Note: On 12/12/24 the name of this thread was expanded so that it can be used to extend conversation on this topic. The original title was simply "Atoms Fall 'Down.'" The title now refers to other aspects of movement at well so we can include reference to the movement of atoms also in the context of bodies and images.

I'm not sure how applicable this might be, but just watched a Vsauce video on the meaning of "Down". Since Epicurus maintained that atoms fall "down" unless they "swerve" I found Michael's explanation of"down" interesting. I never put this much thought into it... Which makes the Vsauce channel so enjoyable!

Here you go:

https://youtu.be/Xc4xYacTu-E

Post by “Joshua” of December 18, 2020 at 12:07 PM

Haven't had a chance to watch this yet, but I've always had a slight confusion on the "down" issue. Epicurus seemed to think that the "original" motion of any given atom was "down" until it either swerved or hit another atom and ricocheted. Except that the cosmos was beginningless, so I'm not sure when this "original" downward motion happened. Lucretius is clear that an atom in motion is governed by inertial force at a uniform rate of speed in any given direction until they swerve or are acted upon by an outside force. These atoms, once moving in another direction, are not affected by any downward pull. Do I have that right?

Post by “Don” of December 18, 2020 at 2:23 PM

That's my take. Epicurus's whole "down" thing never made much sense to me. Once you have swerving and collisions, you've messed up any original parallel trajectories. Okay, an atom moves in a straight line unless acted on (not sure if that's accurate, but I'm not too concerned about that).

In any case, I found the Vsauce video thought-provoking and enjoyable. It's a fun YouTube channel, and we got to see Michael do a program once with Adam Savage of Mythbusters. A fun night of popular science stuff!

Post by “Joshua” of December 18, 2020 at 3:51 PM

On a side note Don, you may want to give Hello Internet a listen if you haven't already. CGPGrey and Brady Haran. Its my favorite podcast!

Post by “Don” of December 18, 2020 at 4:02 PM

I hadn't heard of that one! I've heard of CGPGrey from other sources but never dug into their work. This is a good opportunity. Thanks for the recommendation [runs off to podcast app to search and subscribe...]

Post by “Martin” of December 19, 2020 at 3:00 AM

The video nicely illustrates what we know today. (Note that turning the balance upside down is just a joke and still just shows the force on us as the counterforce from hard enough material to prevent us from breaking or sinking through the balance and not directly the force with which we pull up Earth. We know from theory which is confirmed by other experiments that we pull up Earth with the same force.)

Knowing this helps to get clear how wrong or misleading Epicurus' reference to down is. Some people have even used this wrong usage to claim that Epicurus was a flat-Earther. Epicurus use of down is so much against his own physics that he probably meant "down" in a different way but I have not yet seen and could not figure out a meaningful way. Maybe the ancient Greek

word had a broader or different meaning than our "down".

Post by “Don” of December 19, 2020 at 7:02 AM

Thanks for those insights, Martin ! In light of what you said, I went back to Diogenes to see what the Letter to Herodotus said:

> Quote
>
> 60] "Further, we must not assert `up' or `down' of that which is unlimited, as if there were a zenith or nadir. As to the space overhead, however, if it be possible to draw a line to infinity from the point where we stand, we know that never will this space --or, for that matter, the space below the supposed standpoint if produced to infinity-- appear to us to be at the same time `up' and `down' with reference to the same point ; for this is inconceivable. Hence it is possible to assume one direction of motion, which we conceive as extending upwards ad infinitum, and another downwards, even if it should happen ten thousand times that what moves from us to the spaces above our heads reaches the feet of those above us, or that which moves downwards from us the heads of those below us. None the less is it true that the whole of the motion in the respective cases is conceived as extending in opposite directions ad infinitum. [61] "When they are travelling through the void and meet with no resistance, the atoms must move with equal speed. Neither will heavy atoms travel more quickly than small and light ones, so long as nothing meets them, nor will small atoms travel more quickly than large ones, provided they always find a passage suitable to their size, and provided also that they meet with no obstruction. Nor will their upward or their lateral motion, which is due to collisions, nor again their downward motion, due to weight, affect their velocity. As long as either motion obtains, it must continue, quick as the speed of thought, provided there is no obstruction, whether due to external collision or to the atoms' own weight counteracting the force of the blow.

It seems a bit more nuanced than I remembered. He seems to say that atoms can move any direction but their downward motion is due to their "weight" which, in a manner of speaking, is correct! The fact that he also says that "Neither will heavy atoms travel more quickly than small and light ones," took me by surprise. I didn't remember that. And that's correct (in a vacuum), right? How or why would he intuit that? I think I need to revisit that Letter.

Post by “Cassius” of December 19, 2020 at 7:55 AM

> Quote from Martin
>
> Epicurus use of down is so much against his own physics that he probably meant "down" in a different way

I strongly applaud that point of view. Surely Epicurus could make mistakes as much as anyone else can, but it's highly unlikely that he would accept and state something clearly contradictory within his core views, so either our texts are corrupted or he had some other understanding of the issue that would reconcile what we see as contradictory.

Post by “Joshua” of December 19, 2020 at 10:16 AM

> Quote
>
> And that's correct (in a vacuum), right? How or why would he intuit that? I think I need to revisit that Letter.

I don't have a citation to hand, but see Lucretius on this point. I think he says that in the absence of air-resistance a ball of wool and a ball of lead will fall at the same speed.

Post by “Don” of December 19, 2020 at 10:25 AM

> Quote from JJElbert
>
> > Quote
> >
> > And that's correct (in a vacuum), right? How or why would he intuit that? I think I need to revisit that Letter.
>
> I don't have a citation to hand, but see Lucretius on this point. I think he says that in the absence of air-resistance a ball of wool and a ball of lead will fall at the same speed.

This?

> Quote
>
> Which but for voids for bodies to go through 'Tis clear could happen in nowise at all. Again, why see we among objects some Of heavier weight, but of no bulkier size? Indeed, if in a ball of wool there be As much of body as in lump of lead, The two should weigh alike, since body tends To load things downward, while the void abides, By contrary nature, the imponderable. Therefore, an object just as large but lighter Declares infallibly its more of void; Even as the heavier more of matter shows, And how much less of vacant room inside. That which we're seeking with sagacious quest Exists, infallibly, commixed with things- The void, the invisible inane.

Post by “Joshua” of December 19, 2020 at 3:06 PM

I might be misremembering slightly! That does look like the right passage.

Post by “Don” of December 19, 2020 at 3:45 PM

> Quote from JJElbert
>
> I might be misremembering slightly! That does look like the right passage.

I thought you were kidding at first, Joshua ! LOL I didn't remember the ball of wool and lead!! That's amazing that he had that kind of insight about mass! Thanks for calling my attention to that!

Post by “Cassius” of December 12, 2024 at 7:33 AM

This (below) was suggested by Bryan

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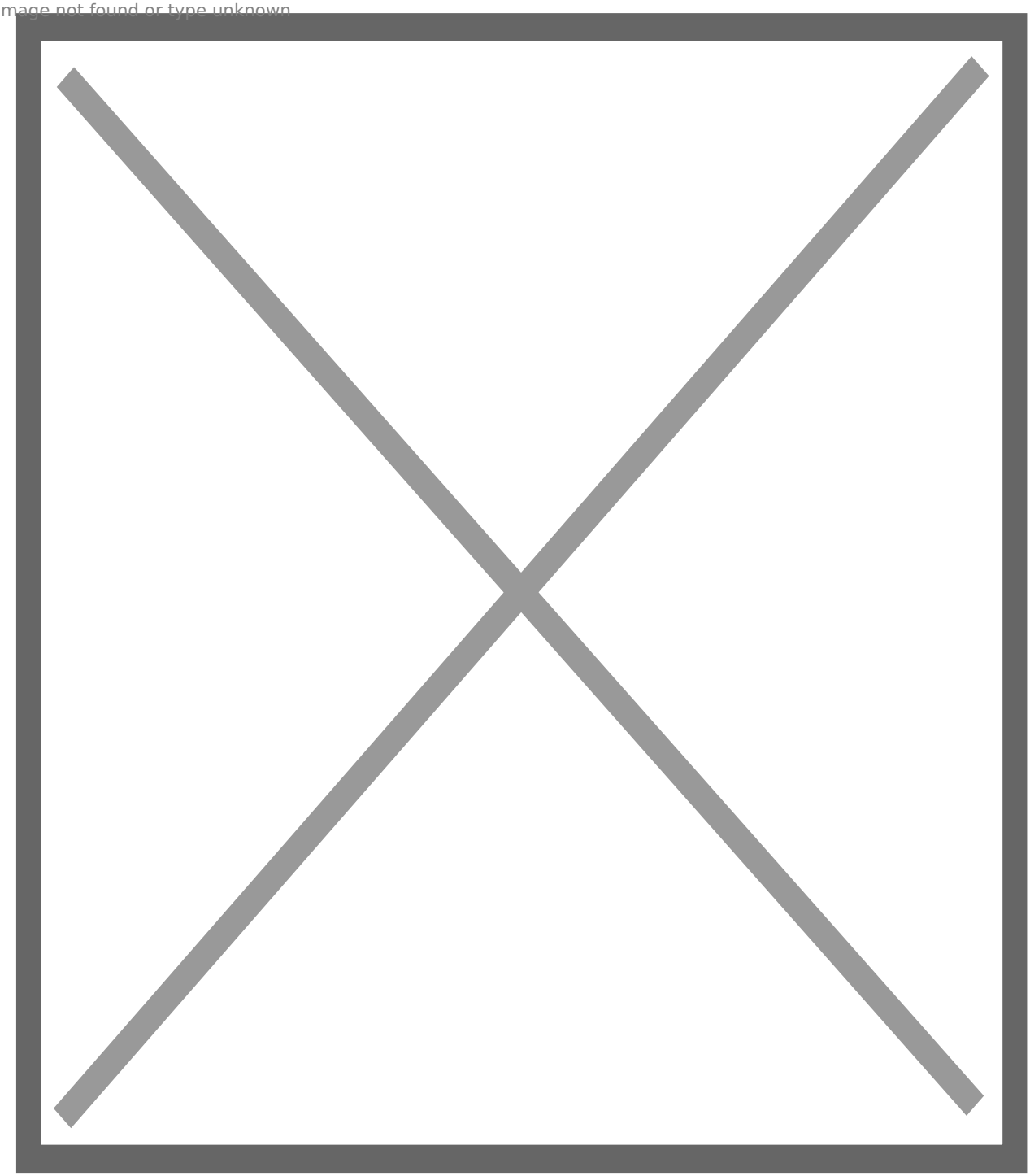

Here Epicurus says that compounds move at different rates, but atoms move at the same rate. Even though compounds appear to stand still, their atoms are vibrating at that same rate.

Post by “Cassius” of December 12, 2024 at 7:34 AM

Also by Bryan:

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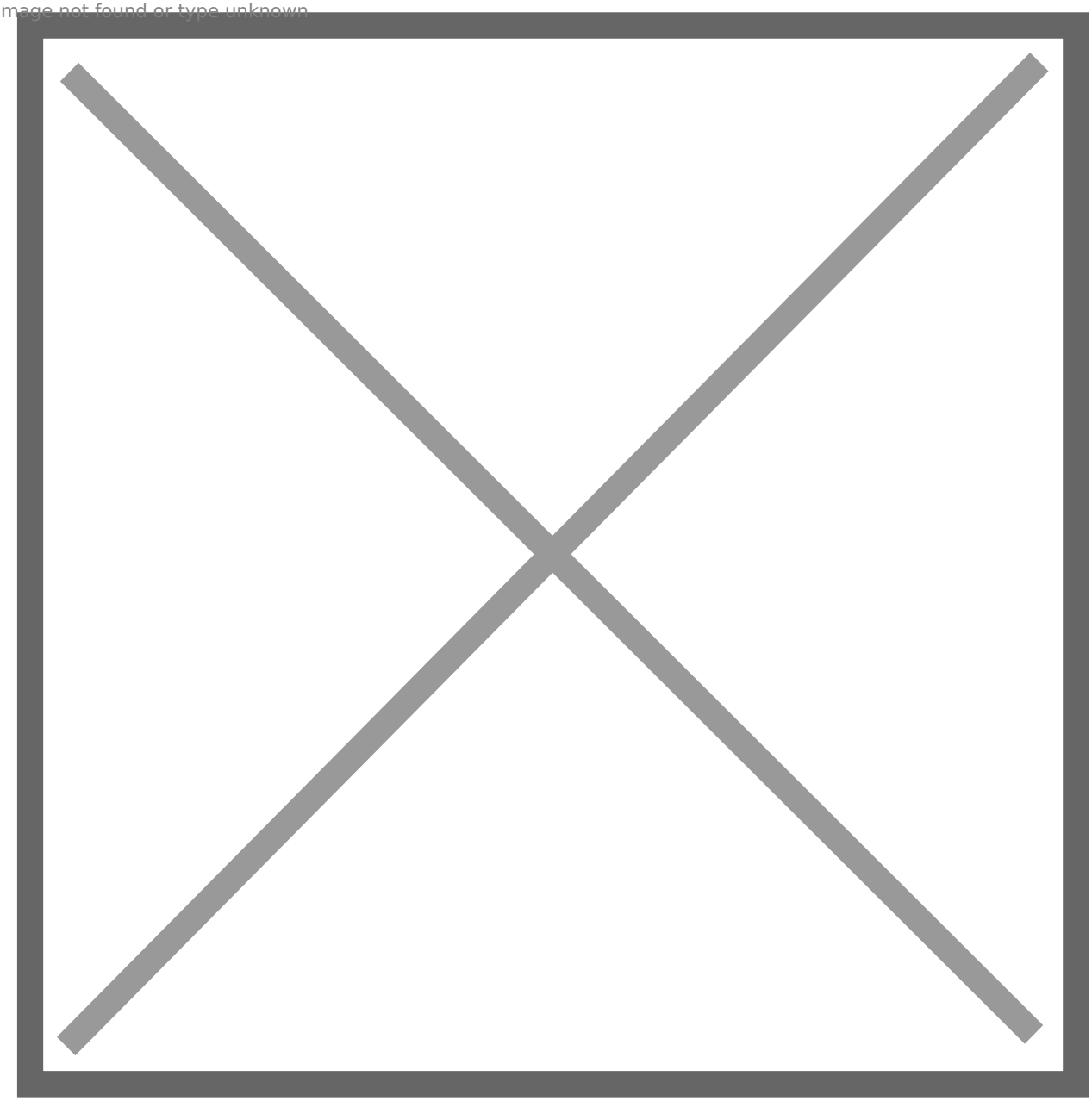

Regarding the direction of the atoms, here Epicurus says that they continue in whatever direction they are going, until they have an impact.

Post by “Cassius” of December 12, 2024 at 7:47 AM

The reason atomic motion came up in the 12/11/24 Zoom is that we were discussing images, and the question arose as to whether images should be considered to be bodies subject to the kind of effects of motion that we observe at the level of bodies (we observe that objects "fall") or whether images travel like atoms at uniform speed in any direction without being subject to "falling" as they travel.

Aside from general interest in the physics involved in Epicurus' view of the movement of atoms, the question arises whether the movement of atoms is related to the movement of images (which was the subject of the Usener section).

Atoms travel at uniform speed, but collide with each other and that affects their direction. Did Epicurus think something similar happens with images?

What issues, if any, related to the movement of atoms and images need to be considered in the processing of images by the mind?

Post by “Cassius” of December 12, 2024 at 8:01 AM

At present I am not finding a thread devoted specifically to the question of whether the swerve was required to cause atoms to come together into bodies, as Lucretius seems to say. Absent another thread that probably needs to be incorporated here too, or at least linked to another thread on that topic if it exists, so I will adjust the title further.

Post by “Cassius” of December 12, 2024 at 8:15 AM

For reference as to Lucretius saying the swerve initiates collisions, and as to whether a collision resulting from a swerve was necessary to initiate world formation:

EPICURUS’ REFUTATION OF DETERMINISM - David Sedley
1. The Swerve
A few facts are, I hope, uncontroversial enough to be set out without defence. Epicurus

inherited Democritus' atomic system, but modified it in a number of respects. In particular, he so vehemently objected to its rigidly deterministic laws as to postulate a minimal. 'swerve'... in the motion of atoms, occurring at no fixed place or time — a doctrine which does not feature, in his meagre surviving writings but is nonetheless amply attested as his; and defended on his behalf by Lucretius (II 216-93). The swerve (a) _enables atoms falling through space at equal speed in parallel lines to collide occasionally and initiate cosmogonic patterns of motion_; and (b) somehow or other serves as a necessary condition for the behavioural autonomy of animate beings — a power often identified as 'free will'.

...

I do not propose to expend much discussion on the swerve's cosmogonical function (Lucretius II 216-42), which I suspect to be a problem dreamed up with a preconceived solution in mind. Chains of atomic collisions in extra-cosmic space could have quite adequately been explained by the lateral intrusion of one or more atoms from elsewhere, despatched, say, by the break-up of a nearby world. The question of how such collisions ever started in the first place would not arise, given the infinity of past time and past worlds. That is, indeed, the view strongly implied by the Letter to Herodotus and the Letter to Pythocles, the physical epitomes which Epicurus wrote when he had already worked out his main cosmological views in Books I-XIII of his On Nature. Since these two works also contain no hint of the swerve doctrine, the likelihood is that it was his later work on psychology, apparently in the closing books of the thirty-seven book magnum opus, that led him to the innovation, and that it was only then grafted onto the existing cosmological scheme.

Bailey Lucretius Book 2 -

[216] Herein I would fain that you should learn this too, that when first-bodies are being carried downwards straight through the void by their own weight, at times quite undetermined and at undetermined spots they push a little from their path: yet only just so much as you could call a change of trend. But if they were not used to swerve, all things would fall downwards through the deep void like drops of rain, nor could collision come to be, nor a blow brought to pass for the first-beginnings: so nature would never have brought aught to being.

[225] But if perchance any one believes that heavier bodies, because they are carried more quickly straight through the void, can fall from above on the lighter, and so bring about the blows which can give creative motions, he wanders far away from true reason.

For all things that fall through the water and thin air, these things must needs quicken their fall in proportion to their weights, just because the body of water and the thin nature of air cannot check each thing equally, but give place more quickly when overcome by heavier bodies. But, on the other hand, the empty void cannot on any side, at any time, support anything, but rather, as its own nature desires, it continues to give place; wherefore all things must needs be borne on through the calm void, moving at equal rate with unequal weights. The heavier will

not then ever be able to fall on the lighter from above, nor of themselves bring about the blows, which make diverse the movements, by which nature carries things on. Wherefore, again and again, it must needs be that the first-bodies swerve a little; yet not more than the very least, lest we seem to be imagining a sideways movement, and the truth refute it. For this we see plain and evident, that bodies, as far as in them lies, cannot travel sideways, since they fall headlong from above, as far as you can descry. But that nothing at all swerves from the straight direction of its path, what sense is there which can descry?

Post by “Cassius” of December 12, 2024 at 3:00 PM

I personally am in the camp of those who think that Lucretius did his dead level best to transmit Epicurus faithfully. Therefore whenever Lucretius says something clearly then I would wager that it reflects what Epicurus taught. But f someone were to ask me for an example of a line in Lucretius that has the most potential for deviating from what Epicurus himself taught, this - especially the part I underlined - would be the line that I would put under the microscope:

> Quote from Lucretius 2:216
>
> But if they were not used to swerve, all things would fall downwards through the deep void like drops of rain, nor could collision come to be, nor a blow brought to pass for the first-beginnings: so nature would never have brought aught to being.

But before I were to reach the conclusion that this deviates from Epicurus' own views, I would first want to examine the Latin original to see whether there is any chance of a subtlety of translation or other way to reconcile it. I presume that this isn't a scholium addition since it's poetry, but I presume that is not likely due to it being in poem form.)

Certainly like everything else swerves would go back infinitely in time, so there would have been no "first" swerve. As Sedley says it doesn't seem likely that Epicurus would have looked to the swerve as the reason why atoms come together in bodies, but maybe there's something even subtler going on that would have led him to think that it did. I don't gather that the letter to Herodotus is clear as to what it was that causes atoms to "***stick***" together after their initial collisions? That doesn't seem likely either, but maybe he was developing a theory that whatever causes the swerve has other emergent effects as well.

Are there other alternatives? Maybe Epicurus simply developed the swerve theory later in life and the Herodotus letter was earlier, and never revised, as Sedley seems to think? This calls for creative thinking.