

Who Was Right? An anachronistic debate on the
power of pure reason to discern the nature of the
universe

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November 18, 2012

1 Introduction

DAMIEN: I call up the spirits departed and diverse of philosophers past, to put forward their theories of how the world is, and to, using the knowledge of real physics of my time, dispute among themselves as to whether their beliefs were justified, and who, if any, may justly claim credit for having deduced truth from their intuition. First I call Lucretius, to speak for the ancient atomists. Others present shall include Heraclitus, philosopher of fire's eternal conserved flux, and Parmenides, teaching that all is unchanging One.

Let the games begin.

LUCRETIUS: Thank you. My ideas are, of course, not my own, but only, in Latin verse – and now, alas, mere English prose – express the truths revealed to us by that divine thinker, Epicurus, who showed men (and women, for in his Garden he taught slaves and women as well) the reality of eternal atoms and the void, and of the swerve that saves free will, and why we need not fear gods or death.

All things consist of eternal and indivisible but finite atoms, moving in empty space, for all time. This must be so, for we see that nothing truly arises from nothing, nor does anything vanish. So the substance of matter must be eternal, and what we see around us we may assume to be true everywhere, so the universe itself must be eternal, not springing forth *ex nihilo*. These atoms move through empty void, for thus is motion possible, and must be perfectly hard, for thus can they be eternally resistant to change, and also thus can softness be produced, though a mixture of hardness and void, by which the hard surface may yield, yet softness could never produce hardness.

DAMIEN: Wait, why couldn't soft substance be compressed to feel hard? It happens with cloth, or bread.

LUCRETIUS: That happens because those substances are made of hardness and void, and as you squeeze the bread you remove the give, until only resistance is left. If substance was infinitely soft, it could keep on giving and giving, and never would hardness be reached.

Now, these atoms have weight, as Democritus did not think to give them, and so they must fall forever. But so that they may strike and combine and thus create the world we know, Epicurus has revealed to us that they swerve by chance, deviating from their downward course, and thus do the interactions of matter and our own free will arise.

As for the truth of Epicurus, is this not verified by the teachings of your chemistry? All matter is made of atoms, vision is images from an object striking an eye, life is the mixing of atoms from rain and soil in different combinations, and atoms move at random in Brownian motion while particles have quantum choice. Combine this with Democritus's teaching that the Milky Way is composed of many stars, too dim or far away to distinguish, and our teaching that life arises from random combinations, but appears designed because only the organisms well suited to live do live, and you shall see how complete our triumph was.

DAMIEN: Hold on there! Aren't you claiming far too much credit? All you say is true, yet there's so much that's been left out, and of questionable quality. For example, you say everything is falling. Yet I don't feel like I'm falling. I'm sitting right here, typing these words.

LUCRETIUS: Well, everything is falling together. Your sofa, the floor, the planet, your computer, all at the same rate, so you don't notice the falling.

DAMIEN: But you never actually said that, I'm just letting you filch the concept of Galilean relativity from my mind. And if everything's falling at the same rate, then it might as well not be falling at all, and Democritus's vision of atoms simply swirling around and colliding is more elegant, no?

LUCRETIUS: Well.

DAMIEN: And furthermore, the swerve is unnecessary. Somehow you lot got it in your heads that if everything were falling, that had to be the dominant motion. But in truth you could have horizontally bouncing and swirling atoms all falling together, and still bouncing. Unless you had an unrealized notion of air resistance in the back of your mind, so that your vision of falling atoms meant their horizontal motions had to be eventually checked unless renewed by

swerve. But that contradicts the statements of void, which should provide no brake to motion. So there are big flaws in your vision: you didn't see Galilean relativity, despite it being easy enough for anyone on a cart or ship to see, and you introduced unnecessary concepts. Brownian motion isn't really like the swerve, it's just the aggregate of deterministic collisions.

LUCRETIUS: But what of quantum indeterminacy? And free will?

DAMIEN: Quantum... is not really like anything anyone had thought of before, I think, and the introduction of the swerve seems too unprincipled, too unfounded, to give it credit. And I've never seen how a particle swerving, or an electron tunneling, at random, gives me free will. I do things for desires and reasons, sometimes gaining or losing weight due to unconscious mechanisms, but randomness isn't *will*. And even if the particles had will, what would that have to do with my will, on such a larger scale? But I don't want this to be about me, let's leave it at saying this move was unconvincing to a whole lot of people.

There's still more to pick on in your vision, and that's before we hear from other philosophers. You argued it was necessary that the atoms be eternal, yet the atoms of chemistry are not eternal. They can change from being atoms to ions, gaining or losing electrons – that's sort of like their gaining or losing hooks, but perfectly reversible, so the change doesn't imply eventual decay. And the core of the atom, the nucleus, can change more profoundly, if more rarely. Which is part of the problem: you all did an excellent job of anticipating real explanations of how the observable world works, but it's not so convincing that it had to be that way. In particular, "eternal" could be replaced everywhere by "not eternal, but so long-lived that we don't notice creations or destructions or changes". The whole world could be radioactive, but on a timescale so long we don't notice it, just as bismuth turned out a few years ago to be radioactive, but with a timescale of ten to the nineteenth years.

LUCRETIUS: But if the world is eternal, then even long-lived things make it impossible to explain how we exist, for there would be an eternity of decay preceding us.

DAMIEN: So perhaps the world isn't eternal, then. We don't think it is, after all; everything we see expanded from a Big Bang, before which we know nothing.

LUCRETIUS: Yet I reject an idea that the Big Bang could have arisen from nothing, starting time. And I am not alone: some of your own thinkers talk of eternal inflation, or universes evolving stellar formation through black hole cosmogenesis. Thus is eternal existence conserved, through change.

As for chemical atoms, while it is true they are not truly eternal – though note how hard the nuclei are, as Rutherford found! – these changeable objects are themselves composed of truly eternal and identical parts, the electrons and quarks. It's a level lower down than we imagined, but the principle is the same.

HERACLITUS: *cough* I think it is high time that I stepped in, for the rationalizations of the atomists are getting out of hand, and it is time for another perspective. Lucretius, these particles you speak of, quarks and electrons – they are not the eternal atoms you seek. They may last forever on their own – though quarks cannot live on their own, only in little bags, so we are really talking about electrons, protons, and bound neutrons, while acknowledging the changeability and composite nature of the latter two – yet may be annihilated in a flash by contact with their anti-particles, resulting in pairs of gamma rays – matter to light – and perhaps other novel and temporary particles. Your description of vision as images striking the eye was, I concede, inspired and somewhat accurate, yet these images are not made of fine atoms, fine eternal and indivisible particles, but of photons. You might want to claim them as atoms of light, yet I refute you, for there is nothing eternal about them. They arise from atoms and disappear into atoms again.

It is I who anticipated all this, for I taught that the universe was fire in eternal but conserved flux, fire compressing down to matter, matter expanding again into fire, a certain amount of fire giving a constant amount of matter, and back again. The universe is eternal, but eternal change. Your precious atoms and their component particles convert to light, and light converts back to particles.

DAMIEN: Yes, light – not fire. And how is your idea any different from the water of Thales or the air of Anaximenes?

HERACLITUS: Water is truly a compound substance, made of atoms; air is so atomic that its compressability was the first great piece of evidence for atoms. The fire of the hearth may not be exactly the primordial substance, yet I assert that it is closer than the others. Looking at your physics, what I was reaching for was the concept of *energy*, for that is what is conserved. The light striking matter turns not into energy but into motion of the atoms, or potential of the electrons, which can then emit light again. Energy transforms from matter to light to motion to potential, and back again, every which way. Of the elements we ancients proposed, fire is most like it, not a substance but an ever changing process.

As for the eternal universe, yet with bounded past, some of your physicists are invoking my exact word, to speak of an ekpyrotic universe, consumed entirely by fire when two branes collide, from which what you see arises. All to fire, all from fire.

DAMIEN: Hmm. I can grant you something in spirit – yet Anaximander’s unbounded and invisible *apeiron* seems at least as good a precursor of energy as fire is. (I speak for him; he couldn’t make it today.)

HERACLITUS: Yet did he not say his substance was immutable? And what does ‘unbounded’ mean? One thinks of some broad fabric of substance permeating the universe, which bunches up into the observable elements, but that’s not it at all. I think my fire is closer in the end, for it changes, and I stressed the notion of conservation.

LUCRETIUS: But what does it change to? You had no time for atoms, or the void. And you, and Thales, and Anaximander and Anaximenes, all put divinity and intelligence into your prime substances. Your fire changes into atoms in reality, which then move mechanistically. If I am forced to concede a principle, let us note that it is only one principle; we still explained the phenomena around us far better than anyone else.

DAMIEN: What did you have to say about magnetism?

LUCRETIUS: ...I don't want to talk about it.

DAMIEN: Heh, I'm just teasing. You did do well overall on the everyday front. Still, Heraclitus is right, the eternal nature of the components seems rather doubtful, as does the eternal universe of both of you. And if it is eternal, it clearly went through a phase that obliterated anything we'd recognize as atoms.

LUCRETIUS: Perhaps there is another level down? And energy is quantized? String theory?

DAMIEN: I'm not going to give you credit for physics we don't even speculate about yet. Energy might be quantized but it's still not the eternal atoms that you wanted. Strings... well, I don't know enough to talk about them. (Does anyone? Heh.) I guess they might be eternalish, though different energies of vibration change their properties.

PARMENIDES: You're all wrong.

DAMIEN: Oh, hi Parmenides. Do tell.

PARMENIDES: There is no change. All is one. Change is impossible, reality is timeless and uniform. The void is nothing, and nothingness cannot exist. I agree with the atomists and Heraclitus that things cannot arise from nothing, nor can things pass into nothing, but just as the atoms cannot change, so can the universe not change. There is no motion –

Damien kicks a rock. "Thus do I refute it."

PARMENIDES: – only the illusion of change. Look at a different branch of your physics – special relativity. The universe is a block of space-time, our lives static world-lines in the block, like the path of a worm through an apple. Our consciousness flickers through lines, like the worm, but the line already exists, and nothing truly changes from the divine perspective outside of time.

DAMIEN: Einstein is not really like anything you actually said.

PARMENIDES: That's what I *meant*. Or should have meant.

DAMIEN: Reconciling the plasticine block of space time with the randomness and lack of hidden variables of quantum mechanics is more than I want to engage in, but I acknowledge you have a point, or at least the ghost-model that comes

from my trying to make your fragmentary writings make sense, hybridized with what I know of physics, has a point.

So, let us recap and take stock. The world is made of particles, mostly nigh-indivisible atoms, that move around and combine and come apart from combinations. Insofar as they change, they are composed of even more fundamental particles, indivisible though not un-transformable. The atomists were pragmatically right. Yet, in a real sense, the monists from Thales to Heraclitus may be said to have been right as well, for the atoms are not eternal, but are composed of... not really a substance, more of an accounting identity, that we call energy, that everything transforms to and from. Parmenides' idea of eternal being and lack of change seems insane, yet finds some purchase.

On the other hand, you all may well have been wrong in insisting on an eternal universe. Certainly what we see had a beginning for all practical purposes, with time and space expanding from a point or near-point. The jury is out on whether there's more, or whether we could know if there's more.

But the more fundamental question is whether I can give you credit for being right, or if you were all shooting in the dark and getting partial credit by guessing at chance. Ideally, the rationalists would reason from first principles, and get everything significantly right. You're all wrong, in part.

HERACLITUS: Yet are we not all partially right? You have not presented or considered anyone whom you can say is entirely wrong. Is it not significant if all of us who sat and thought about how the universe could be, sans any real evidence, got something right? It's not quite like the blind men and the elephant, for we weren't observing anything indirectly, just thinking. And it's not that the more accurate ideas preferentially survived: I'm fragmentary, so is Democritus, the atomists were never popular, and the people making the copying decisions had no idea what was right.

ARISTOTLE AND PLATO: Indeed, mostly they were copying us. How come we're not getting more of a voice here?

DAMIEN: I'm biased against you, plus you do have more surviving texts, which I haven't read much. I gave up on Plato when I tried.

Heraclitus, I don't think it's entirely fair to say you weren't observing anything; you live in the world and observe it every day (or did); even if you weren't making any experiments or deliberate observations, you were thinking about observations made since childhood. But the point about being partially correct is interesting, though I don't know what to make of it. Perhaps it's just my mental flexibility in adapting modern physics to your various ideas, or indeed my bias in calling up thinkers whom it is easy to adapt.

ARISTOTLE: Hey, you have to give me some credit. Sure, I was wrong about void not existing, yet nature does abhor a vacuum, in that matter expands to fill it if not otherwise presented. And my laws of motion were perfectly sensible for things moving in a fluid.

DAMIEN: So your observations and explanations were right. Your reasoning from first principles wasn't – you just took your observations and naive categories and properties as fundamentals. Also, what was that about women having fewer teeth?

ARISTOTLE: I don't know, I plead posthumous amnesia. Are you sure I even said that, vs. someone else using my name to enhance the status of his writings?

DAMIEN: I don't know either. Not a classical texts scholar, here, despite my parents.

PARMENIDES: Actually, I'd like to get a word in here, speaking for all of us who found the void to be absurd.

LUCRETIUS: The universe is full of void! Vacuum everywhere! If you squint, it's nothing but vacuum!

PARMENIDES: Yet our host said that time **and space** expanded from the Big Bang. Not a fireball of matter and energy expanding through space, but space itself expanding, carrying the energy with it. That implies to me that the apparent nothingness of empty space is in fact a somethingness, one permeable to matter but nonetheless extant. Einstein's gravity changes the shape and curvature of this space. That's a lot of properties for void.

LUCRETIUS: Look, it's functionally void. Atoms moving through it, you just

said so yourself.

PARMENIDES: But if we're talking about reasoning from first principles... this just makes you a better Aristotle, explaining the easy observations of the universe. It's easy to look at outer space or an atom today and think "oh, it's just void". To recognize that even apparent nothingness needed structure and support, that took true insight, and we should all be given credit for that.

LUCRETIUS: *sputters*

DAMIEN: I'm still hesitant to give any of you credit for anything. But you do have a point about space. And there's talk of false vacuums, and churning quantum foams, and network models of space-time.

HERACLITUS: And your vacuum is full of forces and fields. My contemporary, Democritus, attributed no weight to atoms, saying it was only arose from the interaction of atoms. Is that not like the Higgs field, and modern ideas that inertia is not a separate property that just happens to be always the same number as the gravitational mass or charge – unlike electric charge, which is independent – but something that somehow arises from gravitational interactions with everything else in the universe? Is a void a void if you are moving through gravitational and electric and nuclear (very weak) fields? Not to mention all those neutrinos. Your universe seems full of substances, albeit largely subtle ones.

DESCARTES: Not to mention mind! All this stuff and nonsense about "nothing exists save atoms and the void". You atheistic cognitive scientists are convinced you can explain mind as patterns in matter, yet you base this entirely in the general success of materialistic hypotheses, and the apparent effects of the brain on cognition. 'Decisions' may be made mechanistically, by a computer or automaton, but no case for subjective experience arising from dead matter has convinced anyone not pre-disposed to such a belief. The unity of experience over a collection of dumb and distributed particles, the collapse of observed quantum wavefunctions – you have no good explanations for them.

DAMIEN: True. But neither does anyone else. Mind as a substance in itself may be a true hypothesis, but so far it has been an unproductive one. As I'm

debating whether to give credit to those who may have anticipated observations about material reality, I can safely ignore people who argue about things for which no one can claim any credit at all. So no, we won't mention mind any more.

As for judging credit – well, that's hard, since most of you just asserted things as obvious or self-evident, without giving much reasoning, at least that I've read. The atomists gave arguments, but not very convincing ones – why should the atoms be unchangeable, vs. being able to change readily between different forms, without having component structure, or losing anything in the process? Some philosophers asserted that was absurd, that anything that can change must have structure to change with – I think William James went there, discussing thoughts – but I don't see it. Why can't A simply have the property of changing into B, and vice versa?

Our world has aspects of atoms and void, the void has aspects of being a substance, which things move through nonetheless; the ultimate nature of space and time, their origin and whether they are continuous or discrete, whether eternal and infinite or bounded, are ultimately as mysterious as they ever were. If we're talking fundamental philosophy, I don't know if any progress has been made whatsoever. We're just much better at predicting and manipulating what we see.

So I conclude with “Mu”.

ALL, CONFUSED: What? The twelfth letter of the Greek alphabet?

DAMIEN: ...never mind.

2 References

- (1) *The Atom in the History of Human Thought*, Bernard Pullman
- (2) *The Nature of Things*, Lucretius. Translated by Frank Copley
- (3) *The art and thought of Heraclitus*, Charles Kahn.
- (4) *Heraclitus*, Philip Wheelwright.
- (5) *Heraclitus, fragments*, T. M. Robinson.