Searching for the Atoms of Life

By Avi Loeb on September 22, 2020

The search for extraterrestrial life is one of the most exciting frontiers in Astronomy. The recent detection of a potential biosignature in the atmosphere of Venus raised the possibility that life might exist on the nearest planet to Earth. Absorption of light at millimeter wavelengths by phosphine molecules was identified in the Venusian cloud deck located 35 miles above ground level, where the temperature and pressure obtain values similar to the lower atmosphere of Earth. There, microbes may reside in droplets at a density that is orders-of-magnitude smaller than in air on Earth, having a possibly common ancestry to terrestrial life due to the frequent exchange of planet-grazing asteroids between Earth and Venus. Conclusive evidence for extraterrestrial life will have to await a probe that will scoop material from the Venusian clouds and search for microbes in it.

We assign special significance to finding extraterrestrial life because it would imply that we are not alone in the Universe. But do our personal interests carry any notable weight in the Universe at large? In this context, my Harvard colleague Stephen Greenblatt emailed me recently a problem raised by Lucretius’ version of Epicureanism: “since we are all made up out of the atoms that we share with inanimate matter, is there a particular value in life forms?” My reply as a physicist was simple: “We are complex structures of atoms and we tend to get emotional when witnessing other complex systems. But the splendor of complex structures of LEGO does not imply that they carry anything else beyond the pieces that make them.”

The question of whether there is something beyond our physical body boils down to a straightforward line of inquiry: “is physics a complete description of nature?” So far, based on all experimental evidence, the answer is in the affirmative.

Works of art marked by special beauty, such a Leonardo da Vinci’s Mona Lisa – which is paint on canvas, or Michelangelo’s David – made of marble, trigger a sense of awe and an emotional reaction. But they do not carry any building blocks beyond the standard model of physics. The same is true about our most advanced creations in computer technology. We respond to artificial intelligence (AI) systems as if they had a life of their own. Our interaction with living things can be viewed as a natural extension from works of art and technology to systems with a higher level of complexity. In fact, the Turing test is all about our inability to detect the difference between an interaction with a human and a computer.

When structures are too complex for us to fully understand them in detail, we assign an abstract meta-level description for their behavior that goes beyond the hardware that makes them. Software engineers at Google do not fully understand how their AI system operates but they can attribute general qualities to its response to data. What we label as
the “human mind” is probably a meta-level description of this sort. It has to do with the behavior of one of the most complex system we know, a human, in response to the environment. A human is a structure of atoms, so complex that we lack the computational capacity to forecast how it will respond to particular circumstances. “Free will” is linked to the unpredictability of our crude model of humans and the limited information we have on their environment.

Our scant understanding applies to ourselves as much as it does to others. What we call “myself” is different from “someone else” in the amount of data we have on it and the fact that whatever happens to it impacts our functionality. But just as I do not have a better understanding of my liver compared to the liver of another person, I do not understand the inner workings of my mind any better than the mind of others.

Given this perspective, the “mind” represents an emergent phenomenon of a complex system which we do not fully comprehend. But science is work in progress, and it is possible that we will gain a better understanding in the future. As our knowledge will improve, less of the human mind will appear mysterious and more of its phenomenology will be associated with the physical body, in the same way that the charm of the Mona Lisa can be traced back to the specific paint marks left by de Vinci’s brush on the canvas.

Of course, this notion might be unsettling to philosophers who wish to elevate the status of what it means to be human beyond the physical reality of atoms. To that, all I can say is that reality is whatever it is, irrespective of the misconceptions that people have about it. The Sun did not revolve around the Earth just because philosophers thought it does.

This perspective also carries a narrative for the end of our life. It’s minimalistic interpretation of death is that it resembles to unplugging a computer from the wall socket. The system shuts off abruptly and the hardware becomes inactive afterwards. One is left with a body that returns the atoms it borrowed for a short time from Earth. Burial resembles the disposal of the computer relic in a recycling bin, making its raw materials available for new structures to form.

Stephen replied with an insight from his brilliant book and essay on the subject. He argued: “atomism for Lucretius was meant to be therapeutic; it was intended as a form of consolation. This notion of therapy was already in question in Lucretius’ time – Cicero asked what on earth was consoling about the prospect of returning to one’s constituent atoms? – and there is something bleak, it seems to me, in your version as well. One looks for consolation elsewhere, I think […] in the wonder aroused by art; in the sheer joy of existing.”

I endorse Stephen’s bottom line. After decades of studying the physical world, I am coming around to appreciate the value of the art as consolation. With it, greater pleasure can be drawn from the way things are organized than from understanding their building blocks, especially at a time when we are stuck in advancing fundamental physics.
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(Credit: Nick Higgins)