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Conjuring signs of life from the cosmic soup

Scientists offer tantalising insight into how atoms were jolted out of their inertia

Carl Sagan, the American astronomer, author and science populariser, once rhapsodised that the “cosmos is within us. We are made of star-stuff.” And yet, in one sense, we are plainly not. While our bodies indeed contain atoms that can be found in the cosmos, the pleasing atomic arrangements that constitute you and me are “alive”. Somewhere along the cosmic timeline, certain permutations of atoms were jolted out of their historic inertia and the ball of life began to roll.

Now scientists have delivered a tantalising insight into how such jolts — from simplicity to complexity, from lifelessness to lifelike behaviour — might be accomplished. Physicists at Emory University in Atlanta gathered tiny plastic particles and sprinkled them into a vacuum chamber containing argon gas.

While playing with the gas pressure, student Guram Gogia noticed the particles behaving oddly: they began “switching” between fluid and crystalline states. Mr Gogia compared it to leaving a tray of ice cubes out in the kitchen — and seeing it repeatedly melt and refreeze of its own accord. A paper on this curious finding, co-authored by Mr Gogia and colleague Justin Burton, was published last month in the journal Physical Review Letters.

The thought of plastic particles jiggling around a chamber in lockstep may not stir the soul, but it shows that unexpected complexity can emerge from simplicity. Notably, living organisms demonstrate complexity and changeability. Dynamism, and the switching of one state to another, such as the firing of neurons, is a hallmark of life.

This kind of approach — finding out how simple building blocks can be assembled in a way that whips up something of surprising complexity — is one of the most exciting areas in science today. A relatively new field known as the physics of living systems is trying to understand biological behaviour in terms of its most fundamental physical processes. And one of the most basic questions is: how does a free-floating cosmic soup pour itself into atomic arrangements that permit life to arise?

Jeremy England, a biophysicist at MIT, is a feted but controversial academic ploughing this furrow. He has speculated that life emerges naturally as a consequence of thermodynamics, one of the most basic principles in physics. Groups of atoms, he suggests, adopt arrangements that allow them to extract more energy from the environment. That energy is subsequently dissipated as heat. It is this energy process, he believes, that drives the growth of increasingly complex structures, which may eventually acquire the characteristics of living things.

As England explained in a 2014 interview: “You start with a random clump of atoms and if you shine light on it for long enough, it should not be so surprising that you get a plant.”

The secret of life, he points out, must lie in atomic architecture: if you chop up a bacterium into its constituent parts and put them back together randomly, you will not get something capable of metabolism. That process — crucial to life — only transpires if the components are locked together in a specific way.

He theorises that living organisms may have undergone adaptation in response to the energy characteristics of their environments; two encouraging papers he co-authored this year show simulations of what happens when chemicals are thrown together under specific energy conditions.

Fellow academics want to see such simulations run with real-life chemicals that reflect the mix found in the primordial soup. Others are more sceptical: squeezing energy tricks from a jumble of chemicals does not exactly equate to unveiling the secret of life, and says nothing about the central role of DNA.

To throw some pedantry into Sagan's poetic thought: we are made of expediently rearranged star-stuff but we are still not sure how it happened.

The Financial Times – Science – 8 November 2017

https://www.ft.com/content/b6402f18-c482-11e7-b30e-a7c1c7c13aab