

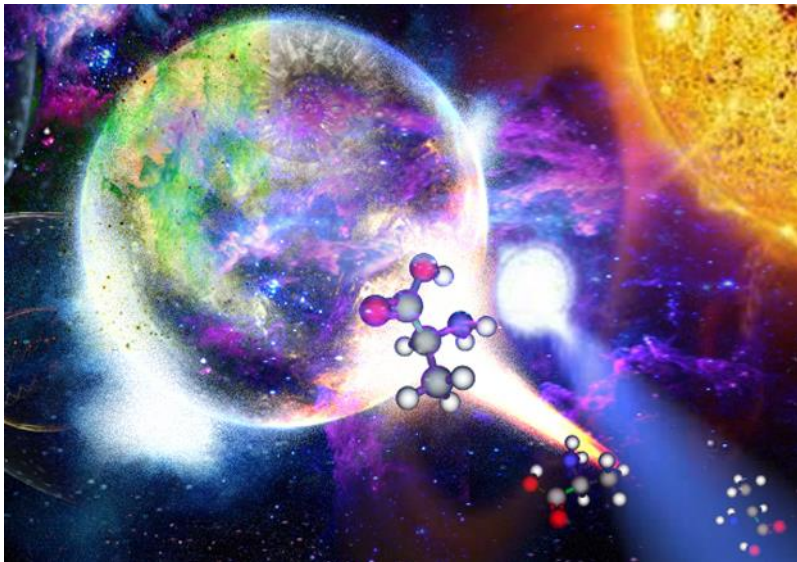
THE STUFF OF LIFE

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Ken Tapping, 6th May, 2024

In a universe that must contain an enormous number of planets, with a good fraction "Earthlike", it is almost certain we are not alone. That raises two interesting possibilities. Could it be that on any planet where some sort of processes can operate to produce life, and the ingredients are available, life is likely to appear? In this case living things from different worlds could be bizarrely different, having evolved completely independently. A second possibility is that the seeds, or the basic stuff of life are produced in space. When a new planet forms, it gets some of this stuff, and if possible, life develops and adapts to the environment in which it finds itself. This idea has come to be known as "Panspermia". Decades of studying the composition and chemistry of the dark, cold dust and gas clouds between the stars suggest the Panspermia idea is more probable.

In galaxies like ours, the space between the stars, especially in the spiral arms, where we live, is filled with dark, cold, clouds of gas and dust. In many cases these clouds completely block the light from stars lying behind them. Those clouds are the raw material for making new stars, planets and living things. In the youth of the universe those clouds were mostly hydrogen and helium, but as successive generations of stars were born and died, those clouds became enriched with the waste products from their energy production: the other elements. Although they are dark and cold, slowly, over billions of years, a lot goes on.



Radio telescopes make it possible to look inside those clouds to see what is going on, and also to detect results of a process of long, slow chemistry. So many signatures of organic (carbon-based) molecules have been detected that a large number have still to be identified. However, among those that have been identified are chemicals critical to the processes of life as we know it, including amino acids, the

building blocks of proteins. However, proteins consist of careful arrangements of huge numbers of amino acids. Assuming those amino acids would happily come together to form proteins is rather like a pile of bricks moving together of their own accord to form a house. This rarely if ever happens, a fact for which the construction industry is grateful.

In Earthly life, the plan for assembling proteins from amino acids is encoded in our DNA. It has been proposed that this magical chemistry may have taken place in our primordial oceans, but as yet, not exactly how.

Some new research suggests that the production of really complex organic molecules works better in space. It is proposed that the cold, dark dust and gas clouds between the stars are a good place for complex molecules to very slowly come together, over millions of years. The chemistry happens on the surface of minute dust grains. Carbon, molecules of carbon monoxide and ammonia, along with other things, get stuck to the grain and then react very slowly to form amino acids. Then, these can combine to form peptides, comprising anywhere between a few and hundreds of amino acids. These have the property of promoting the chemical reactions that are important for life, including forming the membranes needed to enclose cells. Complex organic molecules, including amino acids, sugars and lipids (a family of organic compounds including fats and oils, also important for life) have been detected in meteorites. That is not only evidence that complicated organic chemistry is going on, it shows how these chemicals might have got here.

Similarities in our body chemistries does not mean those aliens are going to look anything like us. The evolutionary path of life on Earth has been shaped by a series of processes and accidents that are probably unique in the universe. The same will apply to all those other worlds.