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ORIGINAL ARTICLE

Life Arriving from Space: Theory and Proof

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Abstract

The recent discoveries from studies of material recovered from the stratosphere combined with studies of carbon-rich asteroid samples converge on the possibility of microbes continuing to arrive from space.

Keywords: Panspermia, stratosphere, comets, asteroids

Introduction

The idea of life originating from the wider Universe is an ancient one. Early references to this concept are to be found in Vedic literature of India dating back to earlier than 1000BCE. A more explicit reference to this idea as well as an elaboration of it in a Western context began with the pre-Socratic Greek philosopher Anaxoragas (c. 500BCE). Since then European philosophers and scientists have flirted intermittently with similar concepts over the centuries (1,2,3,4). However, there can be little dispute that it was the late Sir Fred Hoyle and one of us (NCW) who were largely responsible for reviving this ancient concept in a rigorous form in relation to modern astrophysics and biology and so ushering in the new discipline of astrobiology.

From the early 1980's Hoyle and one of us (NCW) started amassing a wealth of evidence and arguments both from astronomy and biology in support the idea of life is a cosmic phenomenon, and that comets and asteroids were repositories, carriers as well as deliverers of cosmic life. This work led naturally to the need for formulating possible predictions and tests of the theory. One such prediction involved the sampling of the Earth's environment for the predicted ongoing ingress of cometary biomaterial. In the first instance the recovery of incoming biomaterial from the stratosphere at a height of 41km was conducted by a team of scientists linked to ISRO (The Indian Space Research Organisation) using balloons, and thereafter deploying modern biological techniques including epifluorescence microscopy and electron microscopy to test for incoming microorganisms. These experiments yielded dramatic results that are unfortunately still largely being ignored. Reporting on the result of the 2001 experiment we wrote thus in a paper presented at a conference in the USA (6):

"The electron microscopy could be equivocal in regard to the detection of viable cells, but the epifluorescence microscopy deployed leaves little doubt that clumps of viable cells with sizes appropriate to bacteria are present at all heights ranging from 24 to 41km. Since the local troposphere over the launch site was estimated at 16km, the isolates are all above the level at which any terrestrial contamination can be expected, particularly so at the 41km altitude. With an average falling speed for 3 micron-sized clumps at 40km of about 0.3cm/s the infall rate of clumps (assuming a number density of 0.068 per litre) over the entire Earth, area $5x10^{18}$ cm^2 would be $(068x10^{-3})$ x (0.3) x (5×10^{18}) per second.

Assuming an average of 100 individual bacterial cells each of mass 3×10^{-14} g in a clump we obtain

a daily mass input of about a third of a tonne of biomaterial. A *prima facie* case for a space incidence of bacteria onto the Earth may have been established……"

A later balloon flight also conducted by ISRO in 2008 led to the recovery of more stratospheric material and analysis by Dr. S. Shivaji and his colleagues in India yielded cultures of 3 hitherto unknown microbial species which were all highly resistant to ultraviolet light and presumed to be of extraterrestrial origin (7). One of the newly discovered species was named *Janibacter hoylei*, to honour Sir Fred Hoyle. All the new bacteria that were discovered had a large fraction (80%) of their DNA identical to terrestrially common phenotypes, but they were sufficiently different to be listed as "new" types.

Our early results from 2001-2008 are fully consistent with later studies by a team of Russian cosmonauts who reported the recovery of extremophilic microorganisms from the exterior surface of the International Space Station (ISS) which orbits the Earth at a height of 400km (8). Analysis of all the relevant data confirms that the organisms recovered at this height are exceedingly unlikely to have originated from the Earth and are therefore of extraterrestrial origin (9).

Most recently, investigations of fragments from two carbon-rich asteroids Ryugu and Bennu [8] that were recovered directly from interplanetary space deploying spacecraft, have led to important discoveries that can be interpreted as confirming our earlier results. In the case of the recovered fragment of asteroid Ryugu a wide range of microorganisms were actually discovered within its porous matrix, but these have been declared, prematurely in our view, as having most likely arisen to have arisen from terrrestrial contamination (Genge et al, [10]). Although we cannot absolutely rule out this claim, the possibility of microbes having pre-existed within a loosely aggregated fragment of a once "living" comet or asteroid remains, in our view, the more likely option.

Likewise, the recent reports of the existence of life's complex chemical building blocks in spacecraft-recovered samples of both the asteroids Ryugu and Bennu are fully consistent with these molecules being the detritus of life that was already present in the asteroids. Both these asteroids can be viewed as "dead cometary-type bodies" that once contained subsurface liquid water domains replete with microbial life (11).

The assembly of life's chemical building blocks into an "evolvable" biology during the Earth's Hadeam epoch is an unproven proposition against which there are many powerful arguments which as developed by Fred Hoyle and one of us (NCW) from as early as 1982 (12). In our view it is high time that all the evidence pointing to life as a cosmic rather than a purely terrestrial phenomenon is revisited with scientific rigor and without any form of prejudice.

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