CRITIQUE ON VINDICATION OF PANSPERMIA – FALSIFICATION OF HOYLE-WICKRAMASINGHE HYPOTHESIS? P. G. Vaidya[1], Indian Astrobiology Research Centre (IARC), P O Box 8482, Mandpeshwar Post Office, Borivali (West), Mumbai – 400103 Maharashtra, India, pushkar@astrobiology.co.in.

Introduction: In January 2001, microorganisms were isolated from the air samples collected from Earth's stratosphere. It was argued that these stratospheric microorganisms are of cometary origin and thereby cometary panspermia stood vindicated. These stratospheric microorganisms had essentially the same characteristics as terrestrial microorganisms [1-2]. In March 2009 a similar experiment was done and similar results obtained [3]. Interestingly, a review of Hoyle-Wickramasinghe hypothesis papers suggests the contrary [4-6]. Moreover, it has already been shown, in the light of niche ecology and adaptations that these stratospheric microorganisms could not be of cometary origin as they are contrary to the kind of microorganisms one would expect to find in a cometary niche [7].

Discussion: A strong prediction of the hypothesis of cometary panspermia is that cometary injections of microbial life must be an ongoing process [8]. In January 2001 and March 2009 air samples collected using balloon borne cryosamplers were analyzed. The collection was done in the Earth's stratosphere at various heights up to 41 km. Two bacteria and one fungus and four novel bacteria were isolated from the 2001 and 2006 analysis respectively while twelve bacterial and six fungal colonies were isolated from the 2009 analysis. It was reasoned that the stratospheric microorganisms were not of terrestrial origin nor contaminates and thereby they must have come from an extraterrestrial source, the comets. Importantly, they were essentially similar to terrestrial microorganisms. It was asserted that the 'Earth-like' characteristics of the stratospheric microorganisms (of cometary origin) are consistent with panspermia theories [1-3].

These stratospheric microorganisms (of cometary origin) were the n^{th} generation of the microorganisms, which replicated in comets during the cometesimal formation period [7], which lasted for about a million years and marked by the presence of liquid water, allowing the microorganisms to occupy a significant volume of a comet [9].

A review of Hoyle-Wickramasinghe panspermia hypothesis papers shows that even there it was speculated that microorganisms of cometary origin will show adaptations relevant to cometary environment. For instance, it was asserted that 'if microbial life exists and replicates on comets and does reach Earth then one could expect certain terrestrial life forms adapted to cometary environments – species that survive and grow in frozen water, able to carry out photosynthesis intermittently at low light level' [4]. Similar, assertions have been made about what adaptations it would take for microorganisms to survive in the extreme cometary environment [5-6]. The stratospheric microorganisms (of cometary origin) found during the balloon experiments show no adaptations required to survive in a cometary environment [7].

Moreover, it was shown that the cometary environment is an extreme environment and thus is an extreme niche for any microorganism to occupy [7] [10]. The conditions are so extreme that if a microorganism does not adapt then it will die [7]. The primary factors, which make the cometary niche extreme, are primarily cold temperature, low nutrition and scarcity of energy source [11-13]. A unique factor of the cometary niche vis-à-vis any terrestrial niche is microgravity [7]. Replication of microorganisms (during cometesimal formation period which lasted for about a million years) in the cometary niche would call upon evolutionary adaptations in line with extreme factors of the cometary niche and the consequential change in the genetic make-up. A microorganism which is a polyextremophile would be best suited for the extreme cometary niche.

The stratospheric microorganisms from the 2001 experiment were grampositive, non-acid fast, catalase-positive, and facultatively anaerobic. No oligotrophs were found. They exhibited potentially UV-resistant morphologies as the environmental conditions found at 41 km are extreme in terms of UV exposure, low temperatures and pressures [1-2]. The 2009 analysis of the stratospheric microorganisms revealed similar characteristics [3]. In short, the stratospheric microorganisms did not exhibit any distinct adaptations expected to be seen in microorganisms occupying a cometary niche.

Summary: A strong prediction of the hypothesis of cometary panspermia is that cometary injections of microbial life must be an ongoing process. To test this prediction, stratospheric air samples were analyzed (2001 and 2009 balloon experiments) and Earth-like microorganisms found. It was asserted that the 'Earth-like' characteristics of the stratospheric microorganisms (of cometary origin) are consistent with panspermia theories. Interestingly, a review of Hoyle-Wickramasinghe papers suggests the contrary. Later, it was also shown in the light of niche ecology and adaptations, which these stratospheric microorganisms

could not be of cometary origin. So, instead of finding microorganisms adapted to cometary environments in the stratosphere; Earth-like microorganisms were found.

Concluding Remarks: The Hoyle-Wickramasinghe panspermia hypothesis predicted that the cometary injections of microbial life must be an ongoing process [8]. Therefore, we should be able to retrieve microorganisms from the stratosphere, which were injected by the comets. It has been shown that microorganisms of cometary origin must show adaptations as required by the cometary niche [7]. The balloon experiments (2001 and 2009 analysis) found no such microorganisms. Does this suggest the falsification of the Hoyle-Wickramasinghe panspermia hypothesis?

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