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Quest for life on Jupiter and its moons

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The final confirmation of the existence of multicellular life in aqueous habitats on the moons of Jupiter, will be a game changer for the societal approval and acceptance of panspermia which has been long overdue.

Keywords: Panspermia, comets, life in moons of Jupiter

On April 14, 2023 when the Sun moved into Aries marking a new astronomical year (a tradition observed in Sri Lanka and India), ESA's Jupiter Icy Moons Explorer, JUICE, was launched to make detailed observations of the giant planet Jupiter and its three large ocean-bearing moons – Ganymede, Callisto and Europa – to search for evidence of extraterrestrial life. The Juice spacecraft is due to take a leisurely 8 years to reach its Jovian destinations where indirect evidence for bio-friendly habitats have been known to exist for some time. NASA's Pioneer and Voyager probes made the same journey in 1970's and had already yielded a wealth of images and data that were arguably fully consistent with the presence of microbial life.

The theory of cometary Panspermia posits that the complex informational units of life in the form of genes (DNA, RNA), that can be assembled into life forms subject to constraints of natural selection, are distributed throughout the galaxy and beyond (Hoyle and Wickramasinghe, (1981a(1); 1981b(2); 1983(3); 1985(4); 1986(5)) . Bacteria and viruses that can serve as genetic and evolutionary vectors for such a process are, according to this model, incubated and nurtured in the interiors of comets and icy bolides and asteroids. Within such a cosmic evolutionary scheme that bypasses an impossible bottle-neck of spontaneous generation in any single planetary site, it will be expected that self-similar lifeforms develop from genetic units (bacteria and viruses) that are cosmically widespread. The similarity of microbiota as well as more complex aquatic lifeforms that are found on the Earth will most probably be replicated in other "ocean bearing" domains on other planets and moons in our solar system and beyond. Impactors containing the same suite of genes that are responsible for the emergence of such life will be distributed widely throughout the solar system and beyond by processes discussed in detail by Wallis and Wickramasinghe (2004 (6)).

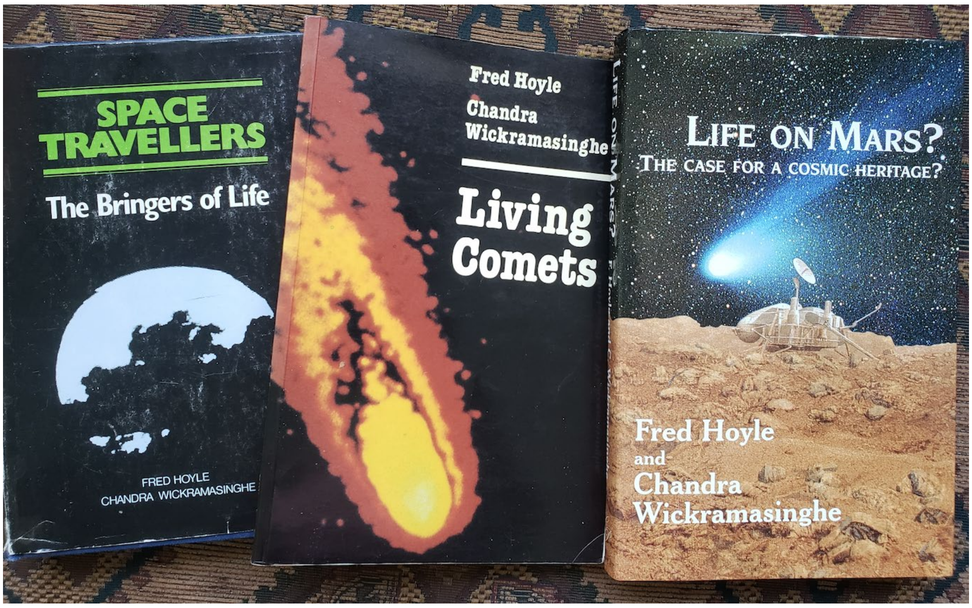

Fig. 1 Covers of scientific monographs by Hoyle and Wickramasinghe developing the theory of cometary panspermia in 1981, 1985 and 1996 where explicit reference to evidence of life in Jupiter and its moons is discussed.

If one takes account of the wide range of ambient conditions that support microbes as well as simple multicellular organisms in multiple locations on the Earth, the prospects for life on the icy moons of the planets Jupiter and Saturn cannot be ignored. The relevant necessary conditions include the existence of long-lived radioactive heat sources in these bodies that could maintain subsurface oceans over billions of years (Hoover et al, 2022 (8)). These would be similar to conditions that prevail at great depths in the Earth's crust, in the Antarctic ice shelves and in the high temperature hydrothermal vents in the ocean floor, where both single-celled bacteria and relatively simple multicellular life forms are known to abound. The limits to multicellular life will only be constrained by the arrival of appropriate genetic programs (DNA) combined with the supply of nutrients and hospitable ambient conditions.

Comets are well known to exhibit emergence of jets and eruptions at heliocentric distances that are too large to be explained by solar heating (Fig.2). The prodigious output of dust and gas observed in the Rosetta Mission comet 67P/CG, comet Hale-Bopp at a heliocentric distance of 6.5 AU and recently the eruptions of the giant comet C/2014 UN271 at an even greater distance of 29AU (9) clearly supports the presence of subsurface biological activity. Likewise, NASA's New Horizons mission in its flyby study of Pluto and its moons in 2015 provided similar evidence of jets and eruptions in relation to the dwarf planet Pluto, again confirming that radiogenic heating is relevant in 1000km-sized icy bodies (trans-Neptunian objects TNO's not unlike giant comets) throughout the outer regions of the solar system (6,7,8,10). Similarly, Triton, often regarded as a "twin" of Pluto, is also similarly active and displays unambiguous evidence of restructuring and mobility on timescales well under millions of years, as can be inferred from the lack of evidence for meteorite impact craters. All the available data points to sporadic high-pressure release of material from subsurface domains that have the ability to support microbial life.

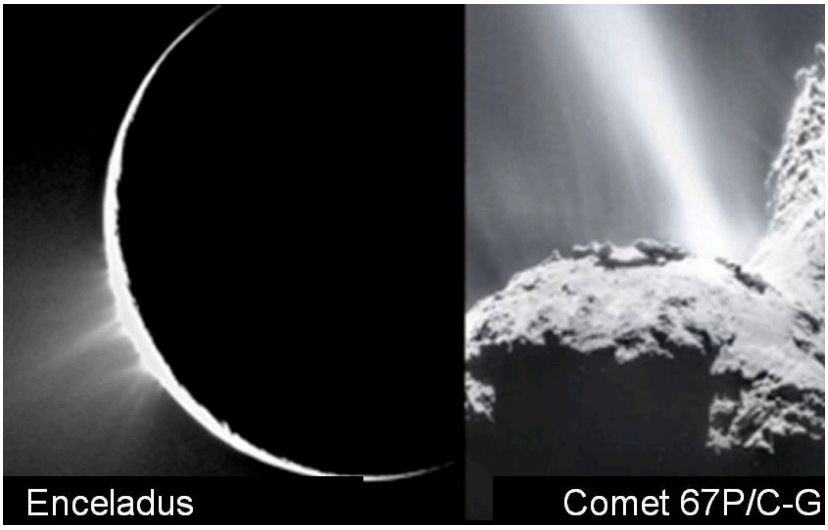

Fig. 2. Plumes of water and methane issuing from fissures in overlying ice. Left: Cassini image of the South pole of Enceladus; Rosetta image of jet of water and organics in comet 67P/C-G.

Viable habitats associated with Jupiter and Saturn have been under discussion for over 4 decades by Hoyle and the present writer (1). In our 1981 book, "Space Travellers – The Bringers of Life" (1), we discussed available data on dust in the clouds of Jupiter and concluded a consistency with bacteria and bacterial spores and an ongoing aerobiology operating in the Jovian atmosphere. We also considered at this time the hypothesis that the rings of Saturn contain bacterial dust expelled from its two icy satellites S13 and S14 that have retrograde orbits about the planet.

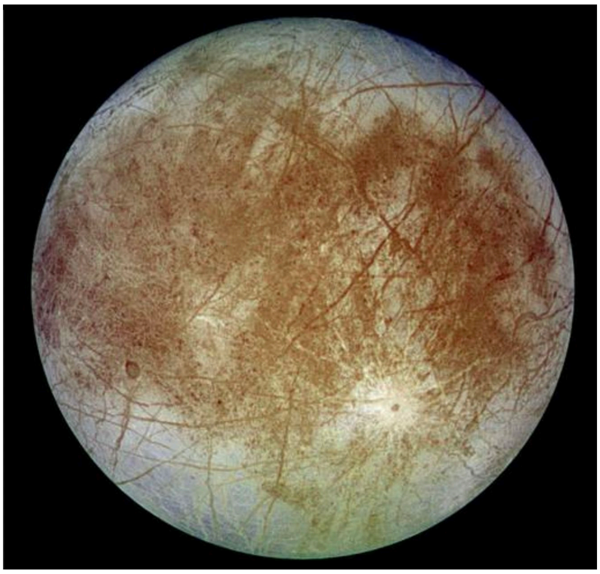

Fig. 3. Multi-cracked icy surface of Europa delineated by orange-coloured pigment

In 1996, after NASA's Galileo spacecraft had examined the surface of Jupiter's moon Europa and discovered a multi-cracked icy outer layer demarcated by orange pigments, we began to argue strongly for evidence of subsurface biology (Hoyle and Wickramasinghe (11)). This is still the most reasonable explanation for all the evidence on this Jovian moon available to date. It is remarkable that the orange coloration of the cracks ESA's is consistent with biological pigments, and evidence of radioactively and/or tidally heated subsurface oceans also remains strong. At the present time the case of a complex microbiota and/or multicellular life (small sea animals) existing on Europa cannot be stronger, and so the recent ESA/NASA missions to this Jovian moon cannot be more timely.

Fig.4. Author of *2001-A Space Odyssey*, Sir Arthur C. Clarke and Chandra Wickramasinghe discussing life on Europa (intelligent dolphins!) in the seas of Europa in 1981

We conclude by noting that in the book entitled “Greetings, carbon-based bipeds” by Science Fiction writer and futurist Arthur C. Clarke several bold predictions of the future are made, some of which have already come to true. Amongst others that still lie in waiting is his forecast that in 2061 in which he states:

“2061. The return of Halley’s comet; first landing by humans. The sensational discovery of both dormant and active life-forms vindicates Hoyle and Wickramasinghe’s century-old hypothesis that life is omnipresent throughout space…..”

We would boldly predict that this realisation may well be achieved with JUICE a full 3 decades ahead of Arthur’s forecast.

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