Testing the Drake Equation in the Solar System

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Whereas Titan is an appropriate target for studying chemical evolution, the planet Mars and the Galilean satellites are favourable sites for the search of extraterrestrial life. The main encouragement for the search for life in the solar system is the possible evidence of liquid water in the early history of Mars and, at present, in the galilean satellites. Hydrothermal vents on the Earth's sea floor have been found to sustain life forms. Possible analogous geologic activity on Europa, caused by tidal heating and decay of radioactive elements, makes this satellite the best target for identifying a separate evolutionary line. We explore Europa's likely degree of biological evolution by discussing experimental tests that have been suggested. The theoretical bases for the distribution of life in the universe are still missing, in spite of considerable technological progress in radioastronomy. We intend to demonstrate that the search for life on the Galilean satellites can provide a first step towards the still missing theoretical insight: If f_i is the parameter in the Drake Equation denoting the fraction of life-bearing planets or satellites where biological evolution produces an intelligent species, then we suggest the equation:

$$f_i = k_1 f_e f_m,$$

where k_1 is a constant of proportionality, f_e and f_m denote the fractions of planets or satellites where eukaryogenesis, or multicellularity, respectively, may occur. Our conjecture motivates the search *in our solar system*, particularly in Europa, for a hint that the key factor f_e is a non-vanishing parameter in at least one extraterrestrial environment.