

## Paradoxo de Fermi: Há mesmo uma contradição?



**Astrobiologia:**  
à procura da vida  
fora da Terra

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# Fermi's Paradox and Restraint Orders

## Why does no one respond?

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**Abstract:** The persistent silence of cosmic immensity despite our efforts to communicate with possible extraterrestrial intelligences has reaffirmed an intriguing paradox in face of the logically estimated chances of intelligent life outside Earth. However, this paradox may not be exactly a contradiction, but an appearance arising from the reality of our universe. Bearing in mind that skepticism is a fundamental element of the scientific purpose, this paper describes the system of reasons why extraterrestrial contacts are very unlikely, even though intelligent life may be a relatively common fact everywhere.

**Key words:** Intelligent life, Fermi's Paradox, extraterrestrial contact

**Resumo:** O persistente silêncio da imensidão cósmica a despeito dos nossos esforços de comunicação com possíveis inteligências extraterrestres tem reafirmado um intrigante paradoxo diante das chances logicamente estimadas de existência de vida inteligente fora da Terra. Entretanto, esse paradoxo pode não ser exatamente uma contradição, mas uma aparência decorrente da própria realidade do nosso universo. Tendo em mente que o ceticismo é um elemento fundamental da atitude científica, o presente artigo descreve o sistema de razões que tornam pouco provável um contato extraterrestre, mesmo que a vida inteligente seja um fato relativamente comum em toda parte.

**Palavras-chave:** Vida inteligente, Paradoxo de Fermi, contato extraterrestre

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## 1. Prologue

Everything we know about evolution and life is virtually confined to Earth. Such is the proportion of this confinement which, for all practical purposes and for we are truly scientific in these matters, we must project us into the immensity of the cosmos with an inevitably anthropic view, supported by a lot of information still largely inconclusive. For this reason, I have preferred, over the years, not to properly inquire about the possibility of life outside the Earth, but to discuss why, if it exists and is intelligent, we do not perceive it. Contrary to what Stephen H. Dole did in the past, I gave priority to the construction of a logical scheme of reasoning with that one could examine the very questions posed here.

The apparent contradiction between the high estimates on the likelihood of extraterrestrial civilizations and the lack of evidence for such civilizations — the “Fermi paradox” — proves to be really illusory if the correct assumptions are made. In fact, the constant discovery of new exoplanets has brought fresh hope to the expectations of intelligent extraterrestrial life, although obstacles to such expectations continue to challenge optimistic minds. Given that for most researchers the real expectation is to know whether we are alone as civilization, I adopt the somewhat comfortable position of starting from the premise that primitive extra-terrestrial life exists. Since Fermi's paradox was masterfully analyzed by Milan Ćirković in his book "The Great Silence", I will focus on describing the constraints related to the search of evidence of alien intelligences. So, the major inquiry that makes sense in present

context is: what is the possibility of an event in which two stellar civilizations meet or perceive one another? The answer shall come from what I call “restraint orders”.

The so-called “restraint orders” are five classes of severe logical constraints to that event. They are sets of objections that are manifested by the dialectical analysis of facts and by the state of contemporary knowledge in cosmology, exobiology, planetology, and other related areas. They are ways of debating and systematically organizing what should be taken into account before emotional comments and fanciful figurations. It is time to take seriously the hypothesis of humanity be alone or isolated in the immensity.



## 2. Five Reasons to Doubt: The Restraint Orders

Silence seems more like an idea. A feeling. A concept. The silence around you may contain many things, but for me the most interesting silence is the one I bring within me. A silence that in a way I can create by myself.

*Erling e*

In fact, this work is a complement to the work of Ćircović, with the addition of a psychological approach and a brief logical formalism that, combined in a lemmatic organization, provide a solid rationale for the discussion of the issue at hand. Such a lemmatic basis is constituted by the restraint orders to which I have referred and which I shall now discuss.

### *1st RESTRAINT ORDER – on the nature of intelligence*

Being intelligence, as it seems to us, the result of a long evolutionary process, it is not satisfactory to generalize both the principle of evolution and the intelligence as an obligatory outcome of the application of the principle. It does not follow that the evolution of the universe, according to the theories in vogue, infallibly leads to life and intelligence in other planets.

Everything suggests that certain aspects are unavoidable to life of any kind. It implies some form of obtaining and converting energy. In later stages, it requires a central command of functions. For nature to be effective in designing an intelligent centralized controller, it is necessary to create specializations configured in certain cells, as more and more complex links are established among many cellular individuals. Link formation most likely occurs through spontaneous induction from the neighborhood. Each cell induces bonding with its companions while it suffers the same induction from those. The link itself is a biophysical phenomenon. What exceeds physics is the biological specialization that is being

established in each linked cell due to the unpredictable increase in the number of links — even among the same cells —, and the growing complexity (not complication!) of their interdependence.

If we assume that biological evolution takes place in certain circumstances, and that in some cases it reaches the stage of intelligent life, there is no reason to suppose only one intelligent central controller project that has been perfected, wherever it may be, from the deferred use of hands with opposable thumbs, and followed the same human mechanism of absorption of fatty nutrients indispensable for the growth of the controller in the first moments of life. There may be forms of intelligence so different that they could not even identify us as intelligent forms, and vice-versa. So it would be risky to assume that different projects would show similar inclinations in their distinct ways of judging reality and dealing with it. For us, the best contact possibilities are restricted to intelligences suchlike the humanoid controller, which considerably limits our chances of success.

### *2nd RESTRAINT ORDER – knowledge and nature in their limits*

It is often said in popular language that "man is able to put into practice all that he can imagine"; an expression of naive vanity. The correct would be "man is able to put into practice everything that nature allows him". The existence of a grand unification theory would be a good start for us to test how far nature tolerates our imagination.

To travel among the stars shall take much more than imagination. We shall need new tools for theoretical elaboration; we shall need colossal efforts in experimental areas. After all, we shall need to conclude whether such travel is even feasible, not only from the technological and physical point of view but in the sense of being productive, to provide conclusive answers and useful results within a period of two or three generations; otherwise, it would be difficult to garner popular sympathy. Of course, with the current sources of energy and with the arsenal of theories available today, such travel is impossible. I do not believe that, without good evidence of practical usefulness of such incalculable investments, some enlightened society shall support them.

But one question remains. Under what pretexts do we go further? Under the pretext of the search for survival solutions that we cannot manage here (although they are obvious!)? Or are we going to make sure there's nothing waiting for us out there? Or do we go on space-caravels to lay flags in the sidereal "indies" to finally say, "Yes, we are still conquerors!""? Judging from the history of mankind, one should not expect too much altruism in such hypothetical undertakings. I think that, assuming imperatives of perpetuation, for any of the above questions an advanced civilization would respond with denials, even if it holds some more efficient transportation technology, simply because it would not be worth the effort; considering aspects of survival, just as stellar empires are unsustainable from the point of view of energy consumption, to seeking energy solutions outside the star system itself would be illogical, since the "primary" of the system is the largest

source of energy available to a civilization (see Dyson spheres).

### *3rd RESTRAINT ORDER – logic, extermination and survival*

When human intelligence is faced with a large-scale challenge to which the social price is known to be high, the first sensible thing to do is to measure the degree of importance of the eventual success in terms of world survival, even if in a long-term perspective. Extrapolating for the worst estimates about the decline of Earth's potentialities over the next 3 centuries, we would remain far from total depletion of reserves in general. In addition to everything the oceans still have to offer to us in the future, the space between Earth and Moon would be a repository of life in open provocation to our best space engineers. All this sounds much more concrete and logical. If we have to invest heavily in survival, let it be with pragmatism and logic! Other intelligences like ours would make the same reflections, and, after the initial romanticism, it would prevail the logic of exploring their own neighborhoods. Besides, throughout the centuries, human intelligence has been strongly inclined to predatory acts, with special predilection for the barbarization of the most defenseless human groups. We do not have parameters of comparison, but, if by hypothesis, the predatory impetus is a characteristic of humanoid intelligences (or even of any intelligence) in their preliminary states leastwise, few civilizations would escape from self-extermination and would go so far as to develop superior contact and interstellar navigation technologies. From this perspective,

many civilizations would have vanished by their own self-destructive tendencies.

#### *4rt RESTRAINT ORDER – G-decay and red giants*

Let's start with the restrictive fact that the narrow zone of habitability around the primary (combined to earth-like size of the planet and presence of a weighty moon) leaves few options for the flowering of intelligence as we know (the best example we have is the neighboring Mars that never had the ideal conditions of a stable world capable of sustaining slow evolutionary processes and resisting occasional catastrophes, although speculation about a certain geophysical phase that made it quite similar to Earth is reasonable). While this is clear, events that lead to extinction, although occurring at long intervals of time, are not as rare as one might suppose, being a drastic factor in stopping a civilizing process. Leaving aside the best known, it is possible, although not yet confirmed, that star systems are affected by a cumulative gravitational effect which I have called G-decay (G of gravitational). In fact, “decay” has been used here referring to the explosive decomposition of a planet into fragments<sup>1</sup>. The idea assumes the gravitational

field model in permanent regeneration due to LeSage. Since bodies are massive condensations of the gravitational continuum, in this model they would be absorbing gravitational energy constantly. Under normal conditions, the thermodynamic equilibrium would be preserved as long as the body maintained a cooling gradient proportional to the heat obtained from the flow of gravitons. Instabilities in planet's kernel, however, can disrupt the gradient by making the planet warm up more and more with the clash of gravitons. Of course, this situation leads to an anomalous state of excessive energy with obvious repercussions throughout the planetary structure until the creation of lethal fractures. There is evidence to suggest that the planetary explosion phenomenon is not uncommon. If so, this is a physical restraint capable of interrupting the course of a civilization. If there is sufficient technology and time between the detection of the process and its completion, the whole species may migrate to the farthest moons of the system and to far enough space stations.

There is also the expansion of the G-type main sequence stars. In a still remote future, the orbits of the inner planets will be swallowed by the red giant in which the primary eventually shall become. It is too long for any species but imagine that the descendants of a certain advanced intelligence still exist after the expansion of the old yellow primary. They would probably have occupied the farthest planets and satellites of the system, long before to think about to forsake its sun, or even used artifacts for housing purposes.

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<sup>1</sup> Under the prism of celestial mechanics and G-decay, Mars may have shared a satellite condition with another much larger orb on the verge of annihilation. The moon status of a large planet would have been ironically fatal. On one hand, it made Mars potentially less “flashy” to large wandering bodies; on the other, it made the red planet prey of the devastating breath of the main world in his final convulsion. The low atmospheric pressure caused by the loss of gases blown to the vacuum and the gradual cooling progressively hindered the preservation of liquid water on the surface. What's more, it is thought that most of the remaining Martian atmosphere eventually froze in the ice caps. However, the reasons for the cooling of that world are unknown to us; probably a superposition of events, among

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which the long permanence of the dust raised by the explosion of the primary body blocking the warm light of its spectral sun.

### *5th RESTRAINT ORDER – communication and despair*

Communication between interstellar civilizations raises the problem of the intelligibility of possible semantic structures beyond the ever-present barrier of astronomical distances. As it could not otherwise be, there is the questioning of the existence of logical motivators for the necessary undertaking of means of transmission. Again, for practical purposes, the prospects for success here are little more encouraging than the transfer of individuals between two inhabited star systems. At least the radio signals are faster than any conceivable craft with the available technology, and less expensive. Signaling is much less complex than sending a ship with crew, survival infrastructure, computers, fuel, etc. However, although universal laws lead to similar phenomena everywhere, it would be premature to conclude that other articulated languages would give symbolic schemes reducible to human understanding. Species with very different levels of abstraction could not even be identified.

It seems that the transmission of messages is not very pragmatic because of the immeasurable distances to be overcome. Science fiction authors try to outwit nature by postulating the existence of a subspace through which the diffusion of signals and the transfer of spacecrafts would be optimized by the superdimensional properties of this hypothetical medium. Well, all I can say is "what a big physics you've got!". We have no faint hope of constructing a consistent and clear theory that implies the creation of some technology of "portals" for navigation and diffusion of signals

between any two points of spacetime. Theories of this kind presuppose topological manipulations of spacetime, which, if plausible, would require huge amounts of energy, totally out of our reach.

I would say that we have the potential to develop, over time and in extreme conditions of survival, a kind of collective "despair behavior" because of the isolation of humanity. However, in this case the only way to mitigate loneliness would be found new colonies, but I do not think we live so long for it.

### **3. Restraint Orders and Sentient Agglomerates**

I believe that, in the discussions of intelligent life outside this beautiful planet called Earth, the boundary between reason and passion can become so imprecise — and this has often occurred — that the skeptic will sometimes appear to be enthusiastic and optimistic to be unbeliever. The probable absence of evidence — I say probable because it is difficult to conceal from society, for so long, the answers on a subject of such importance — is almost necessarily interpreted as a negative sign. However, to say that "no hint of intelligent life has been detected so far" means exactly that "as far as we could observe, no sign of extraterrestrial intelligence was registered". This quest can remain indefinitely unsuccessful, and never succeed, though universe can be filled with civilizations.

By the logic of restraint orders, there is a certain cybernetic vision that I have adopted as a guide for approaches in this subject, perhaps too

cold for romantics, but of great consistency if we look at natural processes with as little subjectivity as possible. Let us begin by understanding that throughout the universe there are stellar systems that more or less retard the progress of entropy. A relatively well-behaved star such as the Sun, for example, is expected to overcome hydrogen deficiencies and consequent cooling in the future, increasing in size, becoming a red giant. It shall repeat this setting until the remaining mass no longer permits. Similar “anti-entropic” devices establish propensities or tendencies of the system to self-preservation, or rather to the preservation of a state of relative equilibrium.

When an evolutionary chaining occurs, as new complexities are added to the systems, more sophisticated mechanisms of deceleration of entropy are configured, such as genetic predispositions and adaptations for various aims, instincts, will, and, finally, determination, the latter representing the rational state in which the will is kept under control. Interaction devices based on reception and decoding / transmission of signals aimed at entropic deceleration targets are the foundation of cybernetic systems. Generally speaking, the individual, not isolated, endowed of will (a citizen well illustrates it) I called “sentient unity”; the interactive complex of individual sentient unities I called “sentient agglomerate”. In particular, if we are dealing with civilizations, we shall always imply the presence of determination in the actions of the sentient agglomerates in question, a reasonable subsumption for the degree of cultural and technological evolution of species supposedly capable of extra-planetary activities.

By adopting a macroscopic angle of view, I was able to abstract practically all the properties of these agglomerates, except the most fascinating: the ability to acquire control over the energy sources through technological devices. The sentient agglomerate tries to perpetuate its integrity by using artificial agents to establish techniques of acquisition and transformation of energy. It acts precisely because the domain of energy is, as a result of thermodynamics, the logical way to decelerate entropy.

The self-preservative efficiency of the agglomerate depends on the degree of interdependence of the sentient unities: less engaged in individualistic behavior, more associative and productive in the research of the means that would lead to the best results of management and prospecting of resources, these are the features of the collective success.

It is difficult to imagine survival problems for the resolution of which there was only the option of seeking help in other orbs, particularly those who were bulwarks of advanced civilizations. I believe that there is a kind of “virial principle” that balances the potential of planetary agglomeration, proportional to the capacity for logical reflection and preservative interaction of sentient unities, against the dispersal energy of the agglomerate associated with passionate choices of survival and eventual motivators of superfluous demands. Such a principle would be difficult to quantify, so it is better to treat it qualitatively. I will try to formalize these ideas, leaving the reader aware that this is a preliminary approach.



### FORMALIZING DEFINITIONS

i)- We call *f-orb* —  $f(\sigma)$  — every telluric fact that threatens the survival of the sentient agglomerate in the planetary environment. Thus, the anthropic countermeasure  $c$  intended to revert an *f-orb* is, symbolically,

$$\sim f(\sigma): C \rightarrow f(\sigma).$$

ii)- We call *f-orbifold* —  $F(\mathcal{O})$  — (not to confuse with *orbifold*) the set defined by all possible pairs

$$F(\mathcal{O}): \{C_v, f_v(\sigma)\}.$$

iii)- An external event *e-orb* —  $e(\sigma)$  — is any natural fact outside the orb that results in threat to the sentient agglomerate. The anthropic countermeasure  $c'$  intended to revert an *e-orb* is, symbolically,

$$\sim e(\sigma): C' \rightarrow e(\sigma).$$

iv)- We call *e-orbifold* —  $E(\mathcal{O})$  — the set defined by all possible pairs

$$E(\mathcal{O}): \{C'_j, e_j(\sigma)\}.$$

v)- An *x-orb* extrapolation —  $X(\sigma)$  — is a hypothetical action of evasion,

$$X(\sigma): \nu \rightarrow (f(\sigma) \vee e(\sigma)),$$

of the sentient agglomerate from its orb of origin and its primary as the extreme response of survival to a given  $f(\sigma)$  or to an  $e(\sigma)$  event. Total *orbifold* is given by the set

$$T(\mathcal{O}): \{(C_v, f_v(\sigma)) \cup (C'_j, e_j(\sigma))\}.$$

One can think of formalizing the calculation of the probability of an evasive action  $P(X(\sigma))$  based on the five restraint orders, assuming that

$$P(X(\sigma)) = P(t_1(\sigma)) \cdot P(t_2(\sigma)).$$

$$\cdot P(t_3(\sigma)) \cdot P(t_4(\sigma)) \cdot P(t_5(\sigma)),$$

where the  $P(t_k(\sigma))$  are respectively:

a)  $P(t_1(\sigma)) \rightarrow$  probability that evolution in a given orb shall culminate in intelligence based on the humanoid central controller or similar that tends to understand universe likewise;

b)  $P(t_2(\sigma)) \rightarrow$  probability that a sentient agglomerate shall develop efficient interstellar

navigation technology and correlated support technologies;

c)  $\mathcal{P}(t_3(\sigma))$  → probability that a sentient agglomerate shall live long enough to attain high technology, despite its own complexity and the immense internal challenges of survival;

d)  $\mathcal{P}(t_4(\sigma))$  → probability that a sentient agglomerate shall survive to an event leading to extinction (G-decay and primary expansion included);

e)  $\mathcal{P}(t_5(\sigma))$  → probability for the sentient agglomerate to be driven to the despair of adopting interstellar evasion as the best alternative for survival, from a morbid psychosocial state due to the sensation of absolute isolation.

Except item c) , other probabilities in question can hardly be expressed with any formal precision, since the gaps in current knowledge are almost insurmountable. Nevertheless, the simple consideration of entropy as an increasing quantity in the universe allows us to analyze and stipulate at first approximation that

$$\mathcal{P}(t_3(\sigma)) \approx e^{-t/\tau},$$

where “ $\tau$ ” is the average time in years that a humanoid civilization takes to establish technological conditions for radio emissions

and short trips within the confines of its solar system, and “ $t$ ” is the time in years that a signal takes to get to us from a particular solar system. In present context, estimates of the time involved in the evolution of a sentient agglomerate are always subject to uncertainties, since we cannot disregard catastrophic paths that followed here, such as the extinction of dinosaurs. Considering the estimated age of the universe, the time consumed in the evolution of the sentient earth agglomerate until now having the age of the Sun as reference, the possible setbacks in the route of the advanced civilizing process and the very concept of biological aging of the species by the accumulation of deleterious mutations, it is convenient that  $\tau$  refers only to the beginning of a technological culture compatible with the Superior Neolithic period. Thus, we arrive at the representative result that in principle

$$\mathcal{P}(x(\sigma))_{t \rightarrow \gg \tau} \rightarrow 0,$$

which makes very close to zero the product of probabilities regardless of their values.

Lastly, as the probability decays over time, the result of this fact can only mean that the number of elements of the set — the number of interstellar evasive possible cases in response to survival dilemmas — also decays. This is a direct consequence from which the whole external environment undergoes degradation in the same proportions (other potential worlds, for example, are equally decadent while the agglomerate in focus may already be seriously debilitating for the undertakings of a solar exodus). It is also a clear result of the high propensity to fail evasive actions against the restraint orders, especially the second and third.

### *Discussing Restraints*

According to the first order of restraint, it would be necessary to decide whether any form of intelligence, given its scarcity or plenty in the universe, necessarily leads to the same expectations, to the same technological outcomes and prospects for advancement. There is even some authors who defend the idea that it is not decided if intelligence adds significant value to survival. In fact, I see no reason to think ourselves too intelligent in view of human history. It is true, as Hawking said, that "bacteria defend themselves very well without intelligence and will survive us if the supposed intelligence of which we are endowed provoke the extermination of humanity in a nuclear war". But it is no less true that very specialized animals cannot adapt quickly to dramatic environmental changes, whereas man is not only adaptable by culture but hardly succumbs to the natural elements. I think intelligence is a rare alternative to evolution; when adopted, however, it leads to conditions of intervention in the environment that no animal would ever reproduce.

The value of intelligence to survival is circumstantial, since intelligence offers equal potential for destruction. As I see it, the only form of intelligence we know is, from the cybernetic point of view of the interactions with the environment, a complex logical device of feedback and decision endowed with: a) generator of adaptations, b) implementor of extra demands, c) environmental risk and response evaluator, and d) generator of behavioral rules (morality, e.g.). To the feedback and decision logical device model composed of the four items above I call

"H-Model" ("H" of humanoid). A priori, it is not possible to imagine that extraterrestrial intelligences follow exactly the same model, since we only know the human sentient agglomerate. It is doubtful that the implementor of extra demands is a mandatory presence in all models of intelligence.



According to the second order of restraint, the domain of the physics for interstellar travel is a result of both considerable theoretical advances, probably of radical changes in the way modeling and formalization are implemented, as well as relevant experimental achievements and new access to potentially material means capable of promoting processes at very high energy levels. One can think, by way of illustration, of a super-technology that turns time into space in the immediate vicinity of a point (I'm working just now on this subject). With a fourth spatial dimension, in complete absence of time, the limits of conventional space would be broken at the point in question without the paradoxes of relativity, similar to what one does when two points of a piece of paper are joined together to pass from one to the other not by the surface of the paper, but by the rupture at the junction of the points. The four-dimensional continuum would be preserved, differing no more than "instantaneously" by the fleeting emergence of a space tetrad. The fact that we have to drill the paper already points to the amount of extra energy required for the four-dimensional break, not to mention how to overcome the

randomness of the supposed connections between points in the real situation. In addition, the effect would have to be in cascade, thus joining a sufficient number of points for the passage of the body in displacement. Such extrapolations do not present any guarantee of feasibility today either because of limitations of knowledge or because of the very suspicion that even for the most advanced physics there are insurmountable natural barriers. Sentient agglomerates in remote parts of the Milky Way or in other galaxies shall get along the same reality.



The third order of restraint concludes that for a sentient agglomerate to launch into an extensive space program there must be real motivators for survival. I doubt that advanced cultures would make an effort to launch into the cosmos to come and say “hello, we are here!”, or bring exotic recipes from the alien kitchen. Even if those imperatives of preservation are present, it is to be hoped that local resolution megaprojects will be preferred, confined to the domains of the primary. Interstellar travel would thus be remote solutions and moved rather by despair than logic.

The H-model seems vulnerable to what I call "superfluous demands", the result of a feeling that is imposed by the widely proven tendency we manifest in showing dissatisfaction. Aristotle clearly perceived the human tendency more to vice than to virtue; he

understood that few people should not have the right to have much, in detriment of the good of the majority, under pain of encouraging greed and discontentment. The assumptions about the intentional meeting between two sentient agglomerates must take into account that intelligences well punctuated in superfluous demands rely on inherent dissatisfaction. The unsustainability of balance in the unsatisfied minds can lead to extermination before any collaborative consensus, any understanding that survival will depend on the banishment at any price of the main widespread dissatisfaction stimulators.

It may be objected that there was much genuine cooperation in the history of humanity, especially in the acts of colonization. In fact, there were, however, mainly justified by resistance to acculturation and extermination. Of course, long before the European settlers came to the American continent, aboriginal alliances were made for reasons of superfluous demand — demonstration of strength, usury, superstition, and so on —, since in numbers the indigenous population was far from being threatened by lack of natural resources for survival. It may be seen that nowadays little has changed in human cooperativity. This striking feature of the H-model, the ever-present possibility of manifesting predominance of superfluous demands, makes the verb cooperate a poorly altruistic action. As soon as abundance is established, H-intelligence turns to superfluity, sometimes compulsively and uncontrollably toward devastation.



By the fourth order of restraint, the time consummation of a civilizing process along the evolutionary unfolding that could be assumed from the observation of the universe in any direction (supposing in addition that the sentient agglomerate has survived all sorts of catastrophes, scourges, internal crises, etc.) cannot be very different, in order of magnitude, from the one we recorded here. Considering that there is natural aging of the species and that the universe according to the Big Bang model is about 15 billion years old versus 4.6 billion years of solar system's age, we should not expect cultures unimaginably more advanced than ours. It is important to remember that the habitable zone of a stellar system like ours is swallowed by the primary in its first expansion of readjustment, which requires anticipated actions of survival of the sentient agglomerate. In light of what has been said in the previous paragraphs, there may be no escape.

It is important to emphasize that since Lagrange, or even earlier, the idea of planetary explosions being more common events than one imagines has been gaining ground with investigations into the origin of comets and asteroids. By this understanding, the risk of events that lead to extinction over a few tens of millions of years increases considerably, an important fact to consider in the world-line of the sentient agglomerate. Still, as a priority of formation, one must consider the structural subtlety of the stellar system whose planetary arrangement must be such that the presence of gaseous giants makes a gravitational barrier to most cosmic debris, but not to all as to avoid

events necessary to the emergence of conditions for development of life.



Finally, the fifth order of restraint places us in front of the message detection barriers. It is presumptuous to assume that an intelligence entails curiosity about other intelligences. In most conceivable cases, this would be an extra demand, and, as we have seen, the generator of extra demands may be absent in supposed intelligences. As a desperate mean of survival, a request for help would be acceptable, but with a high improbability to be attended by the delay of the message and by the rarity of receivers capable not only to decode the transmission, but to provide some kind of assistance in a timely manner. A small talk that makes sense would take so long that it is wiser to deal with objective pursuits that contain concrete possibilities for meaningful progress for the agglomerate.

I do not mean by this that SETI project proposes to a lost cause. I prefer to see it as a useful instrument of verification, at least in the broadest sense of this concept, since silence only virtually confirms, over time, the restraints discussed here. At this point in the discourse, restraint orders leave no uncertainties about the immanent meaning of the way they are structured and the logical connectivity that links them: intelligence does not exist to bend the universe to its casual will; it is the universe that curves in intelligence and creates the causal will to know itself.

#### 4. Dyson in Conjectures Platforms

On the stage of the optimists of the extraterrestrial intelligent life there is no lack of eminent theorists presenting instigating hypotheses. Perhaps the most inventive and curious possibility of identifying an advanced sentient agglomerate lies in the thermo-optical recognition of the so-called "Dyson sphere". Brilliant physicist Freeman Dyson theorized in 1959 about the possibility that an advanced sentient agglomerate could completely encircle its primary by a spherical coverage of thermal capture devices to maximize the use of the emitted stellar energy, an outstanding artifact which became known as "Dyson sphere". Dyson admits to being motivated by Olaf Stapledon in his book "The Star Maker" of 1937. Stapledon himself attributes the original idea to J. D. Bernal ("The World, The Flesh, and The Devil"), who would equally have encouraged Dyson. It seems that another American science-fiction writer, Raymond Z. Gallun, has come up with similar independent ideas. These comments show how our imagination is excited by the theme of intelligent extraterrestrial life, in my view, as I have already noted, a matter of paramount importance.

The Dyson sphere, said of first genus, is constituted of a set of world-cells arranged in spheroidal way with independent rotation around the primary, wrapping it like an immense Keplerian orbital shell. Each world-cell houses a technological stellar energy capture and storage kit capable of meeting the needs of sentient unities felt in it. As this sphere is not "solid" it can be constructed cell by cell over countless generations until it is

completed in an orbital globular network. The gain of vital space thus established would satisfy the sentient agglomerate that achieved such a fantastic success of survival, and the corresponding energy gain would be, to say little, unimaginable.

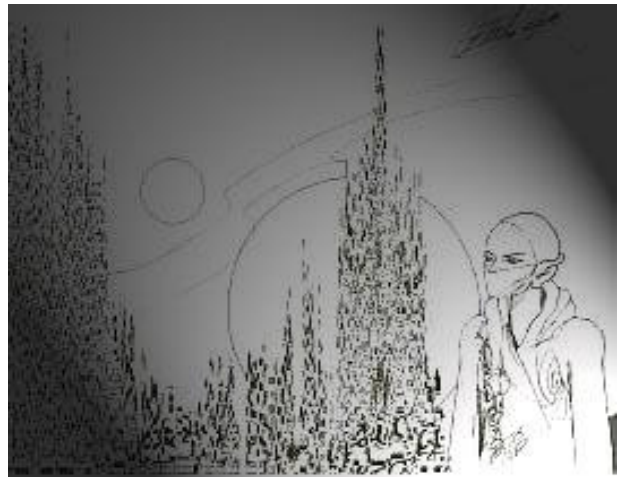
To have built a Dyson sphere would be a fabulous achievement. However, the sentient agglomerate would need material resources well beyond the possibilities of its already exhausted home-world. The stellar system in question would have to count several non-gaseous planets from which minerals could be extracted, if there were suitable materials on these moons in the required quantities. Before that, the problems of the exoplanetary mining should be overcome, that is, the sentient agglomerate would need to have full mastery of interplanetary propulsion, of support to life in extreme conditions, etc.; in short, typical elements of the second restraint order.

Most astronomers are not enthusiastic about Dysonian technologies, considering them to be extremely expensive. I do not think this is a good argument against it. After all, what is "expensive"? Can one imagine this concept sustained by a universal cultural semantic basis? I think not. More certain would be to recognize that it is very difficult to conceive sentient agglomerates with such stability in time to arrive at so monumental technology, not to mention the general constraints involved. In any case, the first genus Dyson sphere requires neither super-materials nor technologies beyond the physical understanding of the universe. In principle, even though there are few chances to find it, it

is undoubtedly a model of a more logical route of survival than interstellar colonizing motions.

## 5. Epilogue

Long time ago, I was a little boy looking at the sky asking the same question that many people do. My father gave me a telescope, so I could extend my daydreams to the Moon and to Mars. Between one look and another, my mind was delighted with the stories of Bradbury and Clark (I remember writing some Martian tales, including illustrations as in Figure 1). Nothing in extraterrestrial fiction occupied the human mind more than speculations about planet Mars. The proximity of this reddish neighbor, opposed to the kalb-al-akrab (the star Antares, “the heart of the scorpion”), gave to Schiaparelli and then to Lowell perfect conditions for the first serious projections of mankind on another globe. There, human eyes gave way to the cerebral orders of search for symmetry while another part of the brain, filled with excitement by the unknown, rationally demanded the search for the differences of artificial creation. The vision of the *canalli* made the astronomer color the rough surface with Lenten tones interspersed with a super-Roman technology of aqueducts pouring the precious polar water into the dry cultivated areas of low latitudes where an ancient civilization defied in agony to extinction. Even the brilliant mind of the great Tesla did not resist the urge to test the efficacy of newly acquired radio technology in attempts to contact the Martians. Humanity naively took its first steps in the search for extraterrestrial civilizations.



**Figure 1** - My old version of Martian humanoids with dust mask.

Of course, none of this would be confirmed. However, man does not bury his dearest legends so easily. They inhabit the secrets that motivate the search for enlightenment. They are dreams from where creation is extracted and goes beyond to even make happen what was just little probability. Thus, after about fifty years of the appearance of the historical book "Mars and the Mind of Man", I decided to express my own scientific conclusions about extraterrestrial intelligent life, while still being a dreamer like that little boy of the 60's.

Are we alone in the Universe? Difficult to know. Although we have not received any evidence of extraterrestrial intelligences, it seems unacceptable to be alone in such a huge universe. However, judging by the results of the efforts undertaken so far, and by the absence of scientifically proven records of alien presence in the vicinities, we are forced to consider loneliness as a plausible reality, not because we are special or unique in the

universe, but because nature may have reserved loneliness for all civilizations as a way of preserving them from conflicts that would inevitably lead them to lose the chance to evolve on their own. Perhaps intelligence is an accidental device created not necessarily for survival but for potential self-destruction; altruism, compassion, tolerance, and love can only be entropy decelerators that end up losing the war against the final disorder; that's why I believe that some emphasis on the discussion of the psychological aspects of intelligence and its importance for survival can greatly contribute to the understanding of Fermi's paradox. Anyway, behind all these conjectures, one fact is certain: silence remains.

After all, silence is not so bad. Perhaps the outer silence is only an extension of our own inner silence. If so, we must learn to deal with it, to like it. Who knows, intelligence may be just the way nature chose to gain awareness of its own silence.

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### A brief postwriting

Scientists have the first duty to unconditionally assume that a) the search for truth is the *raison d'être* of their works, b) science has been the best-pursued way in this quest and c) to be scientist is not to be airtight and insensitive, only rationally skeptical. With these very important considerations in mind, the man of science can also be aware of the social conjunctures (cultural, political and economic) that may come between truth and deceit, thus being able to intervene in the restoration of order. Almost 20 years ago, I read from an author named Joe Orman in the East Valley Astronomy Club newsletter, August 2000, a review of Richard Hoagland's "Monuments of Mars: A City on the Edge of Forever"; for consideration:

"I must admit I was dismayed to find this book in an astronomy club library, and I am somewhat ashamed to be reviewing it. After all, astronomers should promote science, not superstition! My first impulse was to request that book be removed from the library. But I believe the only way for the truth to be revealed is for all evidence to be presented and reasonably weighed; an idea will persist or perish based on its own merits. [...] And anyone interested in promoting the true science of astronomy must also be able to distinguish it from the pseudoscience that is so prevalent in our society. [...]"

Above all, the book in question is, as I could see from the 2001 edition, a collection of numerological trivialities and reveries, typical of the growing appeal to pseudoscience. But why does pseudoscience prevail in our society? Precisely because we live in a "disposable society". If something is disposable, then you don't have to be careful! If information is disposable, there is no reason to worry about its truth and depth. Books such as "Monuments of Mars" fill the void left by postmodern culture, the void of superficial responses, of the pedantic language that features pseudoscientific texts publicized as scientific.

