

## Cosmotheoros: Spiritual Corollaries to the Rare Earth Solution to Fermi's Paradox

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*Let me enjoy the earth no less  
Because the all-enacting might  
That fashioned forth its loveliness  
Had other aims than my delight*  
Thomas Hardy

### **Introduction**

The most significant corollary to the discovery that the Earth is not at the centre of the Universe is that humanity is not at the centre of creation. Thus understood, Copernicanism is a welcome call to humility in the face of rampant human ecological destruction fueled by human arrogance. Copernicus's discovery can be understood as part of a larger, still incomplete, revolution that encompasses the works of Charles Darwin and James Lovelock. Darwin's theory of evolution makes humankind a result of the same process of evolution that produced all earthly living beings; and Lovelock's Gaia Theory underscores the dependency of humans to larger biotic and abiotic processes, both in the present and with regards to "deep" evolutionary and geological time (Primavesi, 2003).

To believe that there is nothing special about humankind in the broader plan of the Universe, to hold that we are a case, rather than an exception, of the general laws of the Universe, is to subscribe to the mediocrity principle. A corollary of this principle is that, given the proper conditions, intelligent civilizations should emerge on other planets. What are these conditions? Since many of them are insufficiently known, estimates on the amount of extraterrestrial intelligence "out there" vary wildly. However, in spite of the optimism of theorists such as Frank Drake, evidence of extraterrestrial civilizations has yet to surface. The contradiction between the apparent high probability of extraterrestrial life (given the vast amount of stars, the considerable age of the Galaxy and the mediocrity principle) and the lack of evidence for actual extra-terrestrial life has been dubbed the "Fermi Paradox", after Enrico Fermi's 1950 comment "where are they?" after estimating the chances of extraterrestrial visits to the earth to be extremely high. Even if no advanced extraterrestrial civilizations have visited the earth (perhaps through not being interested), traces of technological activities such as radio waves should be detectable (this is known as the Great Silence Problem).

Fermi's Paradox potentially poses a challenge to Copernicanism, as it could indicate that the Earth (and its human civilization) is, in fact, rare or unique (Ćirković, 2009). This paper ponders the consequences for Copernicanism (understood as an attitude of humility with regards to the greater plan of the Universe) of this "Rare Earth" solution to Fermi's paradox.<sup>1</sup> We will illustrate Copernicanism through an exploration of the thoroughly Copernican text *Cosmotheoros*, written by Christian Huygens in 1695. Then, we will propose a way of preserving a Copernican outlook while at the same time holding a Rare Earth solution to Fermi's paradox. This proposal entails adding Gaian gratitude to Copernican humility.

Briefly, we propose that to hold both 1) that the Universe is not designed for humankind, and that humankind is in no way special in the larger plan of creation (Copernicanism) and 2) that a planet holding complex life forms, such as the Earth, is indeed a rare cosmological occurrence (rare earth solution to Fermi's Paradox) implies viewing the Earth and its evolutionary history as a miracle and as a gift; as something freely given that should be treated with awe and gratitude.

### **1. The Copernican Revolution and Dark Enlightenment.**

The pre-Copernican view of the Universe, challenged by Galileo, Kepler, Bruno and Copernicus, was inherently comfortable to hold and in accordance with dominant Christian theology. The view of the earth as the centre of the Universe meshed well with the idea that humanity was at the centre of God's gaze and purpose, and with the idea that all of creation was meant to serve man (Primavesi, 2003). Earth, in the pre-Copernican view, was neither a planet nor a celestial body; it was a *sui generis* thing, an *earth*, of which there was only one, at the center of the Universe. The Copernican system turned the earth into one planet among others. Brecht's character in *Life of Galileo* called "the Very Old Cardinal" captures the rejection that the Copernican system produced very well; it is a rejection based on an idea of the self that feels threatened:

I am not any old creature on any insignificant star briefly circling in no particular place. I am walking with a firm step, on a fixed earth; it is motionless, it is the centre of the Universe. I am at the centre and the

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<sup>1</sup>This solution is one among many possibilities (others being, for example, that extra-terrestrials have taken steps to avoid contact; that contact, though not extraterrestrial life itself, is much harder than usually assumed; or that gamma ray bursts periodically wipe out civilizations in such a way that estimations on the time available to produce intelligent life are off the mark, making life rare in time, if not in space; see Ćirković, 2009).

eye of the Creator falls on me and on me alone (Brecht, quoted in Primavesi, 2003, p. 26)

The Cardinal expresses concern about the mobility of the Earth, and the fact that it occupies “no particular place”. In Ptolemaic astronomy, space was in fact organized around the earth. However, strictly speaking, the cardinal is not worried about the Earth’s centrality, but about his own:

Above all [the Copernican Revolution] meant to turn away from the central position in the Universe given to man by God. The Copernican Revolution also involved a turning *towards* an unfamiliar, threatening and incalculable position: one in which the earth, the centre of *our* world, is no longer the centre of the Universe. The closely knit and compact Universe was gone (...) The comfortable, secure interrelation of space and destiny was threatened. And here lies the real cause for unease. It is our own position in the Universe (...) that is seen to be at stake. (Primavesi, 2003, 18).

It is man’s hierarchical superiority over the rest of creation that is threatened by Copernicanism, in at least two specific ways: 1) if the Universe was not created *for* man, then it cannot be assumed that other parts of creation are there for the purpose of serving man (animals don’t exist for the purpose of giving man their skins, hides and milk; and stars don’t exist to facilitate navigation); and 2) if man is not at the centre of creation, neither is he centrally important to the Universe: one can conceive of a God or Universe to which men’s lives and travails are as marginal as Earth’s position in the Milky Way. In Douglas Adams’s science fiction classic *The Hitchhiker’s Guide to the Galaxy* (1995), the most important intergalactic encyclopedia in the Universe has only two words to say about the our planet: mostly harmless.

At stake is the “homocentric claim that man is at the centre of God’s regard, and therefore at the centre of the Universe” (Primavesi, 2003, 20). Christian Huygens, awed by the great size of Jupiter and Saturn as compared to that of the Earth, exclaims:

This shows us how vast those Orbs must be, and how inconsiderable this Earth, the Theatre upon which all our mighty Designs, all our Navigations, and all our Wars are transacted, is when compared to them. A very fit Consideration and matter of Reflection, for those Kings and Princes who sacrifice the Lives of so many People only to flatter their ambition in being Masters of the same pitiful corner of this small Spot. (Huygens, 1698, 141-142).

It is somewhat surprising that Spinoza, perhaps the seventeenth century's greatest combatant of anthropocentrism, who also had a vivid interest in science, and especially in optics, does not explicitly treat the subject of Copernicanism in his work. However, Spinoza's system is a paradigmatic example of what Yovel (1990) calls "dark enlightenment"; that is, the realization that the Universe is neither designed for me nor geared towards my production and that humans are simply another manifestation of God or Nature's impersonal, non-teleological laws:

For in Spinoza's ontology I am, in both body and mind, the product of an impersonal substance-God which has no human-like features and may not be anthropomorphized; in other words, the natural processes which produce me bear no resemblance to my own subjectivity; they do not work by intention and purpose, have no privileged affinity to human affairs and allow no room or special laws for history as distinguished from the rest of nature." (Yovel, 1990, 166)

As we shall see in the next section, Huygens does believe in a purposeful God, but it is a God that shows no particular preference towards humankind or their abode, the Earth. Therefore, the term "dark enlightenment" can be applied to both Huygens and Spinoza if it is used in a broad sense to mean *a view of the Universe in which humankind and the Earth occupy no special place, have no particular importance in it nor serve any special purpose.*

Dark enlightenment is an invitation to humility, an invitation to view "all our mighty Desings, all our Navigations, all our Wars" from a cosmic, de-centered perspective, shedding our ingrained anthropocentrism. It is also a call to wonder, a call to view creation as a whole far more rich and complex than what we see from our limited and marginal perspective. A rejection of anthropocentrism through humility and a sense of wonder at the marvels of creation are two very desirable attitudes in relation to the current ecological crisis. The threat that Fermi's paradox poses to Copernicanism is also a threat to these attitudes. In the next section, we will explore the Copernican mindset in detail through a reading of Huygen's *Cosmotheoros*, a compendium of speculations regarding life on other planets, published originally in 1697. It is an elaborate, well thought-out expression of a Copernican view of the Universe, that expresses awe and humility towards creation, and also it is spectacularly wrong in its speculations.

## **2. Cosmotheoros: A Copernican view of Life, the Universe and Everything**

At the outset of his work, after briefly explaining the Copernican system and pointing out that Jupiter and Saturn possess satellites, Huygens takes on the

possible objection that his speculations on extraterrestrial life go against scripture:

(...) when they hear us talk of new Lands, and Animals endued with as much Reason as themselves will be ready to fly out into religious Exclamations, that we set up Conjectures against the Word of God, and broach Opinions directly opposite to Holy Writ. For we do not there read one word of the Production of such Creatures, no not so much as of their Existence; nay rather we read the quite contrary. For, That only mentions this Earth with its Animals and Plants, and Man the Lord of them; but as for Worlds in the Sky, 'tis wholly silent (...) it's evident that God had no design to make a particular Enumeration in the Holy Scriptures, of all the Works of his Creation. When therefore it is plain that under the general name of *Stars* or *Earth* are comprehended all the Heavenly Bodies, even the little Gentlemen round *Jupiter* and *Saturn*, why must all that multitude of Beings in which the Almighty Creator has been pleased to place upon them, be excluded the Privilege, and not suffer'd to have a share in the Expression? And these Men themselves can't but know in what sense it is that all things are said to be made for the use of Man, not certainly for us to stare or peep through a Telescope at; for that's little better than nonsense. Since then the greatest part of God's Creation, that innumerable multitude of Stars, is plac'd out of the reach of any man's Eye; and many of them, it' likely, of the best Glasses, so that they don't seem to belong to us; is it such an unreasonable Opinion, that there are some reasonable Creatures who see and admire those glorious Bodies at a nearer distance? (Huygens, 1698, 6-8)

Huygens, unlike Spinoza, believes in a purposeful God. The Universe that the Copernican system describes (enormous, full of planets akin to the Earth) could not be created by a purposeful God for the sole benefit of human beings, there being so many stars and so enormous distances in outer space. If Earth is but one planet among many (smaller than many, and also with fewer moons than planets such as Jupiter or Saturn), and not located in any special place in the Universe, it does in fact seem strange that only this planet would benefit from intelligent life forms, if one supposes a purposeful God behind the creation of the Universe.

If God were to give equal importance to each planet, He ought to have populated all of them with as much life, beauty and intelligence as our own; in this paper, we shall call this idea a *parity principle*. The astronomical evidence of the time showed that Earth was a planet similar to, and in no way distinct from, the rest of the solar system:

Having thus explained [the Copernican system], there's no body I suppose but, sees, that in the first the Earth is made to be of the same sort with the rest of the Planets. For the very Position of the Circles shows it. And that the other Planets are round like it, and like it receive all the Light they have from the Sun, there's no room (since the discoveries made by Telescopes) to doubt. Another thing they are like it in is, that they are moved round their own Axis; for since 'tis certain that Jupiter and Saturn are, who can doubt the others? Again, as the Earth has its Moon moving round it, so Jupiter and Saturn have theirs. Now since in so many things they thus agree, what can be more probable that in others they agree too; and that the other Planets are as beautiful and as well stock'd with Inhabitants as the Earth? or what shadow of Reason can there be why they should not? (Huygens, 1698, 17-18)

Huygens shifts the burden of proof to those who would deny extraterrestrial life. The similarities among planets and the absence of additional evidence permit analogical thinking:

If anyone should be at the dissection of a Dog, and be there shewn the intrails, the Heart, the Stomach, Liver, Lungs and Guts (...) could such a Man reasonably doubt whether there were the same Contexture and Variety of Parts in a Bullock, Hog, or any other Beast, tho he had never chanc'd to see the like opening of them?

Huygens explains that his work has a dual moral purpose: 1) to produce humility in men with regards to their importance in relation to the whole of the Universe and 2) to produce awe and admiration at God, the creator and designer, not only of this world but of a great many worlds:

(...) besides the Nobleness and Pleasure of the Studies, may not we be so bold as to say, they are no small help to the advancement of Wisdom and Morality? so far are they from being of no use at all. For here we may mount from this dull Earth, and viewing it from on high, consider whether Nature has laid out all her cost and finery upon this small speck of Dirt. So, like Travellers into other distant Countrys, we shall be better able to judg of what's done at home, know how to make a true estimate of, and set its own value upon every thing. We shall be less apt to admire what this World calls great, shall nobly despise those Trifles the generality of Men set their Affections on, when we know that there are a multitude of such Earths inhabited and adorned as well as our own. And we shall worship and reverence that God the Maker of all these things; we shall admire and adore his Providence

and wonderful Wisdom which is displayed and manifested all over the Universe (...) (Huygens, 1698, 10-11)

In accordance to the parity principle, the other planets have as much, or perhaps more, biodiversity than the Earth. Huygens invites us to consider the difference "(...) between the ants, the Spider, the Fly and the Butterfly, and of that prodigy in that wonderful change from worms" (1698, 35); just among insects, the differences are enormous. If each of the planets is as amazingly diverse as the Earth, the total biodiversity of the Universe should be astounding. Huygens's God, like Leibniz's, is a maximizer of diversity.

Just as Huygens grants all planets biodiversity, he grants their inhabitants the faculties of sight, hearing, taste, touch and smell; as well as the capacity for pleasure, and the ability to study and admire God's creation. There is a generosity that permeates Huygens's work: for example, when discussing the existence of extraterrestrial plants, Hugen states: "(...) the Planets may be allow'd some Bodys capable of moving themselves, not at all inferior to ours, for why should they? And these are Animals. Now for fear of starving those poor creatures, we must have Plants, you know" (1698, 21).

Huygens sees the features of the Earth as gifts from God, and considers it necessary to bestow them, also, to other planets. Here are his arguments for bestowing eyes upon the extraterrestrials, both animals and intelligent beings:

Then if we consider the wonderful nature of Light, and the amazing Artifice in the fit framing the eye for the reception of it, we cannot but see that Bodies so vastly remote could not be view'd by us in their proper Figures and just Distances, any other way than by Sight. (...) And the nice Curiosity of this Perception is admirable, in that it is caused by the smallest Particle of that fine Matter, and can at the same time determine the Coast from whence the Motion comes; in that all these different Roads of Motion, these Waves crossing and interfering with one another, are yet no hindrance to every ones free passage. All these things are so wisely, so wonderfully contrived, that it's above the power of humane Wit, not to invent or frame somewhat like them, but even to imagine and comprehend them. For what can be more amazing, than that a Particle of Body should be so devised and framed, as by its means to show us the Shape, the Position, the Distance, and all the Motions, nay and all the Colours, distinguishing of a Body that is far remote from us? And then the artful Composition of the Eye, drawing an exact Picture of the Objects without it, upon the concave side of the Choroides, is even above all admiration, nor is there any thing in which God has more plainly manifested his excellent

Geometry. And these things are not only contrived and framed with so great Wisdom and Skill, as not to admit of better, but to any one that considers them attentively, they seem to be of such a nature as not to allow any other Method. For it's impossible that Light should represent Objects to us at so vast a distance, except by such an intervening Motion; and it's as impossible that any other Composition of the Eye should be equally fitted to the reception of such Impressions. So that I cannot but think them mightily out, that maintain these things might have been contrived many other ways. It's likely then, and credible, that in these things the Planets have an exact correspondence with us, and that their Animals have the same Organs, and use the same way of sight that we do. Well then they have Eyes (...) And if we must allow them all Animals for the preservation of their Life, how much more must they that make more, and more noble uses of them, not be deprived of the Blessing of so advantageous Members? For by them we view the various Flowers, and the elegant Features of Beauty: with them we read, we write, we contemplate the Heavens and Stars, and measure their Distances, Magnitudes, and Journeys (Huygens, 1698, 44-47)

The eye is so perfectly designed for its purpose that it's hard to think of an alternative way of accomplishing it. And, of course, sight itself cannot be denied to extraterrestrials. Not only is it useful for the preservation of life, it is also necessary for the study and contemplation of creation which, as we shall see, is the greatest gift that God bestows upon the manifold planets.

First, let us discuss pleasure. Is this something that only terrestrial animals should enjoy? According to Huygens:

(...) the senses were not wholly design'd for use; but Men from all, and all other Animals from some of them, reap Pleasure as well as Profit, as from the Tast in delicious Meats, from the Smell in Flowers and Perfumes; from the Sight in the contemplation of beauteous Shapes and Colours (...)

Since it is thus, I think 'tis but reasonable to allow the Inhabitants of the Planets these same advantages that we have from them. For upon this consideration only, how much happier and easier a man's life is render'd by the enjoyment of hem, we must be obliged to grant them these Blessings, except we would ingross every thing that is good to ourselves, as if we were worthier and more deserving than anything else (...) (1698, 51-52)

It would be selfish to deny a gift as great as pleasure to the rest of the planets (or, indeed, to other earthly animals, as we will discuss at the end of this section). In Huygen's arguments, the greater the gift, the more it should



be equally bestowed upon all planets. It is in this light that the question of whether there are extraterrestrials possessing reason and understanding. According to Huygens, the narrowly practical purposes served by reason are not to be held in such high esteem:

And in those things wherein Men provide and take care only of what's absolutely necessary for the preservation of their Life; in defending themselves from the Injuries of the Air; in securing themselves against the Incursions of Enemies by Walls; and against Fraud and Disturbances and Laws; in educating their Children and providing for themselves and them: In all these I can see no great reason that Man has to boast of the preeminency of his Reason above Beasts and other Animals. For most of these things they perform with greater ease and art than us, and some of them they have no need of. For that sense of Virtue and Justice in which Man excels, of Friendship, Gratitude and Honesty, of what use are they, but either to put a stop to the wickedness of Men, or to secure us from mutual Assaults and Injuries, a thing wherein Beasts want no Guide but Nature and Inclination? Then if we set before our eyes the manifold Cares, the disturbances of Mind, the restless Desires, the dread of Death, that are the results of this our Reason; and compare them with that easy, quiet, and harmless Life which other Animals enjoy, we should be apt to wish a change, and conclude that they, especially the Birds, liv'd with more pleasure and happiness than Man could with all his Wisdom (...) (1698, 58-59).

Whatever practical advantages are brought about by reason are outweighed by reason's worries and the capacity to do harm that it brings; so that the lot of Birds seems preferable. What is, then, the true purpose of reason?

What is then after all that sets human Reason above all other, and makes us preferable to the rest of the Animal World? Nothing in my mind so much as the contemplation of the Works of God, and the study of Nature and the improving those Sciences which may bring us to some knowledge in their Beauty and Variety. For without Knowledge what would be Contemplation? And what difference is there between a Man, who with careless supine negligence views the Beauty and use of the Sun, and the fine golden Furniture of the Heaven, and one who with learned Niceness searches into their Courses; who understands wherein the Fixt Stars, as they are call'd, differ from the Planets, and what is the reason of the regular Vicissitude of the Seasons; who by the sound reasoning can measure the magnitude and distance of the Sun and Planets? Or between such and one as admires perhaps the nimble Activity and strange Motions of some Animals, and one that

knows their whole Structure, understands the whole Fabrik and Architecture of their composition? (Huygens, 1698, 60-61)

Huygens makes a distinction between idle contemplation and scientific contemplation; and posits the latter as the highest purpose of human reason. The principal use of reason is not, then, as Francis Bacon would have it, to know causes in order to produce effects, but rather an informed, studious contemplation of God's creation. Reason is an aid to contemplation, not an aid to technology. Huygens goes on to speculate on extraterrestrial sciences. First among them is astronomy, of course, "For supposing the Earth, as we did, one of the Planets of equal dignity and honor with the rest, who would Venture to say, that no where else were to be found any that enjoy'd the glorious sights of Nature's Opera?" (Huygens, 1698, 62).

By now, the ecological import of Huygens' Copernican attitudes should be clear. Science and reason are subservient to the contemplation of God's work; science is an enterprise that should be accompanied by awe (rather than, for example, greed). The Earth is not the center of the Universe, and is as is as deserving of God's gifts as any other planet; man is not the centre of the Universe, and is as deserving of God's gifts as any other creature. In fact, as pointed out above, Huygens sees reason to envy birds:

For they have as great a gusto of bodily Pleasures as we, let the new Philosophers say what they will, who would have them go for nothing but Clocks and Engines of the Flesh; a thing which Beasts so plainly confute by crying and running away from a stick, and all other actions, that I wonder how anyone could subscribe to so absurd and cruel an Opinion. Nay I can scarce doubt that Birds feel no small pleasure in their easy, smooth sailing through the Air; and much more If they but knew the advantages it hath above our slow and laborious Progression (1698, 59-60)

Huygens' Copernican humility is coupled with a rejection of Descartes, who would make man the sole owner of consciousness, *res cogitans*, and thus the ability to feel pleasure or pain.

Of course, it is not true that every planet has life in it, much less intelligent life capable of contemplating "Nature's Opera". Available evidence indicates that Jupiter and Saturn, with all their satellites, are empty and barren. Does this threaten Copernican humility and awe at creation? Are we to return to pre-Copernican arrogance, and to feel and act as if we are the center and purpose of the Universe?

Current astronomical knowledge, coupled with the still-operative mediocrity principle, has led many in the scientific community to believe that extraterrestrial life (although not present in every planet) is abundant, proximate and complex enough to justify the search for extraterrestrial intelligence (SETI). So far, the search has yielded no results, disappointing expectations.

### **3. Fermi's Paradox as a challenge to Copernicanism**

In physics or engineering, a Fermi problem is an estimated calculation based on informed guesses. It is named after Enrico Fermi, who was especially good at such problems. In 1950, at Los Alamos Laboratory, while casually discussing a New Yorker cartoon with colleagues, the renowned physicist performed one such calculation regarding the probability of the Earth being visited by extra-terrestrials. Assuming the mediocrity principle, and factoring in the age of the Universe (that is, the time for intelligent life to evolve in other planets), the times and distances presumed to be required for space travel, the sheer number of possibly life-harboring planets, the fact that life tends to expand by colonizing new habitats, Fermi concluded that the Earth should have been visited many times over already (at the very least we should be able to detect some evidence of extraterrestrial intelligence, such as probes or non-random radio signals). Hence Fermi's question: where is everybody?

After 1950, new scientific discoveries have in fact *exacerbated* the FP, making contact with extraterrestrial intelligence even more theoretically likely. Among these are the discovery of large numbers of extra-solar planets; the confirmation that life originated on Earth in a brief astronomical time; the discovery of microorganisms capable of living in very extreme conditions (which widens the spectrum of likely habitats for extraterrestrial life); and an improved understanding of how life originated from abiotic elements through natural means (see (Ćirković, 2009, 3-4).

Fermi's Paradox, like matters concerning extraterrestrial life and intelligence in general, is sometimes seen as a marginal matter, of concern only to science fiction enthusiasts and wild-eyed believers who treat the possibility of contact with extraterrestrials as a kind of secular transcendence (see e.g, Clarke, 1972). The case for the importance of Fermi's Paradox can be made as follows:

- 1) The suppositions leading to the prediction of contact with extraterrestrials are central to our scientific thinking in general. For example: naturalism (a key principle in biology and evolutionary science), Copernicanism (central to astronomy), or gradualism (a well established principle in biology, geology and linguistics).

- 2) The fact that no evidence of extraterrestrial intelligence has been found implies that one or more of these basic assumptions are wrong. In particular, the assumption that the evolution of complex life forms is a natural occurrence (the alternative being some form of creationism, postulating a purposeful creator) is threatened.
- 3) Therefore, Fermi's Paradox "challenges some of the deepest philosophical and cultural foundations of the modern civilization" (Ćirković, 2009, 2). Thus, "resolving FP is not a luxury but one of the imperatives if we wish our scientific worldview to have even remote prospect of completeness" (Ćirković, 2009, 16).

If we take into account the age of the Galaxy and the amount of planets in it, and if we assume that 1) life originates naturally wherever favorable circumstances occur (naturalism); 2) the Earth is not a particular or special place in the Universe and we should expect similar places elsewhere (Copernicanism) and 3) that biological, cultural and technological change occurs in a gradual and continuous manner over time (gradualism; as opposed to catastrophism, which contemplates fits and starts in these processes, brought about by catastrophic events); then we should expect a large amount of extraterrestrial intelligence in our vicinity, and should be nearly certain of some form of contact. The absence of contact implies abandoning one of these assumptions (among other more fanciful possibilities which are not contemplated here, see Ćirković, 2009).

Fermi's Paradox vanishes if we postulate a special theological origin of life (abandoning naturalism); or if we reject the notion that Earth-like planets are relatively common (threatening Copernicanism). Finally, the calculations regarding the age of the Galaxy need to be re-evaluated if we postulate periodical cosmic catastrophes (such as gamma-ray bursts from the coalescence of binary neutron stars or hyper nova explosions, which would cause mass extinctions in exposed planets) which would re-set the evolutionary clock on nearby planets (jettisoning gradualism), making life rare in time, not in space (see Ćirković, 2004)

There is a lot of merit to the gamma-ray burst solution to Fermi's Paradox (see, e.g Ćirković, 2004). In general, all proposed solutions are hypothetical and speculative. We are interested here in the corollaries that result from adopting the Rare Earth hypothesis and the tension it creates in relation to Copernicanism, not in defending it against competing hypotheses. We will explore this solution to the FP further in the following section.

#### **4. The Rare Earth Solution and Gaia**

In his Copernican rejection of anthropocentrism, Christian Huygens referred to the Earth as a "small speck of Dirt", based upon the astronomical fact that

the Earth is a planet, a celestial body orbiting a star, just like Jupiter or Saturn. However, as it turns out, Earth may be seen as a different sort of thing altogether: whereas the atmospheres of Jupiter, Saturn or Mars are in chemical equilibrium, the “terrestrial atmosphere contains gases like oxygen and methane, which are very likely to react with each other but coexist in high proportions, resulting in a mixture of gases far from chemical equilibrium” (Capra, 1996, 101). The composition of the Earth’s atmosphere is due to the action of living beings upon it, such as animal respiration and the production of oxygen by plants. At the same time, this composition of the atmosphere is what makes life possible on Earth! Life on Earth not only makes the atmosphere but keeps it at a constant composition favorable for life. This indicates that the Earth as a whole is a self-regulating, self-producing system that has life as both an output and an input. It is not a planet that happens to have life in it, but a living planet. This important insight of James Lovelock (1979) is called the *Gaia Theory*, which has given rise to the science of geophysiology (see Volk, 1998).

It is commonly thought that life on Earth is possible because of one happy coincidence; that the Earth is at just the right distance from the sun, Mars being too cold, Venus too hot. This does not take into account the fact that the Sun has become twenty-five percent hotter since the beginning of life on Earth, and yet the temperature of the Earth has remained constant. The Earth’s organisms regulate temperature by, for example, collectively producing a level of CO<sub>2</sub> that, through the greenhouse effect, keeps the Earth suitably warm for life (human produced climate change should not be seen as humans producing toxic stuff, but rather as humans messing with Earth’s self-regulating mechanism, not only by emitting excessive CO<sub>2</sub> but also, for example, by cutting down CO<sub>2</sub> sequestering forests). Another example of climate regulation is the emission of dimethyl sulfide (DMS) by both algae and coral reefs; DMS helps produce clouds in the sky, which, in turn, reflect the rays of the sun, regulating the Earth’s temperature.

Gaia theory does not state that the Earth is teleologically designed for life, but rather that, in geological and evolutionary time, certain negative feedback loops have evolved over time in such a way that a total Earth system (comprising both biological and non biological processes). What evolves is not the Darwinian individual or species, but the total system. Picture, for example, a perfect predator, from which no prey could hope to escape. Soon, such a predator would be extinct, having exhausted all sources of prey. The mechanisms of evolution do not produce well adapted species or individuals, but rather well adapted, self regulating, *systems* produced by co-evolution.

In this sense, the Earth is more than a mere planet or “speck of Dirt”; Earth is astronomically a planet, just like Jupiter or Saturn; but, geophysiology, it

is, as far as we have been able to tell, a *sui generis* sort of thing. The Earth is a rather dull astronomical object; a smallish planet, bereft of rings, and in possession of a single satellite, which can only produce two kinds of eclipse (as compared, for example, to Jupiter's large variety of occultations and transits produced by its satellites big and small). Seen from a geophysiological perspective, Earth is a rare and wonderful sort of thing.

A way to look at the Rare Earth Hypothesis is to think about the different factors that need to be present so that a self-regulating living planet may occur. An intelligent species capable of communicating with humans, or of producing detectable traces, can only evolve in a Gaia-like planet that can sustain life for a sufficiently long evolutionary time (Watson, 2004). There appears to be evidence of microscopic life in Mars, and perhaps microscopic life on other planets is not very rare; the rarity lies in extraterrestrial life being diverse and complex enough to regulate its planet's atmosphere.

What needs to happen in order for a Gaia-like planet to occur? Ward and Brownlee (2000) have outlined a number of critical steps in order to achieve complex metazoan life, each of which can be ascribed a certain probability. The rarity of a Gaia-like planet is the probability of *all* of these critical steps to occur. Among them:

- Circumstellar habitable zone: a habitable planet needs to be in the very narrow interval of distances from the parent star.
- "Rare moon": having a large moon to stabilize the planetary axis is crucial for the long term climate stability.
- "Rare Jupiter": having a giant planet ("Jupiter") at the right distance to deflect much of the incoming cometary and asteroidal material enables sufficiently low level of impact catastrophes.
- "Rare elements": Radioactive *r*-elements (especially U and Th) need to be present in the planetary interior in sufficient amount to enable plate tectonics and functioning of the carbon-silicate cycle.
- "Rare Cambrian-explosion analogs": the evolution of complex metazoans requires exceptional physical, chemical and geological conditions for episodes of sudden diversification and expansion of life. (Ćirković, 2009, 9)

Another example is the evolution of photosynthesis, which is key to biotic atmospheric regulation (Watson, 2004) and which, being produced through evolution, required a chance mutation. The probability of several events (each with a given probability) all occurring can be derived by expressing the probability of each as a fraction with a numerator of one, and then multiplying all the denominators. The likelihood of a rare moon, for example, is, say 1/100; and that of the presence of rare elements, 1/1000. The probability of

both in a single planet would therefore be 1/100000. The probability of favorable conditions for the emergence of a Gaia-like planet vanishes as we add rare factors that need to occur.

Some of these “rare” factors can be disputed; for example the contention that Jupiter acts as a “meteor shield” for the Earth has been questioned (see Ćirković, 2009, 10; if this is so, however, the implications for Huygen’s Copernicanism would be rather interesting: Jupiter would cease to be a planet of equal or greater dignity than the Earth- because of its greater size and many satellites- and become a mere shield-bearer for our planet). At the same time, the sheer amount of Gaian conditions, each of which is produced by chance, gives credence to the Rare Earth Hypothesis. The Earth was lucky in having some initial conditions favorable for the *emergence* of life, but, without the emergence of a Gaian self regulating system, the climate and chemistry of the planet would not “have persisted in a state favourable for life indefinitely” (Primavesi, 2009, 124). The emergence of such a system required additional luck.

Ćirković (2009), following Fry (1995) criticizes the Rare Earth Hypothesis on the grounds that postulating Gaia-like planets to be extremely unlikely, the hypothesis can be, in some respects, “equivalent to the doctrines openly violating naturalism, e.g., creationism.” (p. 10) The argument goes as follows: If one postulates complex life in a self-regulating biosphere to be a natural event with an astronomically small chance of occurring (say,  $10^{-100}$ ),

(...) then a curious situation arises in which an opponent can argue that supernatural origin of life is clearly a more plausible hypothesis! Namely, even a fervent atheist could not rationally claim that her probability of being wrong on this metaphysical issue is indeed smaller than  $10^{-100}$ , knowing what we know on the fallibility of human cognition. According to the dominant rules of inference, we would have been forced to accept the creationist position, if no other hypothesis were present. (Ćirković 2009, 10)

In other words, since the Rare Earth Hypothesis implies postulating an astronomically small probability for the emergence of complex life, one would be forced to accept the creationist standpoint if one gave a significantly higher probability to human beings (a lot of whom are creationists) being right.

Ćirković’s and Fry’s criticism rests on a logical fallacy that we will state presently and expound upon in the following section. The Rare Earth Hypothesis does not postulate that complex life *in the universe* is extremely improbable; it postulates that life *in a given planet*, is extremely improbable.

An extremely improbable event is, indeed, bound to happen, if it is given enough chances to occur. This does not violate naturalism, but rather is a consequence of the Law of Large Numbers.

### **5. On Miracles**

Last July, Ms. Joan Ginther, of Texas, won the lottery for the fourth time since 1993 (Hawley, 2010). What are the odds? As a matter of fact, around 200 million to one. This is the sort of event that we consider to be miraculous, because it is so unlikely. One is tempted to say that Ms Ginther is favored by the Gods. However, her good fortune not only does not break the laws of probability, but rather it confirms them. Given the total number of people in the world that buy lottery tickets regularly and the amount of time elapsed since the invention of the lottery, a winner of four lotteries was practically a necessity. That *someone, anyone*, wins the lottery four times over their lifetime is a very likely event; that *a given person* does, is extremely unlikely.

Rolling snake-eyes (a pair of ones) on a pair of dice 5 times in a row is a very unlikely event; less than one in sixty million. More precisely  $1/60,466,176$ . However, if I make sixty and a half million attempts, it is a statistical necessity that, *at some point*, I get just such a result. If we define a miracle as an occurrence that only happens one in a million times, miracles happen 295 times a day in the United States, given that country's population (Shermer, 2004). It is a statistical necessity that, "an event with a low probability of occurrence in a small number of trials has a high probability of occurrence in a large number of trials" (Shermer, 2004, 32).

Therefore, from the perspective of a third person, we should not be surprised that miracles occur<sup>2</sup>. However, let's get back to Ms Joan Ginther of Texas. Should she be surprised at her fortune? Of course! The odds of *her* winning the lottery were extremely small! She should jump up and down and be grateful for her good fortune!

The Law of Large Numbers affords us two perspectives on miracles. The third person perspective explains how miracles are to be expected as a statistical necessity, and, therefore, naturalistic in origin and without the need for a supernatural explanation. However, the question of *to whom*, the miracle occurs is a different matter. From the first person perspective, miracles are indeed miraculous, and whoever they occurred to was indeed a

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<sup>2</sup> Of course, extremely unlikely bad things also happen to people, as well as things that are simply odd. Last July, a few days after Mrs. Ginther won the lottery, a group of Australian muggers chased an Ipod bearing med-student into a dark alley, precisely in front of a Ninja School from where a pack of fully customized Ninjas emerged to beat them up and help the student! (Doctorow, 2010).



very lucky person. This, however, does not need a theological or teleological explanation.

According to the Rare Earth Hypothesis, complex life in the Universe is not something astronomically unlikely; but it is quite unlikely in a given planet. The Universe is sufficiently large, and has a sufficient number of planets, for complex life to occur *somewhere*. The Earth was an extremely lucky planet.

According to this Hypothesis, we humans are witnesses and protagonists to an astronomically unlikely event, by pure chance. This seems like a stretch, until we take into account observer self-selection (see Watson, 2004). The only way the Universe can be observed is if an observer observes it; but an observer can only occur in precisely that very strange and unlikely part of the Universe where observers can evolve. Therefore, an observer must necessarily observe a very strange and unlikely sample of the Universe. It is only natural that such an observer will initially take his part of the Universe to be typical and, like Huygens, assume that other planets also evolve observers. It's reasonable to assume, *ceteris paribus*, that whatever part of the Universe I am looking at is typical (the mediocrity principle); but, of course, atypical things can and do occur. In the case of a living, Gaia-like planet, the *reason* I can observe it is *that it is an atypical planet*.

The Rare Earth Hypothesis needs to jettison the Copernican mediocrity principle by way of observer self-selection; it does not, however, imply a rejection of naturalism, and is in no way a veiled creationism. However, it does have spiritual corollaries. The Earth is, indeed, from a first person perspective, an extremely unlikely event, a miracle. In the next section, we will explore the spiritual implications of such a miracle, by understanding life on Earth as a gift.

## **6. Life as a Gift**

What does Gaia mean, when seen as a miracle? The question is not trivial:

Being aware of the greater whole within which we live arouses feelings and emotional responses, such as Darwin's awe, Huxley's admiration as well as Volk's or Sagan's gratitude that are not anthropological curiosities but a necessary part of human reaction to the world. The emotional impact Nature makes on us is also a part of its meaning for us (...) and meanings give things their value. (Primavesi, 2003, 124-125).

According to the Rare Earth Hypothesis, we are the product of an extraordinarily fortunate series of events that could have gone differently in

many different ways. We did not do anything to make this series of events come about; and they are not given with the expectation of a payment of any kind. In *Gaia's Gift*, Anne Primavesi (2003) invites us to see Gaia as a freely given gift. We will adopt her perspective in order to understand the spiritual implications of the Rare Earth Hypothesis.

Primavesi's invitation is to understand the miracle of Gaia through our understanding of gifts, giving and gift exchanges. She points out the critical factors that were present a long time ago and the allowed us to exist:

(...) long before we emerged to do things *to* Gaia, Gaia was doing things *for* us: things that would prove essential for our eventual emergence as a species and for our lives here and now. The support systems essential for our survival evolved over deep time through the synchrony of favourable conditions within three critical parameters: water availability, temperature and nutrient supply (2003, 124).

What is the proper way to receive a gift? The word "gratitude" springs to mind. It is etymologically related to the Latin *gratis*, "out of favor or kindness, without recompense or compensation". A gift, freely given, calls for gratitude; gratitude, in turn, must be given freely. Otherwise, there is no gift-giving but rather an exchange, an economic transaction. What is it to enjoy Earth as a freely given gift of chance? The poet Thomas Hardy writes:

Let me enjoy the earth no less  
Because the all-enacting might  
That fashioned forth its loveliness  
Had other aims than my delight (Hardy, 1978, 94, quoted in Primavesi, 2003, 98).

A series of cosmic accidents gave us the Earth and sentience with which to enjoy Nature's Opera, by pure chance. "We may not claim it as our due nor value it only for its usefulness to us: as something we can possess and exploit for our sole benefit. It is given: neither earned, bought nor expected" (Primavesi, 2003, 99). The proper response is gratitude. An anthropocentric sense of entitlement would surely hamper Hardy's ability to enjoy the Earth.

Since its appearance in 1970, in the aftermath of the Bhola cyclone, tiny New Moore Island was the object of a bitter dispute between India and Bangladesh. In march of 2010, the island disappeared because of rising sea levels due to global warming (Arnoldy, 2010). That tiny bit of land was a freely given gift, a product of chance; its disappearance due to broader systemic causes shows how silly it was to claim ownership in the first place.

A way to understand gifts and gift giving is to contrast it with commodities and trade. Giving stuff away for free “makes standard economic nonsense” (Primavesi, 2003, 113). Recently, conservative columnist Terry Savage wrote a column entitled “There is no Free Lemonade”, where he recounts him and his brother seeing three little girls at a lemonade stand, and his brother asking for the price of the lemonade:

Oh, no," they replied in unison, "they're all free!"

I sat in the back seat in shock. Free? My brother questioned them again: "But you have to charge something? What should I pay for a lemonade? I'm really thirsty!"

His fiancée smiled and commented, "Isn't that cute. They have the spirit of giving."

That really set me off, as my regular readers can imagine.

"No!" I exclaimed from the back seat. "That's not the spirit of giving.

You can only really give when you give something you own. They're giving away their parents' things -- the lemonade, cups, candy. It's not theirs to give."

I pushed the button to roll down the window and stuck my head out to set them straight.

"You must charge something for the lemonade," I explained. "That's the whole point of a lemonade stand. You figure out your costs -- how much the lemonade costs, and the cups -- and then you charge a little more than what it costs you, so you can make money. Then you can buy more stuff, and make more lemonade, and sell it and make more money." (Savage, 2010)

In this, Savage reflects modern conservative thinking (which, oddly enough, does not look kindly upon prostitution...); he goes on to say that the American public fails to understand that government entitlement programs such as unemployment benefits are not free but taken from tax money. He completely fails to see the value or meaning of gift giving.

The giver of a gift does not expect payment in return, as an individual, but rather enriches the system of which he or she is a part. The girls in Savage's story are making life more pleasant in their community; and invited the Savage brothers into it. Also, the thought of giving lemonade away to strangers supposes that strangers get thirsty too. Gift exchange presupposes “a sense of belonging to a group or place as well as a sense of dependence on common resources” (Primavesi, 2003, 115). Giving is closely related to an awareness of being part of, and kin to, a larger whole. The gift of Gaia makes us aware of the larger history of which we are a part, and of the

kinship and dependency we have with earthly beings that brought us our existence both in our evolutionary past and that sustain it in the present:

Not only does [gift exchange] presuppose a sense of belonging to a group or place as well as a sense of dependence on common resources. Its proper practice ultimately requires seeing the vital components of one's life as gifts from other living beings: gifts often given to us through their death. And as they have been freely given, they have to be received and treated as gifts: not as possessions. (Primavesi, 2003, 115).

Gratitude for and towards Gaia means viewing life on Earth as part of an enormous, complex and awesome ongoing story of which we are a part. It means understanding that we are not the sole recipients of the gift of life; and appreciating said gift as such.

Meaningful change in our way of life, in relation to the environment, will not come about without a change in our fundamental attitudes toward the Earth. Sugar, lemons, water, are not bought from the Earth, but freely given by it; and to commoditize Earth's gifts brings consequences:

(...) the huge, interdependent, self-regulating global environment is a gift to all earth's inhabitants: it gives the necessities of life to all members of the earth community: human and non-human. So if the gift aspect of our relationship with earth is ignored and the sources of what we receive go unrecognized, responses to the supply of vital components we receive are reduced to our saying (...) 'It's mine!' We take those components and turn them into possessions; into commodities for cash profit. When this happens on a global scale, as it now does, we are in effect treating the earth as a possession to be traded for monetary advantage. This premise, and its conclusion, was expressed succinctly by an anonymous nineteenth century Native American:

Only when the last tree has died and the last river has been poisoned and the last fish has been caught will we realize that we cannot eat money. (Primavesi, 2003, 115).

## **7. Cosmotheoros Revisited**

The pre-Copernican geocentric model of the Universe was essentially anthropocentric. Man was the goal and center of creation. Pre-Copernican geocentrism did not, as a matter of fact, hold the Earth in great esteem:

(...) at the time, the term 'celestial body' (planet) was not used of the earth. It was considered non-celestial, belonging to the 'sub-lunary world, the unworthy world and cesspool of corruption'. It was heavy, inert, motionless (...)

[T]he central position was not the most honourable, but, on the contrary, the most unworthy. It was, in effect, the *lowest*, and consequently suited to the earth's imperfection. Perfection was located *above*, in the celestial vault (...) whilst 'Hell' was deservedly placed beneath the surface of the earth. (Primavesi, 2003, 21).

Man did not share the Earth's indignity in as much as he was meant for the heavens and was only passing *through* the Earth. Man was *above* the Earth, so much that "in the Noah story, Earth's own fate as well as that of the rest of its inhabitants hinges upon what we do" (Primavesi, 2003, 22). Pre-Copernican Earth was, (as in Copernican Huygens), a contemptible speck of dirt.

Copernican heliocentrism brought humility for man, in relation to the broader Universe; which we have called dark enlightenment. This humility is manifest in *Cosmotheoros*, where the privileges of Earth are bestowed upon all planets. Yet, according to the Rare Earth Hypothesis, the Earth could, quite plausibly, be a very uncommon planet. Astronomical heliocentrism would be accompanied by a new form of geocentrism, in relation to the presence of complex life forms.

But in the Rare Earth hypothesis, man's privilege is not the product of man's being the aim or center of creation, but rather the result of a number of unlikely events. We are not owed this privilege, nor have we earned it. The Rare Earth hypothesis highlights the uniqueness of the Earth, and its nature as a freely given gift. It does not exalt humanity except as the recipient of this gift, and gives him a debt of gratitude. Dark enlightenment, a cosmic view of humanity where it is not a privileged part of the Universe, is still possible. Nothing other than statistical necessity, the fact that given a sufficient number of trials an unlikely event becomes likely, was the cause of human privilege.

Huygens wrote, in part, to exalt the glory of the creator: "(...) we shall worship and reverence that God the Maker of all these things; we shall admire and adore his Providence and wonderful Wisdom which is displayed and manifested all over the Universe (...)" (Huygens, 1698, 11). In *Cosmotheoros*, the wonder and creativity of the Earth is multiplied in every planet; and we are to wonder at the infinite complexity of the Universe. But if the Earth is rare or unique, our wonder finds a different object. The immense complexity of *Earth* is highlighted, as opposed to the enormous, strange and awe-inspiring, but barren objects of the rest of the Universe. Indeed " (...) nobody

will deny but that there's somewhat more of Contrivance, somewhat more of Miracle in the production and growth of Plants and Animals, than in lifeless heaps of inanimate Bodies(...)" (Huygens, 1698, 20).

Within an infinitely vast Universe that does not belong to us, there is a wondrous object as valuable as it is rare. If we hold on to this wonder and to Copernican humility at the same time, the value of the Earth becomes an awesome responsibility. Pre-Copernicanism was anthropocentric; a view of the Universe stemming from the Rare Earth Hypothesis is genuinely geocentric. Copernican humility is combined with awe and gratitude for the Earth. The value of the sight of Nature's Opera is not diminished, but enhanced.

The gifts that Huygens would bestow upon the entire Universe (pleasure, sight, the reason with which to enjoy the sight of Nature's Opera) become a more exclusive province of man. In the model of *Cosmotheoros*, the Universe has as many observer species as there are planets; in the Rare Earth Hypothesis, the rational contemplation of the Universe is a more exclusive gift:

(...) without Knowledge what would be Contemplation? And what difference is there between a Man, who with careless supine negligence views the Beauty and use of the Sun, and the fine golden Furniture of the Heaven, and one who with learned Niceness searches into their Courses(...) who by the sound reasoning can measure the magnitude and distance of the Sun and Planets? Or between such and one as admires perhaps the nimble Activity and strange Motions of some Animals, and one that knows their whole Structure, understands the whole Fabrik and Architecture of their composition? (Huygens, 1698, 60-61)

The awe with which we view the Universe is now accompanied by awe at our very ability to do so. As the sole receivers of the gift of Gaia, earthlings have a responsibility to protect it. As the sole observers of the Universe, humans have a privilege of observation beyond supine negligence.

Taking into account Gaia theory and the Rare Earth Hypothesis, the moral purpose of *Cosmotheoros* can be seen in a new light:

(...) besides the Nobleness and Pleasure of the Studies, may not we be so bold as to say, they are no small help to the advancement of Wisdom and Morality? so far are they from being of no use at all. For here we may mount from this dull Earth, and viewing it from on high, consider whether Nature has laid out all her cost and finery upon this

small speck of Dirt. So, like Travellers into other distant Countrys, we shall be better able to judg of what's done at home, know how to make a true estimate of, and set its own value upon every thing. We shall be less apt to admire what this World calls great, shall nobly despise those Trifles the generality of Men set their Affections on, when we know that there are a multitude of such Earths inhabited and adorned as well as our own. (Huygens, 1698, 10-11)

As far as we know, there are no Earths neither inhabited nor adorned as well as our own. Earth is no small speck of dirt. Our human glories and travails, however, still seem small, as compared to the grander, more complex, and enormously older story of which man is but a part.

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