The Fatal Absence of Evidence for Extraterrestrial Intelligence and its Consequence for Humanity.

By

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Abstract.

The lack of any radio signals or other astronomical evidence supportive of the existence of intelligent extraterrestrial life possessed of technology of sufficient sophistication to bring itself to our attention here on Earth is not, *per se*, evidence of an absence of life, or even intelligent life, in the cosmos itself, but it does indicate that any such advanced societies, if they have come into existence at all, may be extremely rare and comparatively short-lived, destroyed by the very technology that might have brought them to our notice. This, it will be suggested, is the solution to Fermi's famous 'paradox', and the reason no SETI signals have been detected. The lessons we should learn are that life like that on our planet is very rare and precious, and we must not risk destroying it.

Keywords: SETI (search for extraterrestrial intelligence); radio signals; Drake equation; astrobiology; extraterrestrial intelligences (ETIs); extraterrestrial advanced technology societies; self-extinction of such societies; Fermi 'paradox'; absence of SETI signals.

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[1] Introduction.

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The present author has discussed the issue of the possible existence of extraterrestrial intelligent life previously, in Blaber (2005 [1]). He has also discussed the so-called ‘doomsday argument’ and its relation to the possibility, indeed probability, of ecological catastrophe (see Blaber, 2022, [2]; Blaber, 2023a [3]; Blaber, 2023b [4]). The only glimmer of hope he sees is the possibility (not, by any means, a remote one) that the global capitalist system will collapse financially before it does so ecologically, the latter mode of collapse being inevitable, if he is correct (Blaber, 2023c [5]).

We need not rehearse these arguments again here. Carter (in Longair, ed., 1974 [6], pp.292-293) has pointed out that we humans are ‘*necessarily* privileged observers’ (his emphasis) to the extent that our spatio-temporal location is compatible with our existence.

As we shall see, there are vast regions of space incompatible with carbon-based life of any kind, and such life requires a necessary minimum amount of time after the ‘Big Bang’ to evolve. We need not invoke the stronger version of Carter’s ‘anthropic principle’ (p.294). Bergin *et al* (2015 [7]) argue that:

> **‘The development of a habitable world and a stable biosphere requires the delivery of biogenic elements, of which carbon and nitrogen are crucial’ (p.8965).**

This is surely self-evident, and their conclusion (p.8969), that the high carbon/nitrogen (C/N) ratio of what they term the ‘bulk silicate Earth’, or ‘BSE’, is thus significant for any hope of finding life on exoplanets:

> **‘The high C/N ratio of the BSE therefore appears to be a sensitive indicator of the balance of volatile accretion and loss during the final stages of the Earth’s assembly. Viewed more broadly, such a scenario will likely result in a highly variable supply and retention of these key ingredients to the surface reservoirs of terrestrial worlds.’**

So: it is not *impossible* that life is to be found on terrestrial mass planets orbiting other stars in habitable (or ‘Goldilocks’) zones – just rather less *probable* than some might think.

There was an abundance of one vital ingredient for life – hydrogen – created about 380,000 years after the 'Big Bang' (see Peebles, 1968 [8], pp.1-2; Barkana and Loeb, 2007 [9], pp.3-4, pdf.), but the process whereby the heavier chemical elements crucial to the formation of life as we know it here on Earth, carbon, nitrogen and oxygen, were formed by thermonuclear fusion in massive stars was confirmed by Burbidge, E.M., Burbidge, G.R., Fowler and Hoyle in 1957 [10].

They tell us that synthesis of carbon-12 and oxygen-16 require helium 'burning' (i.e., nuclear fusion involving helium) in Red Giant stars, and that these stars must survive between 10-100 million years as Red Giants for this to occur (p.556). Their previous life-spans on the main sequence of the Hertzsprung-Russell diagram[2] will depend on their spectral type[3], but all main sequence stars belong to luminosity class V (dwarf stars, like our Sun, which is about half-way through its main sequence life-span, see Schröder and Conon Smith, 2008 [12], p.157 [p.3, pdf.]), by definition. The larger and hotter the star, the shorter its lifespan, with O and B type stars lasting just a million years or so on the main sequence ([8], ibid.).

Carbon-12 and oxygen-16 are the two most abundant isotopes of these elements, respectively. Hoyle (1954 [13]), building on the earlier work of Bethe (1939 [14], who had already shown that isotopes heavier than helium-4 could not be created in ordinary stars), showed how the chemical elements from carbon to nickel are synthesised in very hot (and thus very massive, because requiring more hydrogen fuel to power their thermonuclear reactions) stars.

The building of carbon and other heavy elements, must proceed, so Hoyle, and earlier, Bethe, tell us, by what is called the 'triple alpha process' ([13], p.129):

$$3\alpha \rightarrow {}^{12}C + \gamma \, .$$

[2] See: Mitton, J. (1991, 1993 [11], pp.186-188); https://astronomy.swin.edu.au/cosmos/h/hertzsprung-russell+diagram.

[3] There is a mnemonic to remember the spectral types of stars: "O be a fine girl, kiss me,' which brings to mind O, B, A, F, G, K, and M, the labels attached to each of the spectral types, from the hottest to the coolest. Our own Sun is a type G. See: https://lco.global/spacebook/stars/types-stars/.

Here, γ represents a gamma-ray photon, and we have changed the way isotopes are represented by Hoyle, who signifies carbon-12 by 'C^{12}'. Three alpha particles – which are helium-4 nuclei, each consisting of two protons and two neutrons – must collide at enormous speed and fuse together to form a nucleus of carbon-12, the essential building-block of life. Oxygen is then created by:

$$^{12}C + \alpha \rightarrow {}^{16}O + \gamma \; .$$

See [13], p.130. C^{12} is also produced, Hoyle tells us (ibid.), by a process involving the unstable isotope, beryllium-8:

$$^{8}Be + \alpha \rightarrow {}^{12}C + \gamma \; .$$

Beryllium-8 itself is the product of two helium-4 nuclei (alpha particles) fused together. Hoyle then goes on to list the following reactions (p.135):

$$^{14}N + \alpha \rightarrow {}^{18}F + \gamma \; ;$$

$$^{18}F \rightarrow {}^{18}O + \beta^{+} \; .$$

Here, β^{+} is an anti-beta particle, or positron. Chiappini, Romano and Matteucci (2003 [15], p.63) tell us that stars with masses in the range 4-8 times solar mass (M_S) contribute most of the nitrogen-14 found in galaxies, whereas stars with masses in the range 1-3 times M_S contribute most of the carbon (after they have reached their Red Giant stage).

As they point out (Section 2.1, p.65), stars with initial masses in the range ~1 to ~5 or 8 M_S experience a phase of double-shell burning at the ends of their lives, during which phase they eject significant amounts of helium-4, carbon-12, carbon-13 and nitrogen-14 into the interstellar medium.

Nitrogen-14 nuclei have seven protons and seven neutrons, and the isotope is the source of radiocarbon, carbon-14, which has the same number of protons as carbon-12, but two additional neutrons. On the other hand, carbon-14 itself decays into nitrogen-14, by beta-decay, with the additional production of an electron and an antineutrino[4].

Nitrogen-13 can be produced by the addition of a single proton (i.e., hydrogen-1 nucleus) to a carbon-12 nucleus, with the emission of a gamma-ray, but it is a short-lived radioisotope, having a half-life of only 9.97 minutes[5]. It does, however, participate in the carbon-nitrogen-oxygen (‘CNO’) cycle, as pointed out by Phillips (1994, 1999 [16], Ch.4, p.114; an additional proton is required, with the emission of yet another gamma-ray, the proton then turning into a neutron by means of positive beta decay, with the emission of a positron and an antineutrino[6]). The whole process is thus:

$$^{12}\mathrm{C} + {}^{1}\mathrm{H} \rightarrow {}^{13}\mathrm{N} + \gamma \; ;$$

$$^{13}\mathrm{N} + {}^{1}\mathrm{H} \rightarrow {}^{14}\mathrm{N} + \gamma + \beta^{+} + \nu^{-} \; .$$

Thus the four main ingredients for biochemistry – and thus biology – were forged, first in the ‘Big Bang’, then in stars, the whole process taking some 12 billion years for them to reach their current levels of abundance in our galaxy, given the ages of the oldest of the most ‘metal rich’ stars, and ‘metallicity’ being a measure of a star’s heavy element content (see Kalirai, 2012 [17], p.5, pdf.). ‘Heavy element’, in this context, is *any* element heavier than hydrogen and helium. 12 billion years is about 86.96% of the age of the Universe (~13.8 billion years; Aghanim *et al*, 2020 [18], Table 1, p.7, pdf.).

[2]. “It’s Life, But Not As We Know It, Jim.”

It is as well, before continuing, to refer briefly to the possibility of life *not* based on carbon, but something else, such as silicon, or possibly carbon and silicon. By this is meant *organic* life, arising out of a process of biological evolution, rather than any cybernetic imitation of it, the result of deliberate design by already evolved intelligent beings.

Petkowski, Bains and Seager (2020 [19]) are surely right to argue that ‘[i]n no environment is a life based primarily around silicon

[4] See: https://gml.noaa.gov/ccgg/isotopes/decay.html.
[5] See: https://en.wikipedia.org/wiki/Nitrogen-13.
[6] See: https://www.britannica.com/science/beta-decay.

chemistry a plausible option' and that 'in a water-rich environment silicon's chemical capacity is highly limited due to ubiquitous silica formation.' In this, they agree with Jacob (2015 [20]), who found no evidence for silicon-based life in the Solar System.

Pace (2001 [21]) argues, convincingly, that biochemistry has universal rules, in effect, and that it requires carbon to function effectively. One idea, that there could be arsenic-based life, has now been successfully refuted (see Basturea, Harris and Deutscher, 2012 [22]). Doig (2017 [23]) points out there are excellent reasons why the twenty amino acids that occur in living cells – and no others – were selected.

[3]. Not Life, But Intelligent Life, And Not Even That...

There could, in fact, be abundant life throughout the cosmos – that is not the issue here. The issue is not life, as such, nor even that subset of life that constitutes *intelligent* life, no matter what theological objections there may have been to its putative existence raised by the Inquisition in Rome, causing them to burn Giordano Bruno at the stake there in 1600 for daring to suggest the possibility of beings like ourselves on worlds other than our own (Bruno, 1584 [24]).

Whether they are right or wrong, no-one ought to be burned at the stake for their ideas, although it should be noted that some theologians were still, not so long ago, raising the same objections to Bruno's argument that got him incinerated (Hebblethwaite, 2001 [25], e.g.).

Islam (and, we might add, Judaism and Unitarianism), lacking a belief in original sin, an incarnation, and an atonement to deal with original sin, has none of the problems the theology of orthodox Christianity might have with the existence of intelligent extraterrestrial life, which Hebblethwaite and his Inquisitorial predecessors find, and found, so problematic, chiefly, the issue of 'multiple incarnations [of Christ]' (see Fettahoğlu, 2021 [26]).

However, our concerns here are scientific, rather than theological, and with the subset of the subset of extraterrestrial life, *if* it exists, which is not merely intelligent, but possesses technology sufficiently advanced to enable it to broadcast radio signals into interstellar space – radio signals which our radio telescopes can then detect, so we can analyse them. No such signals have been detected, in some sixty years of searching (Grimaldi, 2023 [27]). Grimaldi is forced to concede that

> **'Although the elusiveness of extraterrestrial technosignatures might be justified by the... immense search space to be explored, it is however also consistent with the possibility that there are actually no technosignatures to be detected' (p.1, pdf.).**

He claims this 'does not necessarily mean technological exo-civilisations... are extremely rare or nonexistent' (ibid.), but he is up against Fermi's famous (or infamous) 'paradox' in this respect (for an account of the history of this 'paradox', which is not a true paradox, see Jones, 1985 [28])[7].

The Universe in general, and our galaxy in particular, could be teeming with life, either just of the simplest unicellular sort, or indeed including complex multicellular forms – analogues of whales, dolphins and porpoises or orang-utans, gorillas and chimpanzees here on Earth.

It is even possible that civilisations whose energy-production scale is below that of our own (i.e., below Kardashev Type I, see: Kardashev, 1964 [29], p.219) might exist in great numbers, but we would never know, because they are not broadcasting radio signals we can receive, or possibly not at all – and if they are remote from us, we may never know of their existence.

The German biologist, Ernst Mayr (1904-2005; see Mayr, 1992 [30]; Mayr, 1995 [31]), in his debate with the astronomer, Carl Sagan (1934-96), on the subject of the possible existence of extraterrestrial intelligent life, attempted valiantly, but in vain, to convince Sagan that the vast majority of life on Earth manages very well without intelligence, and that intelligence is not the *summum bonum* of

[7] Given the Milky Way Galaxy has a diameter of 100,000 light years (see [11], pp.159-160), it is a simple calculation to work out that any civilisation capable of travelling through interstellar space with an average speed of 0.1% *c* (roughly 300 km s^{-1}) could colonise all of it in 100 million years, which might seem an impossibly long time to us, but might not be to a long-lived species, or one equipped with some form of cryo-technology. The morality of that is another matter: would we like it if some species-centric ETI tried to invade and conquer Earth, and render it ecologically suitable for *their* biological requirements? One further point: whatever UFOs (or 'UAP', as we must now call them) are, they are not spacecraft of extraterrestrial origin.

evolution Sagan imagined it to be. The latter's view of evolution was, indeed, rather unscientific, being more teleological than biological, and owing a good deal (if he did but know it) to Bergson (1907, 1911 [32]). Sagan and Drake (1997 [33]) were still arguing the case for SETI just two years later, however, the former publishing posthumously.

Mayr ([31], op.cit.) points out, reasonably, that intelligence has evolutionary costs, as well as benefits:

> **'some grade of intelligence is found only among warm-blooded animals (birds and mammals), not surprisingly so because brains have extremely high energy requirements. But it is still a very big step from "some intelligence" to "high intelligence." The hominid[8] lineage separated from the chimpanzee lineage about 5 million years ago, but the big brain of modern man was acquired less than 300,000 years ago... it required complete emancipation from arboreal life to make the arms of the mothers available to carry the helpless babies during the final stages of brain growth. Thus, a large brain, permitting high intelligence, developed in less than the last 6% of the life on the hominid line. It seems that it requires a complex combination of rare, favorable circumstances to produce high intelligence.'**

Mayr also notes that none of the instances of non-human terrestrial intelligence have been sufficient to found a civilisation, and that there have been twenty civilisations on Earth over the past 10,000 years,

> **'from the Indus, the Sumerian, and other near Eastern civilizations, to Egypt, Greece, and the whole series of European civilizations, to the Mayas, Aztecs, and Incas, and to the various Chinese and Indian civilizations. Only one of these [has] reached a level of technology that has enabled them to send signals into space and to receive them.'**

[8] Zoological and paleoanthropological nomenclature has changed in the interim in favour of 'hominin', as opposed to 'hominid'. All extinct and extant members of the genus *Homo* are classed, now, as members of the superfamily Hominoidea, family Hominidae, subfamily Homininae and tribe Hominini, but the family Hominidae now includes *all* the great apes (the genera *Pongo*, *Gorilla*, *Pan* and *Homo*) whereas the subfamily Homininae, subdivided into the tribes Hominini and Gorillini, just includes humans, chimpanzees and gorillas.

Mayr also notes that it is by no means certain that extraterrestrial alien life-forms would have sense organs adapted to receive audio-visual stimuli in the way we are, so, even if they possessed the means to convert radio signals into electronic ones, they still might not be able to make sense of them.
Finally – and this is a crucial point – he argues that all civilisations are finite in duration, and illustrates his point thus:

> **‘Let us assume that there were really intelligent beings on another planet in our galaxy. A billion years ago their astronomers discovered Earth and reached the conclusion that this planet might have the proper conditions to produce intelligence. To test this, they sent signals to Earth for a billion years without ever getting an answer. Finally, in the year 1800 (of our calendar) they decided they would send signals only for another 100 years. By the year 1900, no answer had been received, so they concluded that surely there was no intelligent life on Earth. This shows that even if there were thousands of civilizations in the universe, the probability of a successful communication would be extremely slight because of the short duration of the “open window.”’**

Mayr asks why, then, there are still proponents of SETI, and finds that the proponents ‘are almost exclusively astronomers, physicists and engineers’, rather than biologists.

Drake’s presentation (Drake, 1961 [34]) at the US National Radio Observatory in Green Bank, West Virginia in November, 1961 of his eponymous ‘Drake Equation’ has stimulated much thought and debate. He argued that the number of civilisations in the Milky Way Galaxy, N, whose electromagnetic signals are detectable would be given by:

$$N = R_* f_p N_e f_l f_i f_c L \ .$$

Here, R_* is the average rate of star formation per year in our galaxy; f_p is the fraction of those stars with planets; N_e, the average number of those planets that may develop an ecosystem; f_l, the fraction of those planets that succeed in developing life; f_i, the fraction of these that develop intelligent life; f_c, the fraction of these that develop interstellar communication; and finally, L, the length of time such civilisations survive and continue to send such communications (see also SETI Institute, 2020 [35]).

So far, the value of N is zero, but that could be because $f_i = 0$, or because $f_c = 0$, or $L = 0$. Of these, the last is the most ominous possibility for ourselves of all, and we shall more to say about this shortly.

As of December 2022, some 5,000 exoplanets had been discovered (Abushattal, Kraishan and Alshamaseen, 2022 [36]). 97% of them are in single star systems, and 2% of them in binary star systems ([36], Figure 4, p.238). by 5th December 2023, this number had increased to 5,557 (NASA, 2023 [37]). None of them are Earth mass planets in the habitable zones of their stars, except by stetching the definition to its breaking-point, however, and nor are any of them broadcasting the coherent radio signals that would be expected from a civilisation like our own (Palubski, Shields and Dietrick, 2020 [38]; Hill *et al*, 2023 [39]).

NASA (2021 [40]) estimate there are about 100 billion stars in our galaxy. Wall (2020 [41]) gives a different estimate – 200 billion – but claims that 7% of this number are G-type dwarf stars like our Sun, and that each of them may have at least one potentially habitable planet, which would be a minimum of 14 billion potentially habitable planets, if true. Wall is a journalist, not a scientist, however, and the research, by Bryson *et al* (2020 [42]) he is quoting included K-type, as well as G-type stars, and optimistic, as well as conservative, assumptions about what constituted their habitable zones.

On the basis of these assumptions, ([42]) concluded, with 95% confidence, on average, the nearest habitable zone (HZ) planet 'around G and K dwarfs [would be] ~6 pc away' (i.e., ~19.57 light years), and that 'there are ~4 rocky HZ planets around G and K dwarfs within 10 pc [32.616 light years] of the Sun' (p.2, pdf.). Habitable zone planets do not, of course, imply they are, in fact, *inhabited* by any form of life, even if Bryson *et al* are right.

Amino acids and polycyclic aromatic hydrocarbons (PAHs) have been found in carbonaceous chondrite meteorites (Botta *et al*, 2008 [43]). Mason (1963 [44]) informs us that the Type I (out of two types) carbonaceous chondrites contain the most carbon, bound in molecules of some kind, and water, dismissing a potential Type III as containing insufficient quantities of both (p.623). Type I chondrites, he informs us, have potassium-argon ages of between 1.3 and 1.4 billion years (p.640), making them up to 31.1% the age of the Solar System, but, so he argues, their true age may be consistent with that of other meteorites, given the low retentivity in the chondrites of radioactive argon, so they may be much older, and closer to the age of the Solar System itself, i.e., 4.5 billion years (pp.640-641). He notes that all of the then current theories of the origin of these meteorites would be unable to do so, especially if any of the material they contained turned out to be biogenic (p.644).

There was, of course, the great excitement in the mid-1990s over the alleged micro-fossil found in the Martian meteorite ALH84001, which turned out to be something of a triumph of hope over reasonable expectation, not for the first (or last) time for NASA’s astrobiologists (Kerr, 1997 [45]; McSween in Cavalazzi and Westall, eds., 2019 [46]). Such meteorites may have been the source of volatile materials, including carbon, on Earth, but they did not originate from beyond our Solar System, except in the sense that everything in it did, prior to the formation of the Sun itself (see Kurokawa *et al*, 2021 [47]). In any event, there is a very long way indeed from a collection of amino acids, or even polypeptides or proteins, to the simplest protozoa, such as the simplest of all, *Carsonella ruddii*, a bacterium with just a single circular chromosome 159,662 base pairs long (Nakabachi *et al*, 2006 [48]), as pointed out by Raggi, Bada and Lazcano (2016 [49]) and Cockell, McMahon and Biddle (2021 [50]).

The *faux* ‘biological’ explanation for Venusian phosphine ([50]) refer to reminded the present author of old episodes of the BBC television series, *Dr Who*, dating from the early 1970s, when the then Doctor, played by the late Jon Pertwee, used to invoke ‘Venusian karate’, ‘aikido’ and ‘miles’, and sing ‘Venusian lullabies’ to tame the monster that was supposed to live on the planet Peladon. However, in the days before we sent space-probes to the planet to find out what it was really like, it was still possible to present rather more ‘realistic’ science fiction depicting Venus as a habitable world – and indeed one teeming with life, as C.S. Lewis does (Lewis, 1943 [51]).

[4]. Conclusion.

On the basis of Mayr (1995 [31], op.cit.)'s argument, we may conclude there is a reasonable chance that Drake's factors f_l and $f_i \gneqq 0$, if the latter is somewhat lower than the first.

On the other hand, his equation really needs to be re-written to take account of the difference between non-radio broadcasting and radio-broadcasting civilisations. If we do this thus:

$$N = R_{*} f_p N_e f_l f_i f_c \, f'_c L \ ,$$

where f_c is now the fraction of all planets that develop *any* form of civilisation, and f'_c the fraction of these that go on to develop interstellar radio-broadcasting capability, the point is clarified. It may be that $f'_c \gneqq 0$, although it will be smaller than f_c.

As for L, it seems only too clear that civilisations that do *not* develop our level of technology have a much greater probability of survival than does our own, especially given our current socio-economic arrangements. The chances are $L = 0$, and that is the reason why, after sixty years of searching, $N = 0$.

Can it seriously be argued there is a high probability humanity will survive the current century, armed as we are with the means to destroy ourselves in a nuclear war, filling as we are our air, water and soil with numerous different pollutants, and raising global temperatures by continuing to burn fossil fuels, destroy trees and wetlands, whilst we reduce biodiversity and produce a larger population than a grossly damaged global ecology can hope to feed (Dirzo, Ceballos and Ehrlich, 2022 [52])? The greater our technological sophistication, the greater our affluence and population, and the larger our adverse impact on the planetary ecology needed to sustain us in being (Holdren and Ehrlich, 1974 [53]).

An intelligent extraterrestrial land-dwelling mammalian-analogue species that did *not* have the dubious benefit of an Industrial Revolution might survive as long as 550 million years, which is very many hundreds of millions of years longer than our own will, on present form – but its existence will never come to the notice of the SETI Institute (see Farnsworth *et al*, 2023 [54]). St Paul informs us

‘Knowledge puffeth up, but charity edifieth’ (1 Corinthians 8:1)[9]; he might have said *intelligence*, for he prefers the ‘foolishness of God’ to the ‘wisdom’ of human beings (1 Cor. 1:25).

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