FERMI QUESTION, FERMI PARADOX: ONE HIT, ONE OUT

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ABSTRACT. Our understanding of the universe and the history of life on Earth suggests we may not be alone in the Galaxy. Today we are ignorant of where "they" are, if they are, as was Fermi when he asked, "Where are they?" Many scientists believe the way to seek for answers is to search for "their" radiated signature. (Hence SETI, now.) But some have argued persistently that since they are not here, they are not out there, and a few insist the situation is paradoxical. This note samples speculations supporting this view and concludes one cannot make a worthy paradox from absent evidence, a belief that interstellar travel will soon be a cinch, and a willingness to predict the distant future of intelligent species.

It is said that Enrico Fermi once asked, "Where are they?", referring to the possibility that humanity might not be the only intelligent, technological Galactic species. This sensible query has sparked an odd debate in professional and public media. Whereas some scientists express the firm opinion that we are not alone, that we even may be one of a multitude, some others argue that "they" are not here so they are not out there, and a few even insist the situation is paradoxical.

That the Fermi Question is a natural one for humans is shown by the long philosophical history of the extraterrestrial life debate (Dick, 1982, and Kamminga, 1982). But there is a crucial difference between ancient philosophical discussions and modern arguments. Today we have a wealth of new data on the origin and evolution of life on Earth and on the nature of the universe. This new knowledge strongly implies that life may be widespread in the Galaxy. Also, unlike our ancestors, we can explore the cosmos in many ways denied our forebears.

Nevertheless, as in the past, the present answer to Fermi's question must be this: We do not know where they are or if they are. We have yet to notice a single reputable artifact of extraterrestrial life. We have yet to identify an extrasolar planetary system. And we do not know if life can evolve to intelligence elsewhere than on earthlike planets.

To be in a state of nearly total ignorance about something important is quite normal and common. In principle, absence of evidence is neither evidence of absence nor evidence of presence. Therefore, until

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we have some direct data on the existence and nature of an example of intelligent extraterrestrial life, we cannot escape domination by the anthropocentric predicament. We remain, as in the past, only able to devise totally fictional scenarios out of our earthly experiences and persuasions. If the query is as important as it certainly seems to be, there is but one course to follow: We should continue to study the origin and evolution of life here and to expand our explorations of the cosmos in both directions from the surface of the Earth.

Now a paradox appears only when someone notices contradiction between some tenet or principle and accepted opinion or belief. The principles in this affair are:

(1) Terrestrial physical processes have been found to occur elsewhere in the universe whenever we have been able to make the appropriate tests.

(2) Impressive evidence supports the idea that the origin and evolution of our species was a natural result of the operation of basic physical processes in a suitable and sufficiently enduring environment.

(3) Our powerful microwave transmissions happen to effectively advertise our presence to the rest of the universe.

(4) Combining 1, 2, and 3 with what we believe we know about our Galaxy suggests that life may exist on other planets orbiting other stars; and further, that perhaps some of that life may have evolved long ago into species that share some of our practices, abilities, and motivations.

Thus if our Galactic cousins exist, they also may be recognizable from a great distance by means of their radiated "signature" in the microwave band, or in some other portion of the electromagnetic spectrum when we have the proper observational tools.

The logic underlying these principles is a straightforward example of the scientific method in operation. If there is to be a significant Fermi paradox, (1) and (2) must be widely accepted (and they are) and (4) should be countered by scientifically worthy, evidential convictions. Here are some of the contradictory opinions, and a few comments thereon.

A. From some historical disciplines: The history of our species is so replete with accidental and willful twists and turns, so subject to monumental intrusions by devastating forces from within and beyond Earth, that our existence is already a most improbable event. We have been so lucky to survive during the very short existence of our species that it is quite improbable that an intelligent species somewhat like us should arise and survive to exist with us in the Galaxy.

Comment: This is seeing the tree but not the forest. Any individual history is extraordinarilly improbable. Myopic disciplinary chauvinism does not make a worthwhile paradox.

B. From the physics/astronomy area: They are not here so they are not out there.

Comment: This has been the tenor of altogether too many, largely

repetitive, papers. On reading them, I cannot avoid wondering which came first, conviction about our probable singularity or conviction that if "they" existed we should have noticed them. However, since no colleague has yet claimed paraphysical inspiration (though one Ph.D. thesis came within an eyelash of doing so), I will comment only on statement B and a few of the opinions (C, D, below) offered in support of it.

Statement B is a coupling of two defective declarations.

(1) "They are not here" (this is sometimes extended to include past times): This half of B is widely accepted as a proven fact. I am only inclined to believe it might be correct because I can imagine several reasons why, if they exist, they might not have visited Earth. But more important than anyone's belief about the matter is this: There is no reasonable way to prove this phrase, let alone its extension to the past. To stress the matter with a bit of hyperbole, for all we know there could be a myriad of Arthur Clarke's monoliths buried a few meters under the surface of the Earth, or the mice experiment might be real (Douglas Adams, 1979). In such ignorance any imagined scenario must be considered highly improbable. The only factual statement we can make goes like this: We have not noticed "them" or any of "their" artifacts. As a practical matter, of course, most of us will continue on our way as though ET had never been here.

(2) "they are not out there." We have truly just begun to explore the universe, and there is as yet no acceptable direct evidence, yea or nay, about any possible "they" out there. As a matter of simple logic, absent evidence can prove nothing. However, we know that life and intelligence exist in the universe and experience has taught us to be wary of ideas about any possible uniqueness of our cosmic situation. Then too, the Galaxy is much older than Homo sapiens sapiens. Thus the suggestion that we may not be alone seems much more attractive and worth following up by a search for relevant evidence. Without such evidence no answer is possible.

Proponents of our singularity sharply disagree with the foregoing. Here are two of their supporting points of view:

C. If any evolving species attains our technical level and survives, then, within a very few centuries, space travel will be attractive and common. Whatever technologies are required to make it so will be invented quickly on demand: For example, long term human hibernation; space ships that travel cheaply and safely at speeds which are significant fractions of light speed; genetic retrofitting for lifetimes measured in centuries, millenia, or more; silicon equivalents of human intelligence; von Neumann machines; remaking the Sun for a longer Main Sequence life.

Comment: This appears to me to be nothing more than naive dreams of hi-tech ideology: Anything you want/ you can get/ at the high-tech/restau-rant! What unimaginative science fiction! Professionals do better.

D. At least one of the few, first species in the Galaxy to survive

beyond our level of capability is bound to colonize the entire Galaxy in short order. So, since "they" have not been noticed here, they are not there and, if we survive immediate crises, we are bound to be the lucky ones to colonize the Milky Way because we have spread over much of Earth's landmass.

Comment: Of all our imagined fates only total galactic colonization has been given much consideration by the advocates or our singularity. There is a simplistic view of human migration implied which ignores the complexity of our modern understanding of past migrations. And there is no evidence that we are genetically programmed to colonize willy-nilly every nook and cranny of the Galaxy. To attach such a fate to purely hypothetical species makes no sense whatever. Practitioners of inanimate physics have a crude saying, "If it is not forbidden, it must be." This certainly does not hold for intelligent life. Also, predicting the distant future of even modest segments of humanity clearly is not a human forte.

At this point I conclude that "They are not here so they are not out there" is nonsense, and so might end this tale. But principles 1 and 2 in this so-called paradox have also been questioned. So to round out the matter, here are two points of view challenging these principles.

(Y) Models of the Earth's primordial atmosphere demonstrate that life zones around stars are so narrow that it is nearly miraculous that Earth landed within the life zone of the Sun. There may be no other "earth" so fortunately positioned in the Galaxy.

Comment: Models can prove what you will when some of the true boundary conditions and processes involved are, as they are, still uncertain. Schneider and Thompson (1980) summarized the situation this way: "None of this is meant to discourage further ingenious - or even speculative - use of climatic models on cosmic questions. But we conclude that cosmic conclusions from climatic models should be accompanied by clear admission of the vast uncertainties in the climatic component of the argument, let alone other parts of the problem."

(Z) Stochastic calculations of the probability of forming the first living cell or string of DNA out of a mixture of elements and simple compounds predict that the probability of producing a living organism lies in the range 10E-1000 to 10E-30000.

Comment: If this were true, we wouldn't be here either. I am at a loss to understand why anyone would consider a stochastic approach for the problem at hand. Complex chemical entities are formed from chemical elements and simple compounds via a series of intermediate reactions, each one of which is deterministic.

The Drake equation is used often to illustrate in elementary symbolic shorthand the many depths of our ignorance relating to the plenitude of intelligent, communicative species in the Galaxy. In the decades since its conception, this simple expression has triggered many tracts, such a convictional to-do, and even mathematical overembellishments, that I wholeheartedly agree with a colleague who suggested that arguments about

the equation should occur only over a table with plenty of beer, but not in print. I herewith propose identical treatment for the Uniqueness versus Abundance debate; or, as Martin and Bond (1983) put it, "Drake-Sagan chauvinism versus Hart-Viewing chauvinism". Until we achieve some useful data from "out there", we are all thralls of the anthropocentric predicament, however enthusing it may be to pretend we are not.

The principles behind the Fermi Question provide strong, inductive support for exploring the cosmos for signs of other intelligent species. Those who argue for our unique galactic status have presented no scientific arguments in support of their positions. In this situation, the one sensible course is to explore the Galaxy for relevant knowledge, however and wherever one thinks it may be attainable.

Finally, it seems to me that "Fermi Paradox" is an unfortunate and thoroughly misleading appellation. We have annexed the name of that truly fine physicist to a great question. Let's leave it at that.

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