Contact in Context

ET: Come And Gone Unnoticed?

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Drake's Equation strongly suggests there are many advanced extraterrestrial societies. Fermi asked: *Where is everyone*? This paradox is resolved if the extraterrestrials visiting us are stealthy, so unobtrusive as to be unnoticed. We present one plausible scenario to support this possibility.

A modified Drake's equation provides a strong argument for the existence of extraterrestrial life and advanced space alien civilizations. In a nutshell, it posits that

Number of Space Traveling Civilizations =

$$(\text{Number of Stars}) \times p_1 \times p_2 \times p_3 \times p_4 \times p_5$$

where the p_i are the probabilities:

p_1 = Probability that a star has planets,
p_2 = Probability that a planet is habitable,
p_3 = Probability that a habitable planet has life,
p_4 = Probability that life evolves to become civilized,
p_5 = Probability that a civilization explores the stars.

Since the number of stars in our galaxy is about 300 billion, even small values of the probabilities p_i lead to a large number of space traveling civilizations. Recent discoveries in astronomy and exobiology suggest that p_1 and p_2 are not very small. Fermi's paradox then asks: Why haven't we seen them?

It is unlikely that we are among the earliest civilizations as millions of stars have already burned out. So, why haven't we detected any space aliens? Is Drake's equation misleading? Is space travel is impossible? It is argued[1] that the space aliens surely exist. We present a scenario for space aliens; one where they exist, could be plentiful and yet we would not have seen them– even if they have visited Earth.

MASS, BARRIER TO SPACE TRAVEL. The big barrier to space travel (as we now understand physics) is mass. It requires enormous amounts of energy to move even ordinary sized masses across inter-stellar space rapidly. So we should expect space traveling aliens to be *very* small. An advanced technology would use micro space ships with some basic sensors (sound, images, etc.) and that carry nano-robots (nanobots). These nanobots are very intelligent, self replicating (using common materials) and capable of building many other types of nanobots. Once an alien ship arrives in our solar system, it parks in space and sends the nanobots out to build facilities, more sensors and, perhaps, more micro space ships. The actual alien life form need never get close to us; it can use remote sensors to provide direct input to its mind. Indeed, the alien mind could be some combination of organic life and manufactured devices (electronic, molecular and ???). This approach allows the alien to travel "reasonably" close to the speed of light using "reasonable" amounts of energy and to visit many star systems at once.

MODELS FOR SPACE ALIENS. As we view the wide variety of life forms, it seems unlikely that all, or even most, of the space aliens would be "almost" human in form. Human-like aliens are nice for the movies (after all, there are people "underneath" many of the alien characters). The almost human alien form is also natural for the naïve who think in terms of goblins, demons, and the like. Yet it is highly likely that life will evolve into something quite different from us.

PROBABLE EVOLUTION OF TECHNOLOGY. It is unrealistic to expect to accurately predict the probable evolutionary paths for either technology or life. Yet it is reasonable to have a broad vision of the various possible evolutionary paths and to make conjectures about the nature of possible directions. We do this for five areas of technology and comment on the potential speed of progress.

- **Computers.** Computer hardware technology is widely recognized as fast moving and having broad impact on society. It is unlikely that this fast pace of development will slow soon. Computers in the next century or two will operate much faster, they will have huge numbers of processing elements, and these elements will shrink in size by many orders of magnitude.
- **Algorithms.** Computer algorithm technology has been progressing just as fast as hardware technology but this rapid growth is much less widely recognized. Consider two example computations: (1) Compute all the factors of an integer of 1 million digits, (2) Compute the power output (thrust) of a particular jet engine as it propels a plane along its path. Algorithms are already known which, in principle, can compute these quantities. However, they require amounts of computer power that

are far beyond any current capabilities. Progress in algorithms is to find better methods (algorithms) that require fewer computational steps for these answers. Recent studies[2,3] argue that, since the 1940s, the progress in algorithm technology has provided a larger growth in "solving power" for these two computations than has been provided by the 10^{14} increase in computer hardware speed. The impact of increases in algorithm technology is related to the difficulty of the computation. One cannot increase the efficiency of computing 7 times 13 by orders of magnitude; but it is exactly the very difficult computations where one needs the most computing power and where the impact is the greatest. While the progress of computer algorithm technology is not well documented – nor even well understood – like the progress in computer hardware technology, it is plausible to estimate that, over the next century or two, advances in this area will result in many orders of magnitude speedup in solving truly difficult, complex problems.

- **Nano-technology.** Nano-technology produces devices and processes at very, very small scales. Eventually we expect to see machines the size of molecules and even complex machines will be the size of complex molecules. In the near term we expect to build devices only 5 or 20 atoms wide. This technology is still in its infancy but many experts project that it has the ability to produce, for example, machines that go inside the body to kill, nurture or modify various cells; machines inside automobile tires that to sense imminent failure and signal a car to stop; machines in our food that detect the presence of a few cells of salmonella or e coli and then sound an alarm. This microscopic scale of technology is already well developed in electronics; we should expect it to be extended to mechanical, chemical and biological processes.
- **Genetics.** People have been practicing genetic engineering for millennia to improve crops and livestock. The increasing understanding of DNA will lead to enormously more rapid and versatile genetic engineering. It is clear that many diseases and animal characteristics can be modified and controlled. It is not yet clear how far this technology can go; we might, for example, be able to modify humans so they have titanium fingernails that never break. But it is clear that people will be able to see in the infrared or x-ray spectrums and that direct mind-computer connections will be made. It is very plausible that we will be able to modify the genetics of a chipmunk so its actions are controlled by a person's thoughts. Note that there is great synergy here between computing (in computing which DNA changes to make) and nano-technology (in actually changing the DNA).
- **Cyberminds.** The application of computing, nano-technology and genetic engineering makes it possible to create Cyberminds, the direct integration of computing and sensors with the brain. It is even plausible that this can lead to the complete transfer of a mind (one's self) into a computer. Such an electronic person can have all the sensations, all the pleasures and disappointments, all the self-awareness of a living person. In this process, many limitations on life are removed such as disease, constraints on size or strength or the physical environment (as long as the sensors work). New senses can be created: seeing infrared and ultraviolet waves, feeling magnetic fields, microscopic and telescopic vision. Minds can "talk" silently and secretly (using encryption) or openly with one another. By increasing the "mental" processing power (adding electronics), the number of simultaneous cognitive processes could be increased from the current two or three to dozens or even thousands. It is hard to imagine the mental processes of such a person; they will be as different from ours as ours are different from those of worms – or an even lesser life form. A single being has so many activities that there is more of an analogy to a community or nation than to an ordinary person.
- **Speed of scientific progress.** The average speed of scientific progress is uncertain. Recently there has been rapid advance at nearly exponential rates but earlier there have been dark ages of little or no progress. New dark ages could arrest or even reverse technological advances but they are unlikely to disrupt the overall trend. Looking at the record and history, both recorded and surmised, it is plausible that developments like those suggested above will occur in the next few centuries, or perhaps millennia. In the life span of the earth, this is just a blink of the eye. Keep in mind that, at the current pace of scientific progress, one society's science appears like black magic to a society just two or three centuries behind it. Thus we should expect the space aliens to possess "black magic" and not just "Hollywood magic".

How then will the science appear that is 20,000 or 2 million years more advanced than ours? It is very hard to say but a plausible conjecture is that we simply will not recognize it.

SO WHERE ARE THE SPACE ALIENS? Assuming that the above lines of technology development occur, the space aliens have probably come (and perhaps gone) without anyone being aware of it. As an analogy, visualize a sea anemone on a rock in the Pacific wondering about the space aliens. It searches and studies its environment continuously and thoroughly, looking for signs of space aliens. A scuba diver drifts by and takes a picture of the anemone's rock and swims on. The anemone senses nothing and concludes that perhaps he and his kind are indeed alone in the universe. Would the space aliens care if we see them? Probably not.

WHAT DO THE SPACE ALIENS WANT? What would the space aliens want when they visit Earth? It is very unlikely they want any bulk items; the cost of transporting a gram of some mineral to a distant star probably exceeds the cost of manufacturing a ton of it

from raw materials. It is unlikely they want our technology, nothing we have will be interesting to them. They could want "travel photos", records of the different and curious ways that stars, planets and life have evolved in the universe. They might be looking for a new home; their star system might be dying and they need to move on. They are very likely to be interested in "defense reconnaissance". If there is one kind of space alien traveling around, then there is probably another kind, too. The most believable "law" of evolution is survival of the fittest; life is driven to survive whether it is an individual, a family, a tribe or a nation. Thus even an "omnipotent" space alien species will be on guard against other equally powerful and competing omnipotent species.

CAN WE DISTINGUISH BETWEEN SPACE ALIENS AND GOD? Suppose, for some reason, that the space aliens decide to reveal themselves to us. Would we be able to distinguish between them and God? Most religions and cults have "signs" to be used to recognize God, or the Devil, the spirits, etc. These signs are primarily black magic and the exhibition of superhuman powers such as:

- **Raise the dead,**
- **Cure the sick,**
- **See through walls or over the mountain,**
- **Create and destroy objects instantly,**
- **Control the sun, moon and stars,**
- **Read minds.**

Which of these signs could not be produced by space aliens only a few millennia more advanced than we are? And, if the aliens can't produce them, which of them can't they fool us into believing they have produced?

The conclusion of this line of thought is that there is likely to be no connection between us sensing or seeing space aliens and whether they have visited Earth or not. A secondary conclusion is that we will probably have to be very clever to detect a visit by space aliens; it is extremely unlikely that they will make a Hollywood-style landing on Earth.

REFERENCES.

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3. J. R. Rice, *Numerical Methods, Software and Analysis*, Academic Press, New York, Chapter 10, 1993, pp. 536-539.

TECHNICAL POSTSCRIPT: How to explore the stars (if you are very small and very smart). This discussion assumes that interstellar travel is practical for very small objects. While it is unreasonable to predict specific technologies for centuries or millennia in the future, we outline a plausible scenario for use by space aliens to explore the universe. The exploration stages are:

- **Initial interstellar travel**. The alien is established on a star system with full resources. It propels one or several small (a few grams) probes toward another star up to 5 light years away. A large impulse is used to provide a speed of, say, 25% of the speed of light. It takes 20 years for the probes to arrive.
- **The probes establish simple bases.** A probe consists of a computer (of enormous power by current standards), a large set of nanobots which can construct other nanobots, a minimal power source and a minimal long range scanning capability. Upon reaching the new star system, the probes brake using "friction" (light sails, atmospheric braking, etc.). Their computers allow them to manage the braking with great accuracy. They locate a very low gravity object with a few basic materials and "land" there. The nanobots start building a power source, more nanobots and a communication facility. A message is sent home with reports; responses are returned. Communication requires 5 to 10 years for a message and response (depending on the distance involved). This stage takes 15 to 25 years (mostly for braking).
- **The probes survey the system and establish advanced bases**. The added power allows for better scanning and sending simple exploratory probes to other low gravity objects. A small set of bases is created which provides the raw materials for building whatever the advanced bases need. This includes substantial power sources, extensive nano-manufacturing facilities, a high bandwidth interstellar communication facility and a fleet of observation probes to survey the star system in detail. Regular communication takes place with home to direct and guide the development of the bases. This guidance could include aborting the development if nothing of interest is found in the star system and it is not an essential part of the alien's exploration/expansion plans. This stage requires 25 to 50 years.
- **The alien establishes its presence in the star system.** Once the alien establishes that the star system is "interesting" and the bases are secured, the alien can move its "presence" there. This movement is electronic, not physical, in the beginning. This stage requires 10 years.

This scenario suggests that it takes about 100 years for the alien to establish itself in a new star system a few light years away. It is reasonable to assume that the alien has a very long "life span" (several millennia) and it has a distributed existence (its "being" exists in several places at once). This speed of exploration and colonization is very compatible with its life span.

This speed of expansion allows an alien to cross the galaxy in a few million years, a rather short time on the galactic scale. We do not conjecture about what the alien does next, perhaps inter-galactic travel is feasible if one is patient enough. We conjecture that when two aliens species meet, the result is probably war and the survival of the fittest. Thinking about that should provide ample material for a large number of science fiction novels.