

Extraterrestrial Intelligence

Eric W. Solomon, B.Sc., Ph.D., FBCS, CEng

Independent computer consultant
3 Clissold Court
Greenway Close
Green Lanes
London N4 2EZ
United Kingdom
E-mail: esolomon@cix.co.uk

Abstract

After suggesting that speculation about the existence of extraterrestrial life has a very long history, the infamous existence probability calculations are alluded to before moving on to the main topic of detecting the existence of alien life forms. Three possibilities for detection are explored, the detection of signals, the observation of artifacts, and personal encounters. One conclusion is that the best hope for detection lies in picking up private communications in the form of compressed messages broadcast without special regard for the problems of very long distance communications. The possibility that unmanned probes have already been observed is discussed and the dangers inherent in personal encounters are briefly sketched. A program for the expansion of the SETI project is adumbrated, and the essay concludes with discussion of what would constitute formal proof of the existence of alien intelligence.

IT IS A FAIR BET that a select band of thinking people have, over many centuries, considered the possibility that the stars are distant suns. That being so, it is a short step to considering whether there might be other “people” warmed by these distant suns who would see our own sun as just one of the multitude of stars in their skies. However, to voice such thoughts was, until quite recently, to invite an unpleasant demise at the hands of the church or the state. In our time it is thankfully true that the worst fate that can befall such dreamers is castigation in the media. However, the subject of extraterrestrial life, and intelligent life in particular, has gained greater respectability in recent years and now few, if any, academically trained scientists would deny its possibility, or indeed, certainty. The evidence strongly suggests that, given the right environmental conditions, and over a sufficient span of time, matter will organize itself into life forms of some kind. The formation of self-replicating molecules depends on chemistry, temperature, chance, and time, but once established they will survive, adapt and evolve. How such molecules are assembled and how they eventually combine to make up what we know as “higher” forms of life will not concern us here. But that, given the right conditions, this will inevitably occur, is the prime supposition justifying a search for extraterrestrial intelligent life.

To reduce verbosity and avoid the use of acronyms such as ETI let us refer to extraterrestrial life forms as “aliens” with the implication of intelligence being understood from the context.

Guestimates

Who has not seen estimates of the number of intelligent civilizations in our galaxy which are based on counts yielding the incidence of sun-like stars, the probability that any such star has an earth-like planet, and the guessed probability that any such planet will provide the essential nutrients to sustain life? At the end of this chain of probabilities come various wild conjectures concerned with the likelihood that life will evolve into intelligent forms without destroying itself in conflict. Whilst such calculations are not without interest — after multiplying the various probabilities they usually arrive at between ten and one million civilizations in our own galaxy — they will not be repeated here.

We are not alone, perhaps

It is a tenet of science that, having observed or measured some feature of the world, it should initially be assumed to be a norm. Thus, where religious belief used to place man and the earth at a special position with respect to the rest of the universe, science prefers to say that our position and local conditions are unexceptional. It is probably this “norm” principle, rather than any particular knowledge of the nature of life, which leads many modern scientists to admit the likelihood that extraterrestrial life does exist. So, on this assumption, we come to the knotty problem of detection and recognition.

Nothing of interest can be said concerning detection without recognition, and recognition without detection is meaningless. We shall therefore take these terms to be synonymous. One might expect detection to be difficult in the case of intelligent aliens and practically impossible in the case of unintelligent aliens. Strangely though, the latter may be detected before the former through observation of the chemical make up of planetary atmospheres. Carbon based life, and plant life in particular, leaves a characteristic chemical signature that has been confirmed in observations of the earth from surveillance satellites. We have the technology for this in all respects save one — optical (or electromagnetic) resolution. Resolution dictates the ultimate useful field size of our radio and optical telescopes. Low resolution implies that even if we accurately point a telescope, the detail which we want to observe will be swamped by signals from the surrounding area within the field. High resolution means that we can “zoom” in so that the telescope field contains just what we want to observe and little else. The resolution of a telescope is directly related to the size of its primary collector, a mirror, lens, or dish aerial and very large collectors of any kind are expensive. Fortunately though, it has been found possible to simulate large telescopes with an array of well separated smaller ones. A considerable amount of computation is involved in correlating the received data so we pay for the cost-saving in terms of time, which we can afford in the context of a search for alien life.

Detecting intelligent forms

Turning now to the mode of detection, this might be classified as active or passive, from our point of view. It must be active if aliens are ignorant of, or indifferent to, our interest.

Detection then depends upon active search on our part. It is passive if aliens thrust themselves, as it were, upon us. Then we would become aware of them whether we liked it or

not. Some in the UFO community claim that we are being visited, and hence that detection is passive. On the other hand, participants in the SETI project (Search for Extraterrestrial Intelligence) are actively searching for signs of aliens. Whether detection in SETI will be active or passive is debatable. Will we, for example, eavesdrop on private alien communications, or will we pick up signals broadcast with the express purpose of attracting attention?

It would appear from reports that no “intelligent” signals have yet been picked up despite a quite intensive search program. What, then, are the chances of success?

Broadcast signals

First, we must ask if we are safe in assuming that signals from aliens would be broadcast via the electromagnetic field. We know of only a few fields capable of carrying signals between separated points. In principle the gravitational field could do so, though the technology would strain credulity, and budgets! Astronomically large masses would have to be moved around, and pretty fast at that, to carry information at a useful rate. There are several quantum fields, important in communication across nuclear distances, but seemingly useless for communication at the macroscopic, let alone astronomical, level. This leaves the electromagnetic field - we know of no others. Conjectures concerning tachionic fields and so forth take us nowhere at the present time. It therefore seems certain that if we are to detect alien activity it will be through picking up signals in some part, or parts, of the electromagnetic spectrum. Which part of the spectrum to investigate has been a much-discussed topic. Some wavelengths are useless for long-range communications because of high absorption by interstellar dust and planetary atmospheres. Others are hard to detect at the low signal strengths, which one would expect unless signals were strongly collimated and beamed directly at us here on earth — a supposition which seems unjustified though this will be discussed shortly.

Second, on the assumption that we have tuned our equipment to a wavelength that is actually being used by aliens, what form will the messages take? Whether signals are digital or analog, or both, seems, for the moment, to be a mere technicality. But there is one problem that has concerned this writer for a long time. That is the matter of message compression.

When we transmit information in the form of a file on the internet we routinely compress it, that is, reduce the file length, in one of a number of possible ways. The same techniques can be, and sometimes are, applied to broadcast messages. It seems quite reasonable to assume that aliens would also want to reduce the length of messages to speed transmission time and reduce the error rate. The general idea behind message compression is to exploit the occurrence of pattern. In the simple, and rather boring, case of the binary message 0101010101010101 compression can be achieved by specifying 9 occurrences of 01. The 9 could be indicated in binary notation as 1001 and could then be followed by 01 subject to the limitation of pattern counts to 15. This example is extremely simplistic and the compression techniques in common use are far more sophisticated than this, but the fundamental objective is the same — to reduce the incidence of pattern, and not merely simple repetition, in the body of the message. Thus, a well-compressed message will appear very random whether it comprises binary digits, analog signal intensities, or whatever. How do we recognize compressed messages?

There is a reasonable chance that we can recognize such messages. Natural phenomena rarely, if ever, exhibit a high degree of randomness. It is, for example, notoriously difficult to produce truly random number sequences, effectively messages, for lottery purposes. Mechanical contrivances involving numbered balls in rotating chambers are probably the best means available at present. Electronic devices like that used in the UK ERNIE machine are probably less truly random. In passing, it is worth noting that one definition of a truly random sequence of symbols (0s and 1s say) is that it is a sequence incapable of further compression. Tricks, like the introduction of special new symbols to stand for arbitrary parts of the message, or the whole message, do not count as they need a dictionary longer than the message.

Will aliens compress their messages? This seems almost certain for private communication, whilst if they are deliberately announcing their presence it is less likely unless they assume that others know the “standard interstellar communications protocol” whatever that might be!

One favorite format often proposed in the context of interstellar “advertisement” is the sequence of N symbols where N is the product of two reasonably large prime numbers, P_1 and P_2 say. Such a message can be interpreted as a rectangular image with P_1 rows and P_2 columns, or vice versa. Of course, such a message must be repeated so that N can be determined. Unfortunately no messages of this kind have been found. Things are never that simple!

We have little idea of whether aliens would want to announce their presence or not, or whether they could afford to do so. Suppose that we knew for certain that aliens lived in some identified stellar system, and that we had the technology to generate powerful signals announcing our presence. Would we do so? If this involved announcing the location of our home planet, probably not. Whatever, the scientific and humanitarian communities believed, politicians would want to play safe until the nature and intentions of the aliens had been established beyond any doubt. And even then they would try to block it! On this basis the only aliens who would announce their presence would be those with such confidence in their defensive capability that they could repulse any unwelcome visitors. And even then, their own politicians would probably block it! But overriding the security concern is the question of cost versus benefit. It is hard to see what tangible benefits would accrue to the broadcaster beyond the sort of satisfaction experienced by those who prepare their own personal pages on the World Wide Web.

It is probable then, that no alien culture has ever announced, or is ever likely to announce, the location of its home planet, though it may announce its existence from other locations.

Von Neumann Machines

John Von Neumann is reputed to have rejected the idea of intelligent alien cultures on the grounds that they would have built advanced surveillance machines capable of selecting suitable destinations, traveling, collecting data, and reproducing. Some of the cultures which dispatched such machines on their missions are likely to be millions of years older than ours, and the machines would, by now, have reproduced to the extent that they would resemble a plague of interstellar locusts! Since no such machines have been observed it is probable either that we are alone, or that we are about the most advanced intelligence around. The latter alternative seems unlikely given the age of the universe and adopting the “nor” principle introduced earlier.

This writer does not know how carefully Von Neumann considered his idea, or whether it was proposed in a lighthearted vein, but he must have realised that an advanced culture could have foreseen the problem of “cosmic litter” and would have limited the reproductive potency of their machines.

Unidentified Flying Objects (UFOs)

In this essay we shall not be concerned with the veracity of UFO observations beyond noting that, after rejecting the renegade weather balloons, temperature inversions, meteor trails, and sightings by inebriates, there remain a few sightings that are unexplained. Assuming, for the purpose of discussion, that UFOs are genuinely associated with aliens, what is their purpose? Could they be Von Neumann machines, space ships, or something else?

One thing seems absolutely clear, their creators either do not mind if they are seen, or they deliberately embellish them to attract attention. Nearly all reported UFOs are illuminated, and usually in very attractive colors. The technology behind alien UFOs is presumably highly advanced and it is inconceivable that their makers would be unable to render them less conspicuous. It seems then that, if they are genuinely extraterrestrial in origin, their creators fully intend them to be seen. Why would they wish this?

One answer is that they intend them to catalyze curiosity. To argue that, consequentially, they would also catalyze intelligence seems to fall into the notorious trap of assuming the inheritance of acquired characteristics. Perhaps stimulating curiosity is their sole purpose although some reports, such as those for the sightings in Rendlesham Forest on December 27th. and 28th. of 1980, describe some sort of sample gathering activity.

The Rendlesham Forest sightings are amongst the most puzzling reported. The famous Roswell incident of 1947 smacks too much of a U.S. Air Force misinformation exercise for this writer's taste! This is not the place to recount full details of one particular UFO report. Suffice it to say that a number of US air force personnel saw a variety of bright, multicolored objects land and take off in the woods near their airbase in Suffolk, and over a period of two successive nights. A nearby RAF base detected uncorrelated radar reflections in the same area. What really captures attention is the admission by several of the observers — who it should be noted were military personnel — that they were so frightened that they retreated from the scene. Such behavior is not induced by sighting a distant lighthouse, as subsequently was suggested by one authority. Needless to say the British Ministry of Defence dismissed the incident as posing no defence threat, but promptly removed the radar records from scrutiny. If the Ministry could not explain the sightings, how could they know there was no defense threat?

At some stage during the Rendlesham sightings one object appeared to be collecting up some sort of ground mist. This suggests scientific data gathering by an unmanned probe.

Sample collection

Sample gathering on a more serious scale has been reported by large numbers of people in the USA. These are, of course, the abductees who claim to have been taken into an alien vessel

and “screened,” or worse. Beyond natural skepticism there is a problem with these reports which will be described.

Shortly after seeing Steven Spielberg’s film *Jurassic Park*, the author had lunch with a Dutch science journalist. He too had seen the film. “Where”, he asked me over our meal, “would Spielberg’s dinosaurs get their gut bacteria?” All but the most primitive organisms have a symbiotic relationship with a multitude of other life forms including bacteria, viruses, fungi, and even worms. They cannot exist without these “passengers”, and large animals in particular need gut bacteria to help them digest their food. It is most unlikely that the bacterial strains which enabled a Brontosaurus to digest the vast fronds of plant material which it ate, would be around today. The point is that, when alien life forms meet, there is an exchange of micro-organisms which usually proves unpleasant, or even fatal, to both. It happens here on earth whenever a species is introduced into a new environment. Given time immunity to the ill effects builds up, but initially these are very evident. None of the alien abductees seem to have suffered serious harm from their adventure. Nor does one hear of any sick aliens seeking hospital admission. No doubt some abductees would claim that their alien hosts were “pure” creatures so advanced in the medical arts that they had no need of symbiotic relationships. They couldn’t know of course!

If we ever meet aliens face to face, perhaps in a “take me to your leader” scenario, it is likely to be behind glass screens in a specially constructed clean room. Aliens would surely not be so irresponsible as to abduct humans for investigative purposes without similar precautions. Yet so many of the abductee stories speak of relations of a much more intimate kind, and one is inclined to dismiss them.

In any case, alien visits, hostile or otherwise are not easy given the finite speed of light above which, according to our best theories, no material object can travel. But one must consider the possibility that an alien life form might have a life span of 10,000 years and regard a journey of 10 light years in the way we might regard a summer vacation.

Have we met already?

History records a number of encounters with strange life forms some of which have been interpreted as alien. Surely the most convincing of these is recounted in the Book of the Prophet Ezekiel written around the sixth century BC. Chapter 1 of this Old Testament book is wholly concerned with an observation, described as a vision, in which four humanoid creatures, apparently equipped with personal helicopters, arrive to speak with Ezekiel.

One needs to read the original, or at any rate the English translation, to appreciate how different it is from all other Bible stories. It does sound very much like the report of a man quite unfamiliar with advanced technology that suddenly comes face to face with it. Detail is described in terms which would be understood by his countrymen even, it seems, down to the visitors protective clothing and the optical and acoustic effects which accompany rotating helicopter blades.

Having met his aliens, Ezekiel takes sensible advantage of the experience to reinforce his message. Or is that too cynical a view?

Detection — What next?

The foregoing material has considered passive detection of aliens via electromagnetic signals, observation of robotic craft, and personal encounters. We have also discussed the active measure of broadcasting signals to attract attention. It seems that the latter is unlikely to have been adopted by anyone owing to the lack of tangible benefits, and also for reasons of security. The conclusion then, is that our best hope for detecting aliens lies in eavesdropping on private communications in the electromagnetic spectrum, and at wavelengths not specifically chosen for their long-range qualities. Such signals are likely to be of very low intensity and a super-sensitive, high resolution, detector will be needed. This should be sited away from the earth, and most probably on the moon. The detector should take the form of an array of separated dish aerials with the principal axis aligned with the galactic plane. As this lies at a considerable angle to the plane of the ecliptic the array would probably have to span a lunar pole and this would mean that one or more of the detectors would lie on the earthwards side of the moon which might be a disadvantage as it would be exposed to reflections from the earth and also to our own transmissions. The general communications aerial necessary for control of the array and return of data would probably have to be situated on the earthward side unless a satellite relay station was put into orbit around the moon.

For electronic equipment the moon is a hostile environment and the central computing facility will require adequate protection from rapid changes of temperature, fluxes of radiation and particles from solar storms, and micrometeorites. A considerable amount of excavation seems inevitable. The computing facility must be multiplexed for reliable and unattended performance.

Recognizing signals as emanating from intelligent beings will be a matter of discovering the characteristic consistent randomness of compressed messages. Decoding and then translating any such compressed message will be very difficult indeed, but that does not really bear on the matter of detection. Of course, detection of an uncompressed message displaying the sort of regularity we see in language plaintext would be a huge bonus, but seems unlikely.

The computing facility for interpreting data from the lunar array should be sited on earth rather than on the moon as it will, no doubt, require frequent modification as new algorithms are devised. Furthermore, a large volume of data will have to be archived and it would not be sensible to store this at the lunar site.

What comprises proof?

It is probably true to say that, in the Western World at least, the majority of people concur with the views of the scientific community that extraterrestrial life does indeed exist. Nevertheless there is much interest in finding hard evidence, and ultimately, proof.

Whatever evidence is found, satisfying church, state, the scientific community, and the public that it constitutes proof at a formal level will be difficult to say the least. Supposing one or the other body was satisfied that proof had been established, how would that be received? The church, of whatever denomination, which announces that it has proof would be believed to the same degree that its other pronouncements have been believed. That is to say — not greatly in

our present times! As regards the state - well, who believes what politicians say? The scientific community rarely reaches unanimity on any topic. While Professor A says she has discovered a fossil dinosaur with feathers, Professor B says that it is a fossil bird with dinosaur teeth, Professor C says it is an accidental juxtaposition of remains from two different animals, and Professor D says it is a fake! So what is proof for one group of people is not proof for another. Even were an alien spacecraft to land in Times Square, and its occupants seek a televised interview with the President it is unlikely that the foreign public at large would believe it was genuine. After all, every day television shows what wonders can be achieved with models and computer generated images. Conspiracy theories would have a field day.

If SETI finds signals suggesting alien communications many in the scientific community will be convinced. But others will say that the signal could be an artifact arising from our own broadcasts. As regards Joe Public, while he undoubtedly wants to believe, he is unlikely to accept as proof an argument stating that the signal randomness could not have arisen through natural processes, and who could blame him!

Only one thing, it seems, would constitute universally acceptable proof, and that is an immediate, unsubtle, and global threat from an alien life form. Fortunately, outside the pages of science fiction that seems unlikely to materialize.

To conclude, there is one other type of evidence that a few people may have accepted as proof. It is of fairly recent origin, unless you count the Almighty as an extraterrestrial intelligence. This is the evidence of our own presence, supported by the conviction that we are not here by accident. Extrapolating from the ideas of Darwinian evolution certain physicists have suggested that evolutionary principles might have been important in the early moments of the big bang universe. Simply put, stable particles survive and unstable particles do not. However, the proposal is that there might have been many possible states into which the fundamental constituents could have settled. Now suppose that, after a few hundred million years of cerebral evolution, an intelligent life form fully understood all the laws of nature. Might such a culture understand what conditions will produce a new big bang universe, and possibly one with certain advantages over their own? They would have reached a stage where they could begin to indulge in experimental cosmology. They could beget new worlds. Furthermore, such a process of regeneration might have happened many times in the past, each evolving a universe with greater potentiality for life. Of course, the word "universe" is a misnomer here. In our current model of the big bang universe time, space, and matter are meaningless concepts until the primary event, but this is not a prerequisite of the theory. Most parts of an existing universe in which a new big bang occurred would not notice the event for a very long time indeed. At the local level the new boundary "wave front" would presumably sweep the old order into oblivion. Outside this wave front nobody would notice.

To this writer, all this seems to be a question of belief concerning the nature of God rather than science. But there are some such believers and for them, our very existence is proof of an endless succession of extraterrestrial intelligences, and benevolent ones at that.