THE SEARCH FOR A RATIONALE FOR INTERSTELLAR COMMUNICATIONS

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In this paper I would like to explore the motives that have been given, or that might lie behind the expressed desire to communicate with other intelligent life forms living elsewhere in our Galaxy.

Several very ingenious schemes for establishing a rapport with alien intelligences have already been developed. Languages that could be easily taught have been devised, with methods by which a vocabulary for communication could be systematically built up. And methods have been suggested for constructing pictorial presentations that could be decoded by any beings having our level of intelligence.

In short, the "how" of communicating by means of radio messages over interstellar distances (once contact had been made) has been worked out. And there are no real technical barriers to our talking to our opposite numbers within a radius of about 100 light-years from the sun. We could--right now--build radio transmitters or lasers powerful enough to send recognizable signals out into a volume of space that includes a considerable number of stars that might conceivably possess planets on which intelligent beings could live.

The "how" has been taken care of well enough. I'd like to discuss the "why" of the matter.

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However, before getting into a discussion of motivations, perhaps a very short review of what various scientists have calculated about the prevalence of other intelligent life forms would be in order.

These calculations, when carried out in detail, usually place numerical values on each of a series of quantities, fractions, or probabilities which, in the end, are multiplied together to provide an estimate of the number of civilizations coexisting with us in our Galaxy. I say our Galaxy because presumably what applies to our Galaxy would also apply to other galaxies; also, because nobody knows how many galaxies there are in the universe, it is more convenient to make calculations for a single Galaxy, specifically, our own, the Milky Way.

The sequence of required quantities goes something like this:

We start out with the total number of stars in our Galaxy (usually taken as 150 to 200 billion).

Next, what fraction of the total population of stars has properties that would make them suitable as primaries in a system where life could flourish? (Possibly 10 or 15 per cent.)

Third, what fraction of these stars has planets?

Fourth, what is the probability that a star with a planetary system would have at least one planet suitable for life?

Fifth, what is the probability that life will appear on a planet where all the physical and positional conditions are favorable?

Sixth, what is the probability that an intelligent life form will appear?

Seventh, what fraction of intelligent life forms will develop a technological civilization?

Eighth, what is the probability that a given civilization will be in existence at the same time as our own? This last factor, incidentally, brings in the somewhat debatable concept that all civilizations have finite lifetimes and that they either destroy themselves after a few hundred or thousand years or else eventually lose interest in exploring the universe and go into a senescent decline or evolve into a yoga-like state of meditation and contemplation.

Finally, the eight factors I have itemized, or similar ones, are multiplied together to produce an estimate of the number of active technological civilizations in our Galaxy.

A dozen or more of such estimates have been published in the last year or so, all with appropriate qualifications and caveats; and I will not take the time to go over these in detail but will divide the estimates into several classes.

1. Estimates that place the number at greater than a million, as exemplified by the calculations of:

I. S. Shklovskiy -- (several million)

A.G.W. Cameron -- (2 million)

Su-shu Huang -- (3 million)

2. Estimates in the thousands, as typified by:

S. von Hoerner -- (~50,000)

F. D. Drake -- (200,000)

3. Finally, there are those who would choose either a very small number or zero.

G. G. Simpson -- (close to zero)

Edward Purcell -- (a few)

George Beadle -- (a very small number)

One of the interesting aspects of these estimates is this. Most of those people who have attacked the question have agreed quite well on many of the factors: The kinds of stars that would serve as suitable primaries (class F, G, and K main sequence stars), the probability that these stars have planets (= 1.0), and the probability that life will appear when all planetary conditions are suitable (= 1.0). However, wide disagreement is found with respect to the emergence of intelligent forms of life and the longevity of civilizations. Hence the great range in the estimates of the prevalence of nonhuman civilizations in the Galaxy--from zero to several million.

One argument against the occurrence of other intelligent life forms is implied by the question, "If there are so many advanced forms of life around, where <u>is</u> everybody?"

There are a variety of answers to this question.

1. The first and most obvious reason that we haven't encountered any other intelligent groups is: there are <u>no</u> other intelligent beings in our Galaxy.

However, a number of other equally valid reasons can be given:

2. There are intelligent beings elsewhere, but interstellar flight is virtually impossible. This is the view very ably expressed by Edward Purcell and Sebastian von Hoerner, among many others who maintain that the only rational approach is through communications--not travel. There is only one thing wrong with this view--it doesn't take into account the possibility of future scientific discoveries or breakthroughs, or the possible drastic lengthening of the human lifespan which could completely change the prospects for interstellar travel.

3. Interstellar flight is possible but none of the other intelligent groups are advanced enough, so have not yet made interstellar flights.

4. Interstellar flight is possible, but the other intelligent groups are so far away that they haven't reached us yet.

5. Interstellar flight is possible, but no other groups have gone in for space flight because it's too expensive and has no economic payoff.

6. Interstellar flight is possible and other intelligent groups are capable of reaching us and know about us, but have a "hands off" policy and are letting us work out our own destiny without interference.

7. Other intelligent groups have reached us but are keeping out of sight, perhaps just observing.

Having gone through this little exercise in armchair speculation, however, I'm afraid we are not much farther along in our pursuit of the question: "Are there other intelligent beings in our Galaxy?"

This question possibly symbolizes the final step in the dislodgement of mankind from the philosophical position it once occupied at the center of the Universe. During comparatively recent historical times our ancestors discovered that the earth, the home of mankind, was not the center of all creation, but they consoled themselves with the idea that at least our Sun was at the center of the visible Universe. Then it was discovered that the Sun was not even at the center of our Galaxy and that our Galaxy did not appear to be at the center

of anything in particular, except a point of view; but still people could console themselves with the idea that mankind represents the highest form of life. This alone remains to be shattered.

And this is really the burning question behind attempts to make contact with extraterrestrial intelligence. It is the desire to find out where Man stands in the universal scale of things.

The motives for interstellar communications can be viewed against the background of the possible levels of prevalence already mentioned. Technological civilizations are either very common--numbering in the millions so that the separations between the closest neighbors are measured in tens or hundreds of light-years, or they are much less prevalent, numbering in the thousands so that separations between neighbors are measured in thousands of light-years; or they are extremely rare--less than 10 per Galaxy so that the separations are measured in tens of thousands of light-years.

The primary motive for contacting another civilization is the interesting philosophical one of simply finding out whether it exists. Another motive that has been advanced is that if we contact another culture, we can learn a great deal from it because it will undoubtedly be far more advanced than we are--just as the underdeveloped nations of the world are now gradually learning to use the technology of the West.

Let's explore this motive briefly. Suppose we did make contact with an advanced civilization about 100 light-years away (which might indicate that civilizations are quite common), then a dialogue with a cycle length of about 200 years could be established. After contact had been established and the preliminaries of teaching them our language or learning their's had been completed, we might then send them a series of questions: Please tell us all you know about the origin and evolution of stars, the origin and evolution of galaxies, the origin of matter, the structure of atoms, the control of cancer, the control of thermonuclear reactions, and so on. Some 200 years later, all the answers would come back. That is, assuming our respondent knew the answers, and could express them in terms we could understand, and was willing to share his knowledge with us. This could result in our suddenly

leaping ahead technologically and scientifically. It could also result in closing the book on the sciences of astronomy and physics, and rendering many of our scientists obsolete. But remember, during that time-lag of 200 years we would not have been standing still, so by the time the answers came back they might no longer be wanted--we would probably already have discovered most of the answers by ourselves. At the present rate of scientific and medical progress, it appears that the time-lag between the formulation of a scientific question and the solution to a problem is a great deal less than 200 years.

On the other hand, the most pressing of human problems are social and political ones--and are peculiarly human in nature. These problems cannot wait for 200 years for a solution, nor is it to be expected that another intelligent species, however intelligent, could do more than give us the benefit of their experience or their advice--which would in all probability be completely irrelevant to human society. In any event, there is no reason to believe that their advice, however excellent, could be put into practice. Moreover, the sudden acquisition of a great store of technological information might even create new social problems. As things are now, many people feel that our technological progress is already outrunning our ability to solve the problems of human society. Whether or not this represents a correct viewpoint, an enormous advance in the physical sciences would make the imbalance still more acute. So the gift of knowledge from our hypothetical, highly-advanced alien radio friends 100 light-years away might not turn out to be an unmixed blessing.

However, if stellar civilizations are very few and far between so that the conversation delay would be measured in thousands or tens of thousands of years, then these civilizations could have little impact on us for a very long time to come. It is almost certain that we would not be able to decode any intercepted interstellar messages unless they contained pictures which might be reassembled, or unless they contained a program for teaching the language being used.

We cannot expect to get much help in solving any strictly human problems via interstellar radio or other communication methods.

It would be interesting, however, to discover the mere existence of intelligent beings elsewhere in the Galaxy--even if a true "conversation" might not be established. I believe that this is a sufficient reason to establish a program of listening for intelligence-bearing signals from the stars. If we do not detect any such signals, it will not prove we are alone in the Galaxy as there might be plenty of radio traffic out there, but none of it beamed our way with a high enough signal-to-noise ratio for us to pick up. But, it is relatively inexpensive to listen and it is possible that such listening could be automated and arranged to scan all the promising stars over all the electromagnetic frequencies that appear to be usable.

Until we do pick up signals from space, we should probably maintain radio silence--as we are doing now. It is only within the past few years that we have achieved the potential for transmitting messages over interstellar distances; whereas other cultures with the technology to detect such signals (if they exist) are doubtless far more advanced that we are. I do not see any need at this point in our history to advertise our presence on the galactic scene. After all, we have absolutely no knowledge of the great unseen radio audience out there, or of their manners and morals. It is true that some of our scientists have presented excellent arguments to prove that actual travel across interstellar distances is quite infeasible. But maybe some of the extraterrestrials out there are not aware of this--and would be quite willing to spend a hundred years or more of their life-spans in travelling to a guaranteed habitable and defenseless planet. There is no reason to believe that a high degree of technology must inevitably be associated with an enlightened moral code. And there is no reason for us to attribute to these completely unknown extraterrestrials a set of virtues far superior to those of some human beings, or some human societies.

I have presented a few opinions about the motivations for interstellar communications--and, in summary--I believe that it would be premature for us to attempt to send out signals that could be received at stellar distances--but that it is reasonable to listen--primarily to satisfy our human curiosity about the place and role of mankind in the universe at large.