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FORUM: von Hoerner on SETI

Astronomer, engineer, philosopher, cosmologist, like a Leonardo da Vinci or a Benjamin Franklin, his interests are broad and his insights run deep.

This interview with Sebastian von Hoerner was made by Mirjana Gearhart of ***COSMIC SEARCH*** *just before we went to press.*

von Hoerner

COSMIC SEARCH: It is almost two decades now without any positive results. Does that mean that SETI is a failure?

von Hoerner: No, I would certainly say not. Twenty years is a short time. Twenty years may seem long, but in astronomical terms and even in the development of science, 20 years is a very short time. So to have no positive result in 20 years is not a failure.

COSMIC SEARCH: Do you consider SETI to be a legitimate scientific pursuit?

von Hoerner: Yes, of course. It is an observational search for something which is theoretically possible. For example, neutron stars were considered theoretically possible a long time ago by Oppenheimer, and we think that in the form of pulsars we have detected them. Quarks (elementary sub-particles) are theoretically possible. We are searching for them which is very difficult and we haven't found any yet, but still the search continues with success as a real possibility. We are searching for gravitational waves because they are a possibility, but we have not found any yet. The neutrino

radiation from the sun is a possibility. We are searching for it but haven't found the predicted amount. So, you see, there are many things which are theoretically possible. We search for them and in some cases we find something and in other cases we have not found them yet. Other intelligent beings are certainly a possibility, so why not search for them?

COSMIC SEARCH: You have often written that the sun is an average star, the earth an average planet, and that mankind has an average intelligence.

"If there is a galactic culture, a galactic club, then why not join it? We would lose our present culture, or what we think is a culture, and merge into a larger way of life."

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von Hoerner: Yes, let us discuss the assumption of being average. The sun being an average star is a statement which we can make with confidence because we know a lot about the stars. But that the earth is an average planet is theoretical and we will have to see if we are right. We have not yet seen any other planets (outside our solar system).

COSMIC SEARCH: Serkowski is doing work on this now at the University of Arizona, isn't he?

von Hoerner: Yes, there are efforts going on but I would say that they are just at, or beyond, our present limits of observation. So far we have not seen planets of other stars. Still, from all our theoretical ideas about the formation of stars, we are almost sure that planets are the rule, so there ought to be lots of them.

Now one step further, regarding the question of life on those planets and the question of intelligence. We have only one single case and that is us. And the question is, can we do statistics when the sample number N equals one? The answer is "yes", if you know the rules.

If you have only one example to go by, with N equals one, then you do have an estimator for the average, and that is the one case you have. This would mean we

should assume that we are average. On the other side with N equal to one, we do not have an estimator for the mean error. In plain English this means that the assumption that we are average has the highest probability of being right but we have not the slightest idea of how wrong it is.

COSMIC SEARCH: That's an interesting way of putting it.

von Hoerner: So much for statistics with N equal to one. We cannot make any solid statements about possibilities on other planets, but, still I would say that the assumption that our development is average has the best chance of being right. If we generalize our own case, our own past development and our present state of mind, we should expect a very large number of similar planets and similar civilizations with comparable kinds of intelligence with whom we could talk.

And why we haven't found any signals yet would just go back to your first question, namely, 20 years is a very short time. We haven't really made any dedicated effort, that is, we haven't spent any money for that purpose. We have used existing telescopes; we have used existing receivers, and only short periods of time. This may be the reason we haven't found any signals. What I have just said applies if we generalize our own present state of mind and situation. But, if we think about our own future and consider what we might be doing during the next 100 or 200 years and generalize that again, then the picture changes considerably.

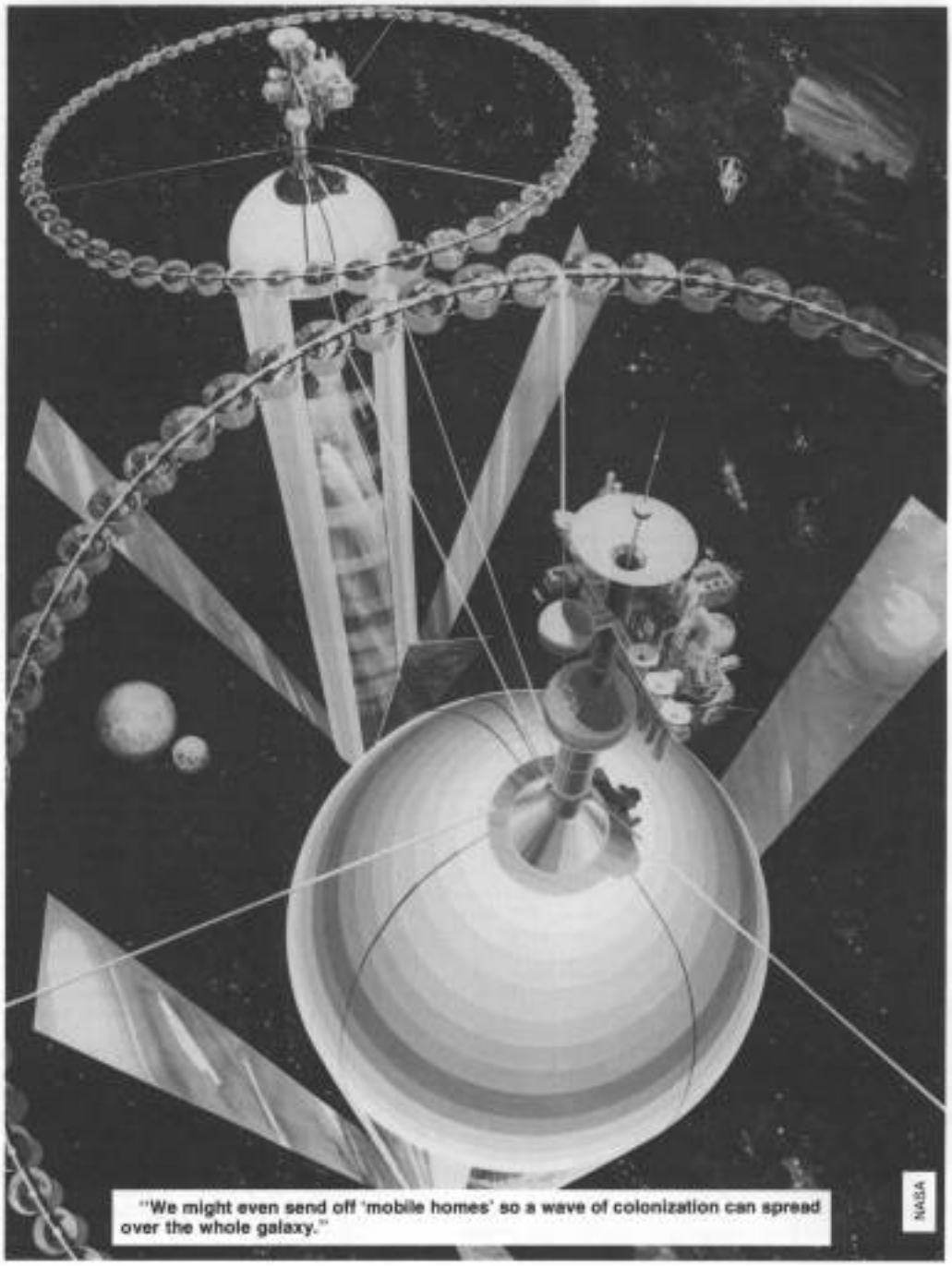
COSMIC SEARCH: Could you please explain?

von Hoerner: Well, we are just beginning our space exploration — sending probes to other parts of our solar system. This activity is just getting started and will probably go on and continue to grow on an even larger scale. Plans for colonies on the Moon or colonies on Mars, underground or in shelters, have already been worked on. There is a lot we could do in terms of mining and of scientific exploration.

Just pure mining of materials is something we will have to consider. We are running out of supplies here on Earth and there are many resources on the Moon and Mars and mainly on the many asteroids. These are big chunks of minerals, and there are about 200,000 which are more than a kilometer in size or larger. Most probably in the next few generations, say in the next 100 years or so, we will

engage in this kind of activity.

If we have colonies on the Moon and Mars with men and women living with their own children and grandchildren, the ties to the home planet will grow less and less important. After a while these colonies might send out people for trips lasting many generations, in 'mobile homes' so to say, to explore other solar systems. And if they find an inhabitable planet they will stay there and colonize it, and if not, they will go on searching.



COSMIC SEARCH: What happens if mankind loses its exploratory instinct and becomes very complacent?

von Hoerner: Yes, that is a different possibility. Let's keep it in mind. I will come to it later.

I think that it is very probable that if we do not destroy ourselves, which has also a

very high chance, that it is very probable that we will send out probes or expeditions to other planetary systems and we will look around in the galaxy. When we settle down on any of these other planets, the same things will be repeated. We will mine moons and other places. We might even send off 'mobile homes' again in other expeditions, so a wave of colonization can spread over the whole galaxy. Actually space travel becomes completely feasible even with our present technology, provided you forget the prejudice that it must be finished in one man's lifetime. Then we can cross the whole galaxy.

COSMIC SEARCH: So that in essence you are generating space colonization?

von Hoerner: Yes, an expanding wave of colonization just like the Polynesians and their tiny little fragile boats that colonized the Pacific ocean one island after another. It took many generations. That will be possible for us in the next generations, and we can do it. Generalizing our own case, we should remember that the sun is not an old star. It has only half the age of most other stars so whatever we think is possible for us should have been done long ago by the others. The number of stars with habitable planets has been estimated to be about one-half a percent of all stars, which means our whole galaxy would have about a billion habitable planets. This wave of colonization should have been started by any one out of one billion possible places about 4 billion years ago. The galaxy should be teeming with life and our own earth should have been colonized long ago by others, which is certainly not the case. The absence of extra-terrestrials in our own solar system would lead to the conclusion that there are no intelligent beings anywhere else, that we are the only ones.

COSMIC SEARCH: What happens if a civilization had encountered the earth, perhaps a long time ago and had a survey team, some kind of a patrol that came by, and said that the earth was not inhabitable for some reason? Wouldn't this be a possibility?

von Hoerner: Yes, this could have been the case at an early time, when, for example, we didn't have oxygen. If they were oxygen breathing beings like ourselves and they came by here and found no oxygen they could have said, "Let's go somewhere else, or try later on" or they could have planted something which would make the development they want.

COSMIC SEARCH: But perhaps by a natural selection effect that could have been the wrong way for something to develop. Perhaps the seed, or whatever they left, wasn't fit to survive on this planet.

von Hoerner: Yes, but again, the numbers are so big it could have been started in any one of a billion ways and a lot of different travelers could have been here and all of them must have found the earth unpleasant.

COSMIC SEARCH: This might be an explanation why we were overlooked by some civilizations.

von Hoerner: All these things are possibilities. Four billion years is a long time and the one billion places where it could have started is a large number. There are other possibilities — our present state of mind, of technology and science and wanting to communicate. It may be that all civilizations which stay too long in this state destroy themselves, or, they survive this state only if they become very stagnant. It could be that either we blow ourselves up or we get stagnant and that there might not be much in between. It is the in-between cases that we look for.

"(The value of) one-way communication should never be underestimated."

COSMIC SEARCH: As you have written, it is a very narrow path we have to follow.

von Hoerner: Yes, there needs to be enough zest and drive left to start a big project, and enough stability and support to keep it going for a long time.

COSMIC SEARCH: Will man's natural curiosity sustain a search that may last centuries or even millennia?

von Hoerner: Yes, that is what I mean. With curiosity and drive and energy — push — you can do all these things. But, on the other hand, we can also destroy our civilization. If you want to avoid this crisis and institute a lot of regimentation and

rules, and weed out everything which is dangerous, you also will weed out this kind of natural curiosity because it would be dangerous. I don't know the answer. The problem is the large number. It might be the case that civilizations just have to get stagnant in order to survive. But I cannot see that it must be so without an exception or two in a billion of cases.

COSMIC SEARCH: We haven't experienced a technological growth for a long enough time to know that in a 100, or 1000 years, we might not become stagnant. Now another question. There are those who say that contact with an extra-terrestrial civilization would benefit mankind and help to solve all the problems that we are laboring to solve on the earth now, for example, war, over-population, pollution, etc. Do you see such a contact as beneficial or otherwise?

von Hoerner: I would certainly think that it would be beneficial. Those who would come in contact with us are those who have survived so they must have solved the problems we are facing. I think the problems we on Earth are facing are quite common. Whoever is around (of these older civilizations) would have had the same problems and perhaps could give us good advice.

COSMIC SEARCH: What if they were malevolent?

von Hoerner: I don't think they would be. Those that are badly aggressive would have killed each other or blown up their own planets. Those who survive would be more gentle, peaceful, and reasonable.

COSMIC SEARCH: They would also have learned how to survive in a small living space too. That becomes important.

von Hoerner: There is a lot to be learned from those who have survived.

COSMIC SEARCH: Do you see that there might one day be a multinational effort in searching for extraterrestrial intelligence? Would that be better than nations looking individually?

von Hoerner: A multi-national effort might well end SETI. For example, we would never have had a man on the moon if there had not been a cold war. We needed the competition. We want to demonstrate our powers, our abilities. That is

one of the big driving forces, at least for those who dispense the money. It is not the driving force for the scientist, but it is for the politician. I think if we make this a completely international effort we will end up with a lot of committees and nothing will ever get done.

COSMIC SEARCH: Perhaps this is a reason to keep politics out of SETI?

von Hoerner: Oh, we should have international conferences and we should try to learn from each other. That is a different thing. But we should not try to organize it money-wise and politically on a common base.

COSMIC SEARCH: Would you speculate on the impact of a successful SETI search?

von Hoerner: It would be much larger than any of us can imagine at the moment. I would say it would be the end of our culture. Like any Stone Age culture coming into contact with us loses its culture. The same would happen to us. We only hope that the others would handle it somewhat better than we did for our own natives.

COSMIC SEARCH: Maybe that's why there has been no contact. "They" are doing a good job of this.

von Hoerner: Coming into contact with a more highly developed culture always means the end of your own. I would say that is a certainty. But whether it is good or bad is a matter of opinion. I would like to see our culture merge with the other one. If there is a galactic culture, a galactic club, then why not join it? We would lose our own present culture, or what we think is a culture, and merge into a larger way of life. This is the only way it should go.

COSMIC SEARCH: And that would assure our continued existence?

von Hoerner: Yes, probably so.

COSMIC SEARCH: If you were organizing a new SETI search with today's state of technology and knowledge of the universe, where would you look? What criteria would you use?

von Hoerner: I would say it could be done in three different ways. Number one is

that you do not make any special search. Many astronomers do normal astronomy and just keep their eyes open for anything unusual which might point to a possibility of other beings. For example, the first pulsar was very suspicious. Unfortunately, it found a natural explanation. What we do is look for unusual things which lead to something other than a natural explanation.

Number two is done occasionally by a small number of astronomers. They think up some special search programs which can be done with existing equipment, using existing telescopes, using existing receivers — maybe special correlators or something — but not investing much money or much time either.

COSMIC SEARCH: What mode of communication might be expected?

von Hoerner: We do not know which mode of communication they might use but we should explore those methods which we know are possible. Radio contact is certainly one, there is no question, so we should search for radio signals. Freeman Dyson ("Science" June 3, 1960) has ideas about how a further developed civilization uses all the radiation of a star by building a sphere around it. This sphere will emit in the infra-red so we should look for infra-red sources. We have found a few but so far they have natural explanations. We should make many different, special planned searches for signals or other signs of life with existing equipment. That's method two.

Now, method number three would involve investing larger sums of money and making dedicated searches with dedicated instruments built especially for that purpose, Again we cannot be sure that we have the best method. There might be much better ways of communication but we should remember that this negative argument will never change. Suppose we say now, let's wait a thousand years. It is likely that in a thousand years we'll know better methods than are known today. But after 1000 years we might say again, let's wait another thousand years for still better methods. The point is we can never be sure we have the best method; it is just not possible. So we might as well start right now after having found one possible method, namely radio contact on a likely frequency.

COSMIC SEARCH: You mean do it now instead of waiting a few hundred years when our priorities might be different?

von Hoerner: Yes, that is a very good point. And we should try several methods. We could build larger telescopes for radio and for infra-red, or optical lasers have also been suggested; so we shouldn't get stuck with just one single method. We should investigate several and we should not hesitate to invest some of our money in them.

COSMIC SEARCH: Let's assume that we have established contact with an extra-terrestrial intelligence. Is the communication a one-way street or is it a two-way street?

von Hoerner: Two way communication we might describe as communication where questions are asked and answers are given. In order that waiting times wouldn't be too long between questions, means that the distances cannot be too great. However, if the distance is as much as 500 light years, for example, the answer to any question will take 1000 years. And the question then is: Will we still be interested in the answer to a question we have asked a thousand years ago? I would say that we probably wouldn't be interested. In this case, it would be a one-way communication where we get a wealth of information without asking for it, but we should never underestimate its value. For example, our whole western civilization has been greatly influenced by the ancient Greeks and their culture although they left nothing for us but a few books and some art. It was a one-way communication. All our cultural inheritance, all our traditions, and we live a great deal by traditions, all this has been a one-way communication from the people of many generations ago to us. One-way communication should never be underestimated.

COSMIC SEARCH: How will the communication be carried out? What kind of language will be used, etc.?

von Hoerner: I think we will be taught. We are the beginners. The others are far ahead so they will talk to us and we will need to learn to understand them and their methods just as children learn from adults.

COSMIC SEARCH: Are you assuming that an extra-terrestrial intelligence has the patience to teach us, and that we are willing to be students?

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von Hoerner: Well, if they have enough interest they will have the patience, and if, again, we assume that we have a strong desire to communicate, it certainly can be done. Even if they are very far advanced they might still know how to talk to children. We learn what they consider to be baby talk and later we will grow up and acquire a fuller understanding.

COSMIC SEARCH: Can you see an extra-terrestrial civilization as picking out certain people within a given range as candidates or students? How would it be done?

von Hoerner: In any interstellar communication, because of the long waiting time involved, it will not be communication between individuals. It will be communication between civilizations. Planet Earth will talk to some other planet somewhere far off.

COSMIC SEARCH: Would an Arecibo-type message of the kind sent out a few years ago to a star cluster, some 20,000 light years distant in the constellation Hercules, be a valid way for us to contact another civilization, or do you think that it was a futile attempt?

von Hoerner: We are sending out messages all the time by radio and television whether we like it or not. These are strong signals and they are going out all the time so we are announcing our presence all around us. This is the first point. Second, there are very few instances where we have purposely tried to send a message. The first is what you called the Arecibo message. This was by radio signals for a very short time and in only one direction. The second message involved a metallic plaque with a picture (man, woman, solar system, pulsars, etc.) aboard Pioneer X, which will pass Pluto's orbit and leave the solar system. The third is the Voyager message. This consists of two metal discs like our records with all the equipment and instructions to play them. The discs have pictures of the earth and sounds of the earth and selections of all our kinds of music. Now these things

are messages from us to other civilizations, but their chance ever of being received is very remote.

COSMIC SEARCH: Then in fact they are a practice exercise?

von Hoerner: They are that, but they are more than that. They are a message to ourselves. They try to make us think about ourselves as seen through the eyes of others and that is very valuable. If you try to say to someone else what you are, you first have to think about what you are. That is very valuable, regardless of whether anyone else listens or not.

COSMIC SEARCH: The messages, then, are a message of the Earth's civilization from a unified standpoint?

von Hoerner: Yes, the messages are about us; we on Earth talk about us, about our intelligence. When we send messages, they make us think about ourselves from a distant point of view which might give us a much better perspective about our own problems. I would say this is very valuable even if nobody else gets the message.

COSMIC SEARCH: Is the recent upsurge in the pseudo-sciences an indication that man is thinking that he has some small part in a huge cosmic connection? Are we interested and receptive to SETI because of that?

von Hoerner: By pseudo-science do you mean things like UFOS?

COSMIC SEARCH: Yes, and astrology.

von Hoerner: That is a very good question and I think there may be some connection. We would like to think that life makes sense, and strong religious belief can give us support and explanations. Astrology can do this for some persons. Many religions talk about higher developed beings sometimes thought to be hovering around trying to help us — we don't call them angels any more but UFOs fit in this category. There may be a certain connection between this belief in higher beings and our strictly scientific search for extra-terrestrial intelligence.

COSMIC SEARCH: Finally, where does SETI fit in a historical perspective?

von Hoerner: I seriously think that trying to establish contact with other beings in the universe is our next great task and that success would mean the largest step in the evolution of mankind since our development of speech about a million years ago. Meanwhile as a fringe benefit thinking about life in space may be helpful in giving us a better perspective for looking at our own affairs and problems.

Sebastian von Hoerner was born in Görlitz, Germany, in 1919. He received his Ph.D. degree in physics from the University of Göttingen in 1951. Dr. von Hoerner was associated with the Max Planck Institute for Physics (Göttingen) and the Astronomical Computation Institute (Heidelberg) before joining the National Radio Astronomy Observatory (Greenbank, West Virginia) as staff scientist in 1962. He has worked on problems of stellar dynamics, star formation, shock front propagation, lunar occulations, cosmology, gravitational collapse, life in space and the structural analysis and optimization of radio telescopes, pioneering the homologous antenna concept. Von Hoerner is the author of three astronomy books and over 65 articles in scientific journals. He has been a visiting professor and lecturer at Cornell, UCLA (Los Angeles), Bonn, Mexico City and Basel (Switzerland), and currently is a member of the Editorial Board of COSMIC SEARCH.

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