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E5_AD_A6_E8_8B_B1_E8_c82_227632.htm TextAre we humans alone in the universe? Or is there intelligent life on other planets?

These questions are not new. What is new, however, is the scientific attempt to discover whether or not other planets beyond our own have given birth to advanced civilizations. In the following article, the author describes the scientific means now available for investigating this possibility and discusses how probable it is that we are not alone in the universe.

THE QUEST FOR EXTRATERRESTRIAL INTELLIGENCE
Carl Sagan
Through all of our history we have pondered the stars and mused whether humanity is unique or if, somewhere else in the dark of the night sky, there are other beings who contemplate and wonder as we do, fellow thinkers in the cosmos. Such beings might view themselves and the universe differently. Somewhere else there might be very exotic biologies and technologies and societies. In a cosmic setting vast and old beyond ordinary human understanding, we are a little lonely. and we ponder the ultimate significance, if any, of our tiny but exquisite blue planet. The search for extraterrestrial intelligence is the search for a generally acceptable cosmic context for the human species. In the deepest sense, the search for extraterrestrial intelligence is a search for ourselves. In the last few years -- in one-millionth the lifetime of our species on this planet -- we have achieved an extraordinary technological capability which enables us to seek out unimaginably

distant civilizations even if they are no more advanced than we. That capability is called radio astronomy and involves single radio telescopes, collections or arrays of radio telescopes, sensitive radio detectors, advanced computers for processing received data, and the imagination and skill of dedicated scientists. Radio astronomy has in the last decade opened a new window on the physical universe. It may also, if we are wise enough to make the effort, cast a profound light on the biological universe. Some scientists working on the question of extraterrestrial intelligence, myself among them, have attempted to estimate the number of advanced technical civilizations -- defined operationally as societies capable of radio astronomy -- in the Milky Way Galaxy. Such estimates are little better than guesses. They require assigning numerical values to quantities such as the numbers and ages of stars, the abundance of planetary systems and the likelihood of the origin of life, which we know less well, and the probability of the evolution of intelligent life and the lifetime of technical civilizations, about which we know very little indeed. When we do the arithmetic, the sorts of numbers we come up with are, characteristically, around a million technical civilizations. A million civilizations is a breathtakingly large number, and it is exhilarating to imagine the diversity, lifestyles and commerce of those million worlds. But the Milky Way Galaxy contains some 250 billion stars, and even with a million civilizations, less than one star in 200,000 would have a planet inhabited by an advanced civilization. Since we have little idea which stars are likely candidates, we will have to examine a very large number of them. Such considerations suggest

that the quest for extraterrestrial intelligence may require a significant effort. Despite claims about ancient astronauts and unidentified flying objects, there is no firm evidence for past visitation of the Earth by other civilizations. We are restricted to remote signaling and, of the long-distance techniques available to our technology, radio is by far the best. Radio telescopes are relatively inexpensive. radio signals travel at the speed of light, faster than which nothing can go. and the use of radio for communication is not a short-sighted or anthropocentric activity. Radio represents a large part of the electromagnetic spectrum and any technical civilization anywhere in the Galaxy will have discovered radio early -- just as in the last few centuries we have explored the entire electromagnetic spectrum from short gamma rays to very long radio waves. Advanced civilizations might very well use some other means of communication with their peers. But if they wish to communicate with backward or emerging civilizations, there are only a few obvious methods, the chief of which is radio. The first serious attempt to listen for possible radio signals from other civilizations was carried out at the National Radio Astronomy Observatory in Greenbank, West Virginia, in 1959 and 1960. It was organized by Frank Drake, now at Cornell University, and was called Project Ozma, after the princess of the Land of Oz, a place very exotic, very distant and very difficult to reach. Drake examined two nearby stars for a few weeks with negative results. Positive results would have been astonishing because as we have seen, even rather optimistic estimates of the number of technical civilizations in the Galaxy imply that several hundred thousand stars

must be examined in order to achieve success by random stellar selection. Since Project Ozma, there have been six or eight other such programs, all at a rather modest level, in the United States, Canada and the Soviet Union. All results have been negative. The total number of individual stars examined to date in this way is less than a thousand. We have performed something like one tenth of one percent of the required effort. However, there are signs that much more serious efforts may be mustered in the reasonably near future. Besides, hand in hand with the recent spectacular advances in radio technology, there has been a dramatic increase in the scientific and public respectability of the entire subject of extraterrestrial life. A clear sign of the new attitude is the Viking missions to Mars, which are to a significant extent dedicated to the search for life on another planet. But along with the burgeoning dedication to a serious search, a slightly negative note has emerged which is nevertheless very interesting. A few scientists have lately asked a curious question: If extraterrestrial intelligence is abundant, why have we not already seen its manifestations? Skeptics also ask why there is no clear evidence of extraterrestrial visits to Earth. We have already launched slow and modest interstellar spacecraft. A society more advanced than ours should be able to ply the spaces between the stars conveniently if not effortlessly. Over millions of years such societies should have established colonies, which might themselves launch interstellar expeditions. Why are they not here? The temptation is to deduce that there are at most a few advanced extraterrestrial civilizations -- either because statistically we are one of the first technical

civilizations to have emerged or because it is the fate of all such civilizations to destroy themselves before they are much further along than we. It seems to me that such despair is quite premature. All such arguments depend on our correctly surmising the intentions of beings far more advanced than ourselves, and when examined more closely I think these arguments reveal a range of interesting human conceits. Why do we expect that it will be easy to recognize the manifestations of very advanced civilizations? Is our situation not closer to that of members of an isolated society in the Amazon basin, say, who lack the tools to detect the powerful international radio and television traffic that is all around them? Also, there is a wide range of incompletely understood phenomena in astronomy. Might the modulation of pulsars or the energy source of quasars, for example, have a technological origin? Or perhaps there is a galactic ethic of noninterference with backward or emerging civilizations. Perhaps there is a waiting time before contact is considered appropriate, so as to give us a fair opportunity to destroy ourselves first, if we are so inclined. Perhaps all societies significantly more advanced than our own have achieved an effective personal immortality and lose the motivation for interstellar gallivanting, which may, for all we know, be a typical urge only of adolescent civilizations. Perhaps mature civilizations do not wish to pollute the cosmos. There is a very long list of such "perhapses," few of which we are in a position to evaluate with any degree of assurance. The question of extraterrestrial civilizations seems to me entirely open. Personally, I think it far more difficult to understand a universe in which we are the only

technological civilization, or one of a very few, than to conceive of a cosmos brining over with intelligent life. Many aspects of the problem are, fortunately, amenable to experimental verification. We can search for planets of other stars, seek simple forms of life on such nearby planets as Mars, and perform more extensive laboratory studies on the chemistry of the origin of life. We can investigate more deeply the evolution of organisms and societies. The problem cries out for a long-term, open-minded, systematic search, with nature as the only arbitor of what is or is not likely New Wordsquestn.

searchextraterrestriala. (coming from) outside the earthponderv. think about slowly and carefullymusev. think deeply, forgetting about the world around onecontemplatev. look at or think about intently. have in mind as a possibility or planexotica. not native. fascinating because strange or different 外国的 ; 异国情调的biologyn. the scientific study of living things. animal and plant life, as of a given area 生物学 ; 一个地区的生物cosmica. of the universe, esp. the heavens as distinguished from the earth 宇宙的exquisitea. extremely beautiful or pleasant, esp. in a delicate or refined wayacceptablea. good enough. satisfactoryextraordinarya. very remarkable. exceptionalunimaginablya. in an unimaginable manner. inconceivablyastronomyn. the scientific study of the stars, planets, and other natural objects in space 天文学arrayn. collection. an impressive display of numerous persons or objects 阵列detectorn. an instrument for discovering the presence of sth.dedicatadv. devoteddedicatevt. set apart for a special use or purposeoperationallyad. in respect to operationoperational

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