UNITED NATIONS

GENERAL ASSEMBLY

Distr.
GENERAL

A/AC.105/206
18 October 1977

ORIGINAL: ENGLISH

COMMITTEE ON THE PEACEFUL USES
OF OUTER SPACE

MESSAGES TO EXTRATERRESTRIAL CIVILIZATIONS

Note by the Secretariat

CONTENTS

Introduction

1. In the course of the twentieth session of the United Nations Committee on the Peaceful Uses of Outer Space, held in Vienna from 20 June to 1 July 1977, the question of extraterrestrial civilizations was raised several times. The Chairman, in his opening statement, asked, in view of the tremendous impact any contact with extraterrestrial civilization would have on our planet, if the Committee could continue to ignore this possible development and if it should not give at least preliminary consideration to the matter. The representative of Czechoslovakia mentioned experiments conducted in the USSR, the United States of America and Canada to detect radio signals from extraterrestrial intelligence and asked the question as to what future steps should be taken in this field. The representative of Austria and the Chairman of the Scientific and Technical Sub-Committee in their statements listed the search for extraterrestrial civilizations among challenges of the future and possible future tasks for the Committee. The representative of Indonesia, in his closing statement, proposed that the Committee take up the question of the search for extraterrestrial civilizations and that it assign the task to the Scientific and Technical Sub-Committee.

2. For the convenience of the Scientific and Technical Sub-Committee this information paper gives a few basic facts bearing on the question of the possible existence of extraterrestrial civilizations and, especially, on experiments in establishing observational programmes to detect the radio signals they might transmit and on messages transmitted from the earth into outer space.

1. Possible existence of extraterrestrial civilizations

3. No positive results have thus far been reported in the search for life, even in primitive forms, on any of the planets and satellites of the solar system. This does not preclude the possibility of life at high intelligence and civilization levels on planets orbiting around stars other than the sun.

4. The majority of scientists, although by far not unanimous, accept the idea that intelligent life may exist outside the solar system. In relevant articles, the existence of other civilizations is considered "not unlikely", "quite possible", or "highly probable" and the number of outright rejections of the idea is quite small.

5. The considerations are based on statistics and probability and not on direct proof or observation. Evidently some assumptions have to underlie such estimates. Extraterrestrial life is generally supposed to be based on physical and chemical processes similar to those on the earth. Life in its known forms requires for its evolution a certain stability of solar radiation over an extended period of time; a certain size of the planet as a condition for the evolution and maintenance of a favourable atmosphere; a certain chemical composition of the surface of the planet; a rather narrow range of temperature; and the capability of an evolved civilization to solve environmental and social problems. Above all, the civilization must not destroy itself soon after it masters the technical means to do so.

6. In its simplest form, the formula for the number N of civilizations with which communication is possible at a given moment, is

$$N = R.L,$$

where R is the rate of formation of these civilizations and L their average longevity.

7. The rate of formation R depends on many factors, such as the rate of star formation at the time of formation of the sun; the fraction of such stars which evolve into suns favourable to the beginning of life; the fraction of such stars which have planetary systems; the average number of favourable planets in the system; the fraction of planets on which life in fact begins; the fraction of life starts that evolve into civilizations, and the fraction of civilizations that are able to communicate over large distances. Many of these factors can be estimated with at least some degree of confidence and they lead, according to one calculation 1/ to a value of R between 0.01 and 0.1 for the galaxy. A factor not accounted for in the above formula is the intention of an extraterrestrial civilization. The probability of a successful communication would be much higher if the other party co-operated rather than kept avoiding any contact.

8. The most critical factor is the longevity L of the civilization, and its estimation is difficult because we have experience with only one example, which takes us only to the beginning of an era of possible communication with other civilizations. If the average longevity was relatively short, of the order of some 2,000 years, the civilizations would be few and, on the average, far apart. If, on the other hand, most civilizations survived for a long time, e.g. for 1,000 million years, the number of possible civilizations, and therefore communications, would be very large, going into millions.

9. That such a large number of civilizations probably exists in the galaxy in spite of so many restricting factors can perhaps be understood if it is realized that the number of stars in the galaxy is of the order of 200,000 million.

2. International discussions in the field of communications with extraterrestrial civilizations

10. Much of the international discussions on this subject are being conducted in the International Academy of Astronautics (IAA) under the acronyms CETI (Communication with Extraterrestrial Intelligence) or SETI (Search for Extraterrestrial Intelligence).

11. One of the first events, not counting lectures and talks by individual scientists, was an informal conference held at the Green Bank Observatory in West Virginia. A Conference on Extraterrestrial Civilizations, organized by the

---

1/ J. Billingham, B. M. Oliver, J. H. Wolfe, A Review of the Theory of Interstellar Communication, 26th Congress of the IAF, 1975, paper A 75-31.

Armenian SSR in 1964, recommended further research of theoretical and experimental aspects of CETI. A proposal to hold an international meeting on CETI was put before the IAA in 1965 and after some delays a conference sponsored jointly by the United States National Academy of Sciences and the USSR Academy of Sciences was held in Byurakan, USSR, in September 1971. 2/ Since that time, review meetings on CETI have been held yearly at IAF congresses. These meetings are organized by the CETI Organizing Committee appointed by the President of the IAA and composed of J. Billingham (United States); C. J. Clemedson (Sweden); V. V. Gogosov (USSR); A. T. Lawton (UK): G. Marx (Hungary); R. Pešek (Czechoslovakia), Chairman; C. Ponnamperuma (United States); Mr. Subotowicz (Poland).

3. Experiments in interception of signals from extraterrestrial civilizations

12. Several experiments in intercepting radio signals possibly transmitted by an extraterrestrial civilization have been reported.

2/ Sagan, C. (Ed.) Communications with Extraterrestrial Intelligence, M.I.T. Press, Cambridge, Massachusetts (1973).

DATE	OBSERVER	SITE	SIZE OF INSTRUMENT (metres)	SEARCH FREQUENCIES (megaHertz)	FREQUENCY RESOLUTION (Hertz)	NUMBER OF OBJECTS	LIMITING SENSITIVITY (Watts/m^2)	TOTAL HOURS	COMMENTS
1960	Drake "OZMA"	Green Bank, W. Va., USA	26	1 420-1 420.4	100	2 stars	4×19^{-22}	400	
1968-1969	Troitskii, Starodubtsev, Gershtein, Rakhlin	Zimenkie, USSR	15	926-928 and 1 421-1 423	13	12 stars	2×10^{-21}	11	21 channels with ΔF=13 Hz were spaced 4 kHz apart; coverage not continuous.
1970 and ongoing	Troitskii, Bondar, Starodubtsev	Gorky-Crimea-Murmansk-Ussuri, USSR	Dipole	1 863 and 927 and 600		All sky search for sporadic pulses	10^4 f.u.	700 and continuous at 50% time	Network of isotropic detectors: cross-correlation from 2 or 4 stations over 8 000 km.
1971-1972	Verschuur "OZPA"	Green Bank, W. Va., USA	91 and 42	1 419.8-1 421 and 1 410-1 430	490 and 6 900	9 stars	5×10^{-24} and 2×10^{-23}	13	
1972-1976	Palmer, Zuckerman "OZMA II"	Green Bank, W. Va., USA	91	1 415-1 425 and 1 420.1-1 420.7	64 000 and 4 000	600 stars	1×10^{-23} and 3×10^{-24}	500	
1972	Kardashev	Eurasian Network, Institute for Cosmic Radiation	Dipole	1 337-1 863		All sky search for sporadic pulses	10^4 f.u.		2 stations operating simultaneously.
1973	Dixon, Cole	Columbus, Ohio, USA	Dipole	1 420.4 relative to galactic centre ±190 kHz	20 000 to 100 000	All sky search for circularly polarized, modulated beacon	1.5×10^{-21}	Continuous	Receiver is tuned to hydrogen rest frequency relative to galactic centre (as a function of direction).
1974	Bridle, Feldman	Algonquin Radio Observatory, Canada	46	22.2×10^3	30 000	500 stars			
1975-1976	Drake, Sagan	Arecibo, Puerto Rico	305	1 420 and) 1 653 and) B=1MHz 2 380)	1 000	4 galaxies	3×10^{-25}	100	Search for type II civilizations in local group galaxies.
1976	U. C. Berkeley "SERENDIP"	Hot Creek, Cal., USA	26	1 410-1 430 and 1 853-1 873 and 917-937	2 500	All sky survey	5×10^{-22}		Automated survey parasitic to radio astronomical observation.
1976	Clark, Black, Cuzzi, Tarter	Green Bank, W. Va., USA	43	8 522-8 523	5	4 stars	4×10^{-24}	7	VLBI high speed tape recorded combined with software direct Fourier transformation to produce extreme frequency resolution (in non-real time).
1977	Black, Clark, Cuzzi, Tarter	Green Bank, W. Va., USA	91	1 665-1 667	5	200 stars	4×10^{-25}	100	
1977	Drake, Stull	Arecibo, Puerto Rico	305	1 664-1 668	2.5	6 stars	8×10^{-26}	10	High speed tape recorder combined with optical processor to produce extreme frequency resolution (in non-real time).

13. The variety of frequencies used in the experiments shows the uncertainty at which frequency the signals should be expected. A detailed analysis shows that the least obstruction in the interstellar space and in the atmospheres of the emitting and receiving planets would be encountered in the microwave region of the spectrum (1-25 gigaHertz). The region between the hydrogen line at 1,420 megaHertz and the hydroxyl line at 1,662 MHz might have a high priority. That region of the spectrum is sometimes referred to as the "water hole".

14. The possibility of intercepting, or alternately transmitting any signals at those frequencies depends on the distance to be traversed and the sensitivity of the receiver. Present day technology is capable of designing systems for achieving interstellar communication. One of the obstacles, however, is the possible interference of other sources of radio emission at or near the above frequencies. The present situation in and around the "water hole" frequencies is the following:

15. According to the Radio Regulations the frequencies 1,400-1,427 MHz and 1,660-1,670 MHz are reserved for radio astronomy and administrations are urged to give all practicable protection to the upper band which is shared by meteorological aids. The frequencies between the two bands have been allocated to space operations, such as telecommand and telemetering, and to navigation satellites and satellite communications with ships and aeroplanes.

16. The International Astronautical Federation submitted a proposal for discussion at the 1979 World Administrative Radio Conference for allocation of the band 1,400-1,727 MHz to a CETI service, to allocate to new satellite systems frequencies outside the protected bands and to elaborate frequency-sharing criteria for services operating in the bands but causing no interference with CETI. This measure, if adopted, would substantially increase the chances for a successful detection of extraterrestrial intelligence.

17. As yet, none of the above experiments has intercepted any signals transmitted by an extraterrestrial civilization. The lack of success can be explained by the very small number of stars examined, by the short duration of the experiment, by the limited frequency ranges examined, and by the comparatively unsophisticated data processing subsystems used. For a reasonable statistical chance of discovering an extraterrestrial civilization, the search would have to be extended millions of times.

18. The long waiting time for a positive discovery could be made shorter by constructing special antennas. One such project, "Cyclops", calls for an array of initially a few, but then progressively up to 1,500 antennas each 100 metres in diameter. The antennas would be connected to a large computer system. The system would be capable of detecting even such relatively weak signals as the internal radio communications of a civilization 100 light-years distant, or a one gigawatt omnidirectional beacon at 1,000 light-years.

4. Messages sent from the earth

19. A communication link can be established not only by intercepting radio signals from an extraterrestrial civilization but also by transmitting such signals from the earth at those parts of the frequency spectrum where radiation can penetrate the ionosphere.

20. Some such signals, in particular on frequency modulation (FM) radio and very high frequency (VHF) television, which are meant for internal communications on the earth or between ground stations and satellites, or radar radiations by some observatories for planetary studies are strong enough to be received at interstellar distances. These are thus unintentional messages to extraterrestrial civilizations.

21. Intentional messages have also been sent, e.g. F. Drake 3/ used the Arecibo 300 metre antenna to dispatch a message in the binary code. This code allows the transmission of two symbols which can be called 0 and 1, or black and white. In this latter symbolism a message can be interpreted as a picture and the scope of information which can be transmitted is very wide. One of the problems with which a possible recipient will be faced is the proper decoding of the message. There are, however, mathematical procedures which are general enough to be known to every advanced civilization. Thus there is a good chance that the message will be correctly decoded by the recipient. It is another question whether the contents of the messages and the symbols used will be correctly understood. One thing will be undoubtedly clear to any recipient: the message is not a natural phenomenon; it necessarily comes from intelligent life.

22. It has to be pointed out that no further plans for transmitting intentional radio messages have been published.

23. Messages of another kind can be carried by spacecraft which is on a trajectory leading out of the solar system into interstellar space. Pioneer 10 and 11, launched in 1973 in the direction of Jupiter and Saturn, carry on board engraved plaques. They indicate in symbols and drawings the location of the sun in the Galaxy referred to the nearest pulsars. Such data should be sufficient for an advanced civilization to determine the position of the sun and of the earth. The plaques also show images of man and woman and contain other data.

24. The substantive contents of a message is a separate question. What information or data should be conveyed to an extraterrestrial civilization to best represent the humanity? The question has not yet been tackled in its general scope. The messages sent up so far contain mostly information needed for correct decoding, basic physical facts, indications on the position of the sun in the

---

3/ C. Sagan, F. Drake, The Search for Extraterrestrial Intelligence, Scientific American Vol. 232, No. 5, 80, 1975.

I. S. Shklovskii, C. Sagan, Intelligent Life in the Universe, Holden-Day, Inc. 1966.

Galaxy, basic data on humanity. The message on the two Voyager spacecraft launched in August and September 1977 carried the first work of art outside the solar system.

25. The two Voyager spacecraft were launched to pass close to Jupiter and Saturn, and possibly Uranus and Neptune, and finally to leave the solar system, have on board copper phonograph records with samples of music of various cultures and times, of natural sounds such as wind and surf and of sound of animals and birds. They contain messages from the President of the United States and from the Secretary-General of the United Nations. This latter message is as follows:

> "As the Secretary-General of the United Nations, an Organization of 147 Member States who represent almost all of the human inhabitants of the planet Earth, I send greetings on behalf of the people of our planet.
>
> "We step out of our solar system into the universe seeking only peace and friendship; to teach if we are called upon; to be taught if we are fortunate.
>
> "We know full well that our planet and all its inhabitants are but a small part of this immense universe that surrounds us, and it is with humility and hope that we take this step."

26. Recordings of messages in several languages by 14 members of the United Nations Committee on the Peaceful Uses of Outer Space were made at an informal meeting of the Committee convened by its Chairman Ambassador Peter Jankowitsch on 2 June 1977. This was the first United Nations message into interstellar space.

27. What should be the contents of future messages? Would work of art represent humanity better than samples of scientific knowledge which extraterrestrial civilizations can be assumed to possess? Should messages be composed under the sponsorship of an international body such as the United Nations if they are to represent mankind? Should a register of messages to extraterrestrial civilizations be established and maintained to facilitate future references since a reply to a given message may take a long time to reach the earth? Should the preparation of messages be done directly at the United Nations as an activity which would unify nations?

28. These and other questions may require consideration by the United Nations Committee on the Peaceful Uses of Outer Space if the answers are to reflect truly the consensus of the international community.
