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Active search strategies and the SETI protocols: is there a conflict?

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The widely approved Declaration of Principles Concerning Activities following the Detection of Extraterrestrial Intelligence and the Proposed Protocol for Sending of Communications to Extraterrestrial Intelligence are examined with respect to how they apply to active as opposed to passive search strategies by radio astronomers. This article maintains that the existing protocols do not and should not impede active search strategies. An active search strategy based on the transmission of an interstellar terrestrial message using the synchronization of the SN1987A hyperboloid is described. A brief discussion is made concerning the social 'pros' and 'cons' for humanity of an active search.

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[1]In diplomatic parlance, the term 'protocol' normally refers to an annex or extension of an existing agreement. In this paper we will follow the interpretation of the term used

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The recent decision by the Congress of the USA to discontinue the NASA High resolution Microwave Survey (HRMS) was a stunning blow to scientists who have spent years of their professional life preparing for this ambitious attempt to find evidence of extraterrestrial intelligence via radio astronomy techniques. Several smaller programmes continue however, and there is a distinct possibility that most of the NASA HRMS programme can be completed with private financial arrangements. Therefore, the quest for the discovery of intelligent life beyond Earth continues, and the issues addressed in this paper remain an important consideration for the community of scientists who have worked in this area.

In developing a protocol[1] agreement to offer guidelines for the Search for Extraterrestrial Intelligence (SETI) with regard to activities following the detection of a signal from an extraterrestrial civilization, the SETI Committee of the International Academy of Astronautics (IAA), has taken a judicious step to encourage SETI researchers to cautiously monitor their own professional conduct. The first protocol agreement sets out in advance of a possible discovery of signals emanating from an extraterrestrial intelligence (ETI) guidelines and procedures for confirming the reality of the signal, announcing such a signal to the scientific community and the public, and replying to the transmitting intelligence.[2]

This detection agreement is among researchers, not among governments. Some institutions involved in the search such as the Planetary Society, are not government sponsored, but are world-wide private organizations. This document therefore has no diplomatic status and is not an international agreement like the Outer Space or Moon Treaties. At the request of Czechoslovakian legal scholar Vladimir Kopal, former head of the Outer Space Affairs Division of the United Nations, the protocol is now called a *Declaration of Principles*.

Abiding by the terms of this SETI protocol agreement is strictly voluntary but its adoption by numerous prestigious groups, including the International Academy of Astronautics (IAA), the International Institute of Space Law (IISL), the International Astronomical Union (IAU), the International Astronautical Federation (IAF), Commission F of the Union Radio Scientifique Internationale (URSI), and the

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Committee on Space Research (COSPAR) give it a credibility that strongly weighs on the conduct of science within its framework. This SETI protocol agreement now faces the test of conducting practical scientific research under its guidelines. As is frequently the case with *a priori* agreements it is possible that this protocol itself could be interpreted in a fashion that might have an adverse impact on the conduct of scientific investigation.

The official title of the first SETI Protocol Agreement is *Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence*. Its focus is on post-detection information policy, not pre-detection search strategies. At one point in the protocol agreement, however, language does exist which could impinge on pre-detection search strategies. Article 8 of the Protocol Agreement reads thus: 'No response to a signal or other evidence of extraterrestrial intelligence should be sent until appropriate international consultations have taken place. The procedures for such consultations will be the subject of a separate agreement, declaration, or arrangement.'

Article 8 has been loosely interpreted to mean that any future sending of deliberately designed messages to possible sources of ETI should be undertaken only after appropriate international consultation. Although it is not explicitly stated that international consultation is necessary for sending deliberately designed signals from Earth prior to detection, some have argued that it was the intention of the protocol to cover such communication. This is a point of confusion that needs to be clarified.

The reason clarification is needed on this point is that it is possible to envision search strategies that use as part of their search the sending of deliberately designed signals to possible ETI locations. Such search strategies are active, in that they involve sending signals on our part, not just the passive act of listening for signals. It is possible that certain cosmic events or conditions might warrant an active search strategy to enhance the possibility of ETI detection. One such strategy, using the explosion of SN1987A for the transmission of call signals to other possible extra terrestrial civilizations, is suggested in the following discussion.

Message in a bottle

The first serious attempt made by humanity to communicate with extra solar aliens took place in 1972, when NASA attached plaques to the Pioneer X and XI spacecraft that were launched that year to swing by Jupiter before leaving the solar system.[3] The plaques were intended to tell any alien civilization that found them about the nature of our species and our location. This enterprise was mainly promoted by Frank Drake and Carl Sagan. Unfortunately – because of the lack of time before the launching – no international advice was considered. As it was later recognized by Frank Drake[4] 'this message was constructed by a very limited group of humans – in fact, three humans – and thus was neither representative of the human race as a whole nor perhaps as informative as it could be. There were editorials published in the British press demanding that any future similar enterprise be engineered by a large international ecumenical group of scientists and lay people.'

Some years later, another similar, but much more sophisticated attempt was developed to include several 'Sounds and Images of Earth' on board Voyager I and II spacecraft.[5] Affixed to each Voyager craft is

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by the SETI community (ie Michael M. Michaud, 'A Unique Moment in Human History', in *First Contact*, B. Bova and B. Preiss (eds), NAL Books, New York, 1990). The 'Declaration of Principles' is neither a protocol nor a formal international agreement.

[2]M.A.G. Michaud, 'An International Agreement concerning the Detection of Extraterrestrial Intelligence', *Acta Astronautica*, Vol 26, No 3/4, 1992, pp 291–292.

[3]C. Sagan, L. Salzman Sagan and F. Drake, 'Message from Earth', *Science*, 1972, pp 175, 881–884.

[4]Sagan *et al, Murmurs of Earth*, Ballantine Books, New York, 1978.

[5]*Ibid.*

a gold-coated copper phonograph record as a message to possible extraterrestrial civilizations that might encounter the spacecraft in some distant space and time. Each record contains 118 photographs and 90 minutes of a selection of 'Sounds from Earth'. Even though the selection of materials that were included were from our planet, the group that took the responsibility to 'speak in the name of the Earth' belongs only to the country that launched the spacecraft.

As part of the ceremonies to dedicate the newly upgraded Arecibo 305-m radio/radar telescope, at 17.00 GMT on November 16, 1974, the telescope was used to transmit a message for possible reception by other intelligent creatures.[6] The transmission was made at a radio frequency of 2380 MHz and bandwidth of 10 Hz. The effective isotropic radiated power was 3×10^{12} watts, and it was transmitted in the direction of the Great Cluster in Hercules, M13, a group of some 300 000 stars 25 000 light years distant whose apparent size closely matches the beam width of the transmission. Details of the information content can be found in footnotes 4 and 6.

No prior news of the Arecibo message was given, even to delegates who discussed interstellar communication at the previous month's International Astronautical Federation meeting in Amsterdam. Yet, at the 1971 USA–USSR International Meeting on Communication with Extraterrestrial Intelligence (CETI) the delegates concluded that such undertakings were best done 'by representatives of the whole of mankind'.

The Arecibo message provoked some major protests. For example, US diplomat Michael A.G. Michaud, maintained that the attempt to send a message to another civilization (an active search) was not just research, but a political act.[7] Michaud suggested a public discussion of the potential benefits and risks of contact. A decision based on this risk–benefit analysis should be made openly, in the full glare of publicity, with the involvement of appropriate authorities. According to Michaud, the decision should not be made by scientists alone.

Another protest was made by Sir Martin Ryle, a Nobel laureate and Astronomer Royal of England. He wrote to several astronomy leaders, with great anxiety stating that he felt it was very hazardous to reveal our existence and location to the galaxy.[8] For all we know, 'any creatures out there were malevolent or hungry' and once they knew of us, 'they might come to attack or eat us.' He strongly recommended that no messages of this sort should be sent again and even asked the Executive Committee of the International Astronomical Union to approve a resolution condemning such messages. Frank Drake[9] wrote him a letter telling him that: 'It's too late to worry about giving ourselves away. The deed is done. And repeated daily with every television transmission, every military radar signal, every spacecraft command. . . . They're too far away to pose a threat. I think that hostile tribes bent on war, be they terrestrial or extraterrestrial, destroy themselves with their own weapons long before they have any notion of how to attempt interstellar travel. The more peaceful nations, who study science and have perhaps cracked the secret of immortality, are more likely to be benevolent, shy, and wary of contact for their own reasons.' According to Drake, Ryle seemed satisfied with his rejoinder and the IAU never did issue a prohibition against interstellar messages.

Clarke[10] states that, 'as our own species is in the process of proving, one cannot have superior science and inferior morals. The combination

[6]The Staff at NAIC, 'The Arecibo Message of November 1974', *Icarus*, 1975, Vol 26, pp 462–466.
[7]M.A.G. Michaud, 'Signal to Messier 13', *Spaceflight*, 1975, Vol 17, pp 119.
[8]W. Sullivan, 'Astronomer Fears Hostile Attack, Would Keep Life on Earth A Secret', *New York Times*, 4 November 1976, pp 46.
[9]F. Drake and D. Sobel, 'Is Anyone Out There?', *The Scientific Search for Extraterrestrial Intelligence*, Delacorte Press, New York, 1992.
[10]A.C. Clarke, *Voices from the Sky*, New York, 1965, pp 215.

is unstable and self-destroying.' If Clarke is right, and if other civilizations recognize this fact, we might expect that very limited amounts of information are available for emerging societies to consume. More advanced civilizations would not want to place potentially destructive knowledge at the disposal of any 'ethically underdeveloped' society. Such knowledge could be a threat to their survival and perhaps the survival of nearby interstellar neighbours. A civilization needs time to work out adequate moral restraints on their own behaviour. If there is something resembling Sagan's concept of the Encyclopedia Galactica, it would probably be encrypted in such a way as to allow their detection only to the ethically more advanced civilizations; those that already know how to be responsible with the power of knowledge and high-technology.

Communication is a two-way process and interstellar communication should be no exception. If everyone is trying to detect signals from other beings without sending out their own, no one will receive a signal. Some scientists[11] argue that we have the technical competence to listen, but not to send (referring to omnidirectional beacons). If we follow this argument we are cast in the role of little children, 'and it is for the child to listen, but not to speak'. Every galactic civilization could find arguments to show that there are 'more advanced civilizations' than their own and that it could be dangerous to 'reveal' their existence and position to other beings. If this is so, it might be impossible to find a threshold where a galactic civilization could feel themselves completely safe. In this way, every civilization could apply the 'little children' argument and only use a 'passive search strategy' instead of an 'active search strategy'.

The idea of the 'listeners-only' universe may be very unlikely. W.T. Sullivan III *et al*[12] has demonstrated that because of military radars and television transmitters, the Earth is revealing itself to any interstellar eavesdropper with an Arecibo-like antenna at distances of 30 light years. An alien civilization with a fully developed cyclops-like array ($\approx$1000 antennas of 100 metres) could eventually detect our presence up to 500 light years from Earth. If we consider the emission of signals generated by the planetary radars, these distances are increased.[13] Sullivan gave the example of the US Naval Space Surveillance System, whose effective radiated power is 1.4×10^{10} watts into a bandwidth of $\approx$0.1 Hz. Its beam is such that any eavesdropper in a declination range of 0^0 to 33^0 (28% of the total sky) will be illuminated daily for a period of $\geq$7 seconds. In this way a civilization with Arecibo-type technology located at 60 light years, or a civilization with a fully-developed Cyclops-type technology, located at 600 light years, could eventually detect our presence. By the twenty-sixth century, $\approx10^6$ stars will be bathed by this 'military radar radiation'.

This generation of humanity has unintentionally revealed our existence and our position to a large part of our galaxy. Perhaps, however, this is typical for emerging civilizations. It may be unlikely that adolescent civilizations are any more cautious and quiet than adolescent humans.

These issues are discussed because they demonstrate our traditional unease about actively sending electromagnetic signals into the unknown depths of space. This traditional unease is still extant in some quarters. Although the authors feel such reservations are rendered meaningless by the above stated facts about Earth having already revealed itself, it is

[11]S.L. Glashow, 'Are we Alone in the Universe?', *The Charm of Physics*, Simon & Schuster, New York, 1991.

[12]W.T. Sullivan III, S. Brown and C. Wetherill, 'Eavesdropping: The Radio Signature of the Earth', *Science*, 1978, Vol 199, pp 377–388; W.T. Sullivan III, *Science*, 1978, Vol 202, 376, and W.T. Sullivan III and S.H. Knowles, in M.D. Papagiannis (ed), *The Search for Extraterrestrial Life: Recent Developments*, D. Reidel Publishing Co., Boston, 1985, pp 327–334.

[13]P.B. Boyce, 'Planetary Radars Have Announced Our Presence: Thoughts on Short Duration Signals, Verification and Responses', 42nd Congress of the International Astronautical Federation, IAA-91-611, 5–11 October, Montreal, Canada; J. Billingham and J. Tarter, 'Detection of the Earth with the SETI Microwave Observing System Assumed to be Operating out in the Galaxy', *Acta Astronautica*, 1992, Vol 26, No 3/4, pp 185–188.

still possible that objections might be made about more active SETI search strategies based on these fears. It is, perhaps, even possible to argue that the spirit (if not the letter) of the SETI Protocols prohibit active search strategies. In an attempt to explore this issue before a controversy arises, the authors would like to present an option for an active search strategy and discuss its acceptability under the rubric of the SETI Protocols.

An active search strategy using a supernova explosion to synchronize time with spatial coordinates

One of the most important problems in SETI research is the need for high synchronization between spatial coordinates (points in the sky) with the arriving time of a signal. The telescope of the receiving planet (Re) has to be pointing to the transmitting planet (TP) when the message arrives at Re and this is at time T_{TPRe} (distance between TP and Re divided by the velocity of light) after TP transmitted the signals at time T_0.

In an independent way, T.B. Tang[14] and P.V. Makovetskii[15] developed the concept of the SETI Ellipsoid. They have proposed to observe only those stars situated on an ellipsoid surface having an Earth at one of the focuses and a supernova (SN) in the other. This concept allows us to relate direction with time. It improves the probability of contact between two galactic civilizations by synchronizing the supernova explosion with the transmission of a message. The geometric spot of all the ETIs whose signals reach the Earth at moment T_0+T_{TPRe} is the ellipsoid of revolution (see Figure 1).

On February 23.316 UT, 1987, the Large Magellanic Cloud supernova was first detected on Earth. Ivan Almar[16] realized that a new SETI Ellipsoid was generated, namely a straight line joining the Earth to the supernova. Since the supernova explosion, this ellipsoid is expanding very slowly in width.

Using simple geometry it is possible to estimate the maximum angular diameter of the ellipsoid for a particular epoch as the angle subtended by the minor axes as seen from Earth. The information of the supernova explosion is travelling at the speed of light, with spherical symmetry around the progenitor star. This is the reason why the SN1987A ellipsoid's semi-axes are functions of time. Figure 1 shows a geometrical description of the main parameters. This concept of synchronization between the arriving time and the space coordinates of ETI messages among different galactic civilizations obeys only the requirements imposed by the laws of physics, geometry, and the principle of causality.

Taking into account that supernova explosions are very rare (about one per 100 years on average in our galaxy), and that SN1987A was the brightest supernova in 383 years, we can assume that most of the possible galactic technological civilizations will pay high attention to this unusual event. For example, in our case, this astronomical event has been observed by instruments on the ground, below the ground, in space, from balloons, airplanes, and from rockets. It has been observed from all the continents including Antarctica. We have studied it at all the wavelengths, from radio to gamma rays, and this explosion started extra-solar neutrino astronomy.

If we want to develop an active strategy using the advantage of the 'magic direction' of SN1987A, synchronized with the 'magic time', we

[14]T.B. Tang, 'Supernovas as Time Makers in Interstellar Communications', *Journal of the British Interplanetary Society*, 1976, Vol 29, pp 469–470.
[15]P.V. Makovetskii, 'Nova Cygni-A Synchro-signal for ETI?', *Soviet Astronomy*, 1977, Vol 21, No 2, pp 251–253.
[16]I. Almar and W.H. Hilton, 'The CETI Ellipsoid and the Supernova 1987 A', in G. Marx (ed), *Bioastronomy: The Next Steps*, Kluwer Academic Publishers, Boston, 1988, p 377.

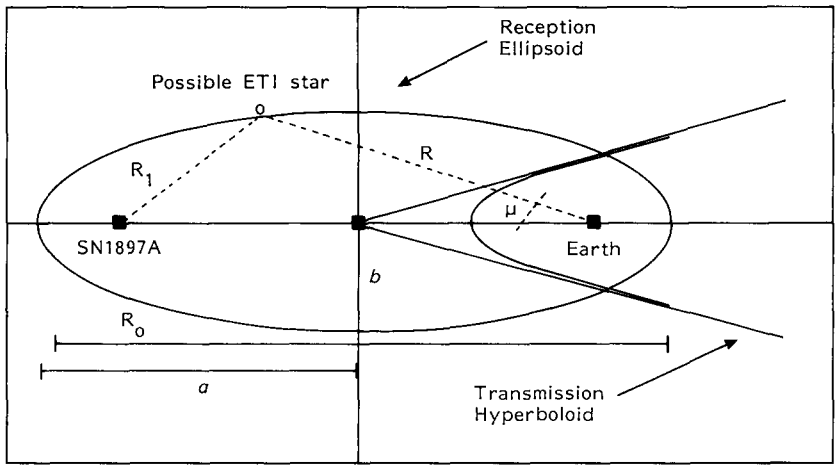

Figure 1. Time-angular strategy for receiving and transmitting call signals between two galactic civilizations using a supernova (SN) explosion to synchronize the space coordinates with the observing time.[a]

[a]Reception of call signals is made by the SETI ellipsoid corresponding to $R_1 + R - R_0 = t$ = constant. Here R_1 is the distance between the SN (in our case SN1987A) and a star with extraterrestrial intelligence (ETI). R is the distance between the ETI star and the receiving planet (in our case the Earth) and R_0 is the distance between SN and Earth (equivalent to the double of the ellipsoid focal distance); *a* and *b* are the ellipsoid semi-axes, and μ the angle between the SN and the ETI star as seen from the reception planet. The scale of this figure corresponds for t = 28741 years (time after the SN explosion, if we use the real t = 7 years, this graph would look more like a straight line), a = 112647 ± 5633 light years, b = 40238 ± 2012 light years, and $c = R_0/2$ = 84500 ± 4225 light years. The transmission of call signals should be directed to the antipodal position of the SN and for this case a hyperboloid of revolution is generated to relate time with position in the sky. See Lemarchand, *op cit*, Ref 18.

should transmit our 'terrestrial message' in the antipode direction of the supernova explosion (see Figure 1). The surface generated for the transmission is an hyperboloid of revolution with the supernova and the Earth in its focus. The dimensions of this hyperboloid are also time dependent. There are only 33 objects inside the hyperboloid of transmission. This is a tiny quantity compared with the 340 objects inside the ellipsoid of reception. Of these 33 objects, we have 16 solar-type stars and 14 non-stellar objects.

According to the literature,[17] there are some planetary radars in the northern hemisphere, mainly located in the USA, with the capacity to transmit a message to these stars. Lemarchand[18] estimated the flux limits of an electromagnetic signal sent from the Earth for the case of three nearby targets (located at distances of approximately 250 light years from Earth). These results show that 'our signals' could be easily detected with the equivalent of present human technology.

The energy from the explosion of the supernova radiated in neutrinos suggested that either a neutron star or a black hole had been born. The theory predicts that the gravitational mass of the collapsed remnant is near 1.4 solar masses. This is a value that appears to be consistent with the properties of the detected neutrino signal. In this case, the gravitational mass is likely to be a neutron star. This neutron star could be a pulsar depending on the magnetic field strength and rotation rate. It also critically depends upon the density of the material surrounding the neutron star.

It is not clear now whether the possible SN1987A pulsar will first be detected in the radio spectrum. The radio pulsar mechanism could be

[17]C.L. Seeger in P. Morrison *et al* (eds), *The Search for Extraterrestrial Intelligence*, NASA SP 419, Washington, 1977, p 125.

[18]G.A. Lemarchand, 'Passive and active SETI strategies using the synchronization of SN1987A', *Astrophysics and Space Science*, 1994 (in press).

shorted out by accretion or be masked by dispersion in the surrounding ionized plasma. Some centuries from now, a possible ETI in one of these SETI hyperboloid stars will observe the same sequence of events that we have observed. Assuming a curiosity and technology at least equal to ours, they should periodically check for the emergence of the pulsar from behind the dust and ionized plasma clouds. This provides us a great opportunity (knowing that the pulsar has not yet appeared) to send a false radio pulsar signal to these stars.

Radio pulsars emit faint, sharply peaked pulses, principally at low frequencies – from 25 MHz to 2 GHz. This fact gives us another advantage in gaining the attention of a possible civilization around these stars. It allows us to send a message coded in a way which the ETI devices developed to search for the SN1987A pulsar could easily detect.

Lemarchand [19] has made a detailed analysis showing how to send a 'fake' radio pulsar signal, without employing any special 'code' or 'semantic' in the transition, to act only as an 'active search strategy' and not as a 'communication strategy'. Because, in general, pulsars have periods from seconds to milliseconds, this is an advantage that could be used to send great amounts of information (communication strategy). For example, in 1974, the staff of the Arecibo Observatory[20] sent an interstellar message to the globular cluster M13, with 1679 bits of information in only 169 seconds, or 10 bits per second. We could send large quantities of information if we used higher period frequencies.

Clarifying the intentions of the SETI protocols

This paper argues that the existing SETI protocol does not specifically prohibit active predetection search strategies. It is, after all, a 'post-detection' protocol. However, active search strategies come close to the boundary of what could be considered attempts at interstellar communication. This boundary needs to be clarified and specified.

As we have demonstrated, our planet has long ago announced its presence to any galactic eavesdropper. There is no way that announcement can be reversed. The type of electromagnetic radiation emitted by our radio and television systems is very weak and very hard to detect at great distances from our planet. Our military systems and planetary radars, however, have emitted exceptionally strong signals detectable at great distances.

These strong signals, however, carry very little information. They would reveal little more than our planet's location, rotation, orbit, and general level of technological development. These emissions are not true attempts at communication since they are not designed to elicit a reply. It is the authors' opinion that this type of electromagnetic emission does not violate either the spirit or the letter of the SETI protocol.

Active SETI search strategies are, however, a more complicated matter. Over the years a number of active search strategies have been proposed (ie Earth-based or space-based interstellar beacons). We have focused on only one type of active search strategy – the pulsar strategy. As humankind continues its endeavour to make contact with ETI it is likely a greater push toward active strategies will be made. The questions surrounding these types of searches should be addressed as soon as possible.

Michaud[21] has been working on the preparation of a second draft (see

[19] *Ibid.*
[20] *Op cit*, Ref 6.
[21] Michaud, *op cit*, Ref 2; and M.A.G. Michaud, J. Billingham, and J. Tarter, 'A reply from Earth?', *Acta Astronautica*, 1991, Vol 26, No 3/4, pp 295–297.

Appendix 1). This 'second protocol' addresses the profound questions of who should speak for Earth, and what should be said on behalf of our species. Unfortunately, it was developed only for the case that we first receive a message. It does not address the issue of the 'active search'. The principles developed for the text were clearly based in the early work of Fasan[22] and the more recent 'code of conduct' proposed by Cocca.[23]

The 'second protocol' calls for an international group to be established to deal with communications with extraterrestrial intelligence. The questions it should answer are, among others, 'Should we reply?' and, 'If we reply, what should be the contents of the message?' This is in line with the thinking of Michaud who states that, 'The proposed separate agreement on Communication with Extraterrestrial Intelligence is not essentially a matter of scientific research, and involves social and political questions of considerable magnitude.'[24]

The authors would suggest that the second protocol also deal with the question of sending signals designed to enhance detection of our own planet. Are such signals permissible within the spirit of the international protocol? What, if any, limits on information content of such signals should be imposed? Are active search strategies to be considered a 'political act'? An answer to these types of questions is needed.

A final statement

An active search strategy is a way of improving on random search strategies (from a spatial and temporal synchronization point of view). As demonstrated by Bates[25] the real difficulty for the SETI search in making first contact is the requirement that the receiver, which must be highly directional, must be pointed toward the unknown transmitter when signals are arriving on Earth. As Bates notes, there is virtually no chance of success for a transmitter and receiver to link up if we follow a random search strategy. The 'active search' toward the SN1987A antipode direction improves the odds for detection and eventually communication. It could be our only chance in several hundred years to make this type of improvement and test our hypothesis.[26]

The pulsar strategy described in this paper could also be used to send large quantities of information into space. If it were so used, we would be crossing over from an enhancement strategy to a communication strategy. Such a step should be done with the careful guidance of the international community. The authors feel that until agreement on an elaborate communication can be obtained, the pulsar strategy with minimum information content could be used to attract and hold the attention of possible extraterrestrial civilizations.

The pulsar strategy is obviously a very long-term SETI endeavour. Hundreds of years are needed for a reply. It is, however, an intellectual adventure that could bind many generations of humans together in a common technological enterprise. Other active search strategies with much shorter 'return times' may, in the future, be deemed feasible. We should keep the active search option open.

Language is now being considered for a second SETI Protocol. The authors would urge that, in drafting of this language, active search patterns be specifically addressed. The information content limits of these predetection efforts should be made to ensure that active search strategies are a legitimate part of the human effort to search for evidence of extraterrestrial intelligence.

[22]E. Fasan, *Relations with Alien Intelligences: The Scientific Bases of Metalaw*, Berlin Verlag, Berlin, 1970.

[23]A.A. Cocca, 'XII Tables for Researchers on Extraterrestrial Intelligence', *Acta Astronautica*, 1990, Vol 21, No 2, pp 127–130.

[24]Michaud, *op cit*, Ref 2.

[25]D.R. Bates, 'Difficulty of Interstellar Radio Communication', *Nature*, 1974, Vol 248, pp 317–318, and 'On Making Radio Contact with Extraterrestrial Civilizations', *Astrophysics and Space Science*, 1978, Vol 55, pp 7–13.

[26]The same idea has been suggested for nova explosions. There are several nova explosions a year in our galaxy. To make this idea work, we must be able to send a message only a few hours after the explosion. We also must know precisely the distances to the nova and target stars. These disadvantages make the 'pulsar strategy' useless for nova explosions.

Appendix 1

Proposed Protocol for the Sending of Communications to Extraterrestrial Intelligence

The signatories agree that communications with extraterrestrial intelligence will be guided by the following principles:

1 Communications with extraterrestrial intelligence will be undertaken on behalf of all mankind, rather than specific nations, groups or individuals.

2 Nations, organizations and individuals will not unilaterally send communications to extraterrestrial intelligence until appropriate international consultations have taken place.

3 The signatories will not cooperate with attempts to communicate with extraterrestrial intelligence which do not conform to the principles in this protocol.

4 An international group including representation from all interested nations will be formed to deal with the question of whether such a communication should be sent, and if so, what its content should be.

5 If a decision is made to develop a communication to extraterrestrial intelligence on behalf of all mankind, the following principles will be observed:
   a Respect for the value of life and intelligence.
   b Respect for the value of diversity, including respect for different customs, habits, languages, creeds and religions, approaches to social organizations, and styles of life.
   c Respect for the territory and property of others.
   d Recognition of the will to live.
   e Recognition of the need of living space.
   f Fair play, justice, mercy.
   g Reciprocity and *quid pro quo*.
   h Non-violation of others.
   i Truthfulness and non-deception.
   j Peaceful and friendly welcome.
   k Cooperation.
   l Respect for knowledge, curiosity and learning.

6 The drafters of a communication to extraterrestrial intelligence will consider detailed information about mankind to be commodity of high value which will not be transmitted without due attention to human security and well-being, and to reciprocity.

7 In the event that extraterrestrials appear to pose a threat to human health, well-being, or peace, no nation shall act without consulting the Security Council of the United Nations.

Source: Michael A.G. Michaud, 'A Unique Moment in Human History', in B. Bova and B. Preiss (eds), *First Contact*, NAL Books, New York, 1990, p 61.