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Chapter 15

Message to an Intelligent Civilization: A Historical Perspective*

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Abstract

METI stands for Messaging to Extraterrestrial Intelligence. The idea of sending messages to other worlds is older than SETI (Search for Extraterrestrial Intelligence). However, the first real attempt of transmission was performed after the first SETI experiment. This chapter retraces the notion of life on other worlds, from the Greeks to the present day. It explores the many proposals to attempt communication with the inhabitants of those worlds, and also the real experiments.

I. Introduction

The Search for Extraterrestrial Intelligence (SETI) is a field of research that listens for a message transmitted by an intelligent alien civilization. The first experiment was in 1961 using the National Radio Astronomy Observatory (NRAO) at Green Bank, West Virginia, conducted by Frank Drake. Many other experiments were performed since, without any result so far.

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The counterpart of SETI is the Messaging to Extraterrestrial Intelligence (METI). The ideas related to METI are older than SETI. This paper will explore the many scenarios, attempts, and real experiments performed over the centuries to contact another civilization.

II. The Idea of Life Outside Earth

The idea that we are not alone in the Universe is not a 20th-century concept but a very old one. As early as the Antiquity, discussions about possible beings living on other worlds were already found in the literature.

The belief in inhabitants on other worlds covered more than the Moon, Venus, and Mars—it extends to all the bodies in the Solar System. Those ideas were still in the air even at the time of Isaac Newton and Edmund Alley.

Antiquity

Leucippus and Democritus (5th century BCE) advocated the existence of living beings on other worlds. They were atomists. They did not mean other solar systems but rather other cosmos.

Epicurus (270 BCE) championed the doctrine of the plurality of worlds. Not all the philosophers of the time were ready to accept the idea.

Lucretius (1st century BCE) is another Greek philosopher who supported the idea of inhabited worlds. He is known to have written:

> For there is such a huge supply of atoms that all eternity would not be enough to count them. There is a force which drives the atoms into various places, just as they have been observed together in this world, so we must realize that there are other worlds in other parts of the universe with races of different men and different animals.

Both Plato and Aristotle opposed the idea of plurality of worlds. The main discussion of this issue in Plato's writings occurs in his *Timaeus*, which contains his view on the physical world. Aristotle's main analysis on the topic appears in his *On the Heavens* and in his *Metaphysics*.

Middle Ages

During most of the Middle Ages, the idea of the plurality of the worlds was rejected. No new ideas on the subject were published, or discussed.

One of the few publications on the possibility of many inhabited worlds was published by the bishop of Paris, Etienne Tempier. The book, known as "the

condemnations," contains a reference to the effect that the prime cause (i.e., god) could have made several worlds.

Renaissance

Giordano Bruno (1548–1600) championed the plurality of worlds, and wrote *La Cena de le Ceneri* (*The Ash Wednesday Supper*) and *De l'infinito universe et mondi* (*On the Infinite, Universe and Worlds*). Those are cosmological works that present the Copernican system. Bruno posited an infinite and homogeneous universe (both spatially and materially), without a center, embracing an infinite number of worlds and numerous solar systems. Bruno's theories constitute a link between certain conceptions descended from the natural philosophy of the Pre-Socratics with the discoveries of contemporary science.

In his cosmology, Earth is just one more heavenly body, as was the Sun. He was burnt at the stake for defending this subject.

Johannes Kepler (1571–1630) wrote a work of fiction known as *Somnium* (*The Dream*) in which he visits the Moon. *Somnium* presents a detailed imaginative description of how the Earth might look when viewed from the Moon, and is considered the first serious scientific treatise on lunar astronomy.

John Wilkins, one of the founders of the Royal Society, wrote an influential fantasy, *The Discovery of a New World in the Moone; or, A Discourse tending to prove, that it is probable there may be another Habitable World in the Moon* (1638). He imagined a means of transportation to the Moon (e.g., a flying chariot), and envisioned human colonies on the Moon and trading with its inhabitants.

Christian Huygens (1629–1695) was the first natural philosopher of that stature to publish on the subject of extraterrestrials. His book was published in 1698 under the name, *The Discovery of Celestial Worlds: Theories about Inhabitants, Plants and Products of Planetary World*, in which he speculated about life not only on planets of the Solar System, but also about life on worlds of other star systems.

Bernard le Bovier de Fontenelle (1657–1757) wrote *Entretiens sur la pluralite des mondes*, a very popular book which was translated in to Danish, Dutch, German, and English. The book itself is presented as a series of conversations between a gallant philosopher and a marquise, who walk in the latter's garden at night and gaze at the stars. The philosopher explains the heliocentric model and also muses on the possibility of extraterrestrial life. Fontenelle's work was not cast polemically against the world views of either the Catholic Church or the Protestant churches, nor did it attract the attention, positive or negative, of theologians or prelates.

In 1752, Francois-Marie Arouet dit Voltaire wrote a book titled *Micromegas*, which is about an extraterrestrial visiting Earth. Micromégas is an inhabitant of one of the planets that orbits Sirius. After some problems on his home planet, he started to travel around the Universe in a quest to develop his intellect and his spirit.

His first stop is Saturn, where he befriends the secretary of the Academy of Saturn. Eventually, they arrive on Earth and circumnavigate it in 36 hours, with the Saturnian only getting his lower legs wet in the deepest ocean and the Sirian barely wetting his ankles. They decide that the planet must be devoid of life, since it is too small for them to see with the naked eye. In the Baltic Sea, the Saturnian happened to spot a tiny speck swimming about, and he picks it up to discover that it is a whale. As they examine it, a boatful of philosophers returning from an Arctic voyage happens to run aground nearby.

The travelers examine the boat and, upon discovering the life forms inside it, they conclude that the tiny beings are too small to be of any intelligence or spirit. Yet they gradually realize the beings are speaking to each other, and they devise a hearing tube with the clippings of their fingernails in order to hear the tiny voices. After listening for a while, they learn the human language and begin a conversation, wherein they are shocked to discover the breadth of the human intellect.

The final chapter sees the humans testing the philosophies of Aristotle, Descartes, Malebranche, Leibniz, and Locke against the travelers' wisdom. When the travelers hear the theory of Aquinas that the universe was made uniquely for mankind, they fall into an enormous fit of laughter. Taking pity on the humans, the Sirian decides to write them a book that will explain the point of everything to them. When the volume is presented to the Academy of Science in Paris, the secretary opens the book only to find blank pages.

At the end of the 18th century, people believed that life could exist on other planets. William Whewell believed it was the case, but not on all planets.

William Hershel and Isaac Newton thought that the Sun and other planets were inhabited. Newton particularly supported the idea that the humans were more intelligent than the rest. All the planets were composed of the same matter as the Earth.

Thomas Wright, Immanuel Kant, Johann Lambert, and William Herschel were also deeply concerned about the question of extraterrestrial life. They thought that the stars are other suns with planets around them.

Cyrano de Bergerac, in his *Voyage dans la Lune*, described a voyage to the Moon and its society. This was an excuse to compare and criticize the current political situation of France.

The Case of Venus

Mikhail Lomonosov [1] was the first to hypothesize the existence of an atmosphere on Venus, based on his observation of the transit of Venus of 1761, in a small observatory near his house in Saint Petersburg.

The atmosphere was thought to be composed mainly of water vapor, like on Earth. It was then easy to imagine a huge tropical forest with all kinds of creatures living in it.

In 1922, Charles Edward St. John and Seth B. Nicholson failed to detect the spectroscopic signs of oxygen or water in the atmosphere. The myth of Venusians still persisted until 1962, when the *Mariner 2* passed by Venus. The probe revealed no life but a dry and toxic planet.

The Case of Mars

In 1888, the Italian astronomer Giovanni Schiaparelli announced the discovery of a network of narrow lines on Mars. He described those as canali, an Italian word meaning channels (i.e., river). Unfortunately, some English speakers translated it to canal, which bring an artificial meaning to the structures.

In the USA, Percival Lowell became the champion of this canal theory and intelligent life on Mars.

Baravashev [2], first Ukrainian bioastronomer, observed Mars from 1920 to 1940. He thought the color changes on the surface were due to the existence of vegetation.

In 1938, the novel *War of the Worlds* (by H. G. Wells) was broadcast as a radio drama (produced by Orson Welles). Newspapers reported that panic ensued, with people across the northeastern United States and Canada fleeing their homes. The idea of creatures living on planets in the Solar System was real for most people of the period.

In 1971, the probe *Mariner 4* reached Mars and sent pictures disproving the idea of complex life on Mars.

Modern Era

After the opening of the era of planetary exploration, the idea of life form in the Solar System was completely forgotten, until the emergence of the astrobiology missions that search for microbial life form.

The new targets for the search of intelligence were the stars and the possibility of planets around them. The proof of the existence of exoplanets came in 1995 when Micheal Mayor found the first one (51 Pegasi). After more than 20 years of observations, the list of exoplanets has almost reached 2,000. It is ex-

pected that 10 percent of the planets in the Milky Way could support life (e.g., may have liquid water).

III. Proposals for Sending Messages

There have been several proposals for communications with extraterrestrial intelligences from the simple conversation with visitors from another planet, to the transmission of signal (optical and later radio) to them.

Those proposals follow the knowledge and technology of the time. Before the discovery of the optical telescope, we saw a lot of proposals involving the construction of huge structures to be put in fire so the inhabitant of the Moon or Mars could see it. It was very difficult to imagine transmitting any other form of signal to other planets to be observed easily.

The same rhetoric applies to the radio waves. After the invention of radio (Marconi), proposals involving radio transmission started to appear. At some point in history, any concept of using optical signals completely disappeared.

One of the earlier proposals came from Karl Friedrich Gauss. In 1820, he proposed the use of giant triangles, set on fire, in Siberia to communicate with inhabitants of the Moon. The construction would have required a 10-miles wide pine forest in the form of the Pythagorean triangle. Inside the triangle wheat was to have been sown to provide summer contrast with the dark green of the trees. In winter, the green of the trees would contrast strongly with the white of the snow, demonstrating the seasonal change.

He also suggested that large mirrors be constructed and attempts made to communicate at a time when lunar beings would likely be observing the Earth and when twilight conditions would be such as to permit the mirrors to reflect light from the setting Sun and beam it to the Moon.

Those proposals from Gauss were reported in the work of Camille Flammarion titled, *La Pluralite des Mondes Habites*. Flammarion recalled a lecture from Arago (Paris Observatory) in which he mentioned a singular proposal by a German geometer to send messages to the inhabitant of the Moon.

In 1840, Joseph Johann von Littrow (director of the Vienna Observatory) proposed sending bright signals to other inhabitants of the solar system by digging a circular ditch in the Sahara, some 20 miles in diameter, and filling it with water on top of which would be poured kerosene. When lit, it was thought the huge circular fire would be visible to hypothetical inhabitants on the Moon, Mars, and other inner worlds.

V. Uminskii [3], in his story *The Unknown World*, described the following method of signal transmission from Earth to Mars. He reported on the experiment

performed by two Americans: the millionaire Brighton and the astronomer Harting from Boston. They decided to establish contact with Mars by means of optical signals. They arranged in Ecuador, 130 km southeast of its capital Quito, a figure in the shape of a cross consisting of nine luminous spots. The distance between the spots was 60 km. To obtain the required brightness, the ground in each of the nine spots located on a hill was covered with powder of magnesia and thus served as a reflector. Fire resulted from igniting 250 tons of a mixture of aluminum powder and fat, distributed in 500 crates and arranged in 5 concentric circles. The diameter of the outside circle was 200 m. The mixture was ignited electrically through a fuse of potassium chloride and sulfur; saltpeter was also used. At the time of ignition of the nine spots, Mars was closest to Earth (56 million km), so if Mars were inhabited, the Martian astronomer would see this star unit clearly, as it shone for 5 hours on the night surface of the Earth (12 October 1892, from 9pm to 2am). The luminous power of each spot reached 40 million candles. The author states that the weather was favorable and the wind drove the smoke away. However, no reciprocal signal followed.

The English writer, J. J. Astor, in his novel *Journey in Other Worlds,* describes a method of signal transmission from Earth into interplanetary space to communicate with a spaceship travelling to Jupiter. He suggested using very powerful electric lights.

In 1869, the French scientist Charles Cros proposed, in his work *Etudes sur les moyens de communications avec les planetes*, the use of large concave mirrors to send light signals to Martians. He also suggested to repeat the experiment, but toward Venus, at its next close-up of the planet. The Venusians experiment was reported by Stanislas Meunier in the journal *La Nature* (1873).

Cros thought that the inhabitants of Mars were smarter than us and those of Venus less intelligent then us. This was quite obvious by observing the distance of each planet to the Sun.

It was Charles Cros who was the first to propose sending images using a system of dots and dashed.

Alexandre Ananoff, in his book *L'Astronautique* reported a proposal by one Schmoll who wanted to establish a network of mirrors at Bordeaux, Cherbourg, Marseille, Stockholm, Amsterdam, Copenhagen, and on the shores of the Gulf of Bothnia to give the appearance from space of the Big Bear constellation. He reasoned that beings on Mars and other worlds could not help but notice the duplication of the well-known constellation and hence recognize it as an attempt at signaling.

In 1896, the newspaper *Kalushskii Vestnik (The Kaluga Herald)* carried a scientific article by K. Tsiolkovsky titled "Can the Earth ever inform the inhabitants of other planets about the existence of intelligent beings on it?"

Nikola Tesla announced, by the end of 1890, that he had observed mysterious electric vibrations when conducting experiments at large altitudes. He suggested than it would be possible to construct an apparatus which would allow us to transmit enough energy to Mars. His project was never realized.

William H. Pickering suggested setting up a large projector with electric light falling onto a huge mirror almost 3,500 feet in diameter so that the light reflected from the mirror would be directed straight to Mars.

In connection with Mars' approach to Earth in 1924, once again a project emerged to send from Earth to Mars an optical signal in the shape of a beam of solar rays reflected from a huge mirror on a slope of one of the Alpine peaks.

Hugo Gernsback, an American, suggested aiming a very powerful ray of light at Mars and sending sounds along the ray. Having detected this ray, a Martian astronomer can pick up the sounds by special instruments.

The German firm, Hertz, built an electric projector 2 m in diameter. Its light intensity reached 2 billion candles. The rays of this projector would appear from the Moon like a star of sixth magnitude. Its electrodes were made of carbon.

The idea of applying radio-telegraph for such interplanetary signals was advanced by the American astronomer David P. Todd soon after Hertz's work had been published.

Back in the 1870s, Alexander G. Bell, the inventor of the telephone, designed a photophone, i.e., a device transmitting articulate speech by means of light. Since a light ray has no weight or inertia, long distances are of no importance when transmitting music and speech by a photophone.

It was assumed that a thousand arc lamps placed on high mountains would suffice to communicate with Mars.

IV. Messages Sent

The real METI experiments started in 1974, by the transmission from Arecibo of short radio messages. Since that time, several messages have been transmitted using a radio telescope. Table 15–1 lists the known METI experiments using radio waves since 1974.

In 1962, a message was sent from the Evpatoria Planetary Radar to the planet Venus. The message used Morse code to send these words: MIR (peace), LENIN and USSR. It was a calibration test for the installation and also the first message to extraterrestrials.

Year	Title	Notes
1962	The Morse Message	Evpatoria
1974	Arecibo	Frank Drake
1986	Poetica Vaginal	
1987	Message from Human Beings to the Universe	Nançay, France, Jean-Marc Philippe
1999	Cosmic Call 1	Evpatoria, Ukraine, Alexander Zaitzev
2001	TAM-2001	Evpatoria, Ukraine, Alexander Zaitzev
2003	Cosmic Call 2	Evpatoria, Ukraine, Alexander Zaitzev
2005	Discovery Channel	Canada
2005	Craigslist	
2006	Cosmic Connexion	CNES, France
2008	Across the Universe	NASA, DSN, Madrid
2008	A Message from Earth	Evpatoria, Ukraine, Alexander Zaitzev
2008	Doritos Advert	
2009	Hello from Earth	NASA DSN Canberra
2010	BEDO social network and Evpatoria	Evpatoria, Ukraine, Alexander Zaitzev
2012	WOW! reply	A reply to the WOW signal received in 1977 but never confirmed.
2013	Lone Signal	
2013	METI Experiment	JAXA
2013	METI experiment from the Toronto Science Fair	Toronto, Canada
2014	METI Experiment	JAXA

Table 15-1: List of transmissions performed during METI experiments.

The Arecibo message is an image of 73 x 23 pixels (1,679 bits) that was sent to the M13 region located at a distance of 25,000 light-years. It contains the illustrations of the numbers one to ten, the atomic number of some elements (e.g., hydrogen, oxygen, etc.), human DNA, and some other piece of information related to humans.

In 1987, a radio message was sent from the radio telescope of Nançay (France). The project was called "Message from Human Beings to the Universe"

and contains more than 10,500 messages. The transmission was aimed at the heart of our galaxy.

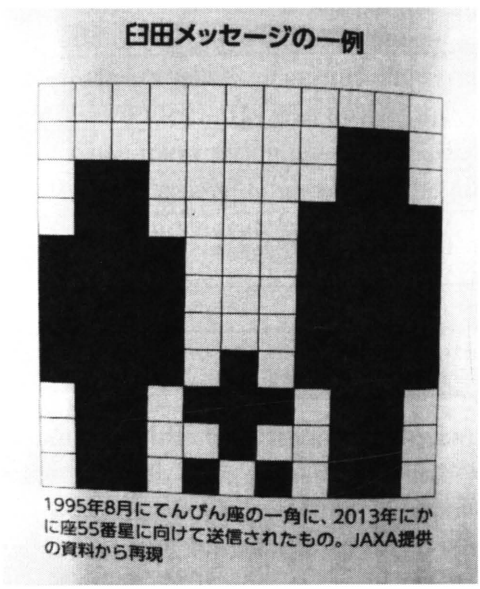
A series of transmissions was sent from the radio telescopes of Evpatoria (Ukraine). In 1999 and 2003, the Cosmic Call series of messages were sent to nine stars. It was the first METI experiment to use close stars rather than far objects. The closest star should receive the message in 2036 while the farthest star in 2069.

When ESA launched the observatory COROT in 2006, the television producer ARTE made a special transmission to the stars. It was broadcasted via the CNES antenna of Aussaguel (near Toulouse). The message is a television show about the mission, humans, and extraterrestrials.

Other METI experiments involving the public were performed (BEDO and Toronto Science Fair). The whole message was built from individual contributions (i.e., pictures, letter, audio).

NASA did two such experiments by transmitting a song by the pop group The Beatles to the Polaris star.

In 2012, National Geographic sent an answer to the WOW! signal. The transmission used the Arecibo antenna. The targets stars are located in the same region as the origin of the signal (i.e., hip 34511, hip 33277 and hip 43587). The WOW signal was first detected in 1977 by the Ohio State University Observatory but never confirmed.



In 2013 and 2014, JAXA did two METI experiments. The first transmission occurred on September 22, 2013, and was repeated on August 22, 2014. It used the 64-m Usuda Deep Space Center (JAXA), broadcast on the X-band with a power of 24 kW. The message was composed with the assistance of JAXA staff, 16 elementary school and junior high school students.

Figure 15–1: The JAXA METI message. Credit: Used with the permission of Shin-ya Narusawa, Nishi-Harima Astronomical Observatory of University of Hyogo.

Space Probes

In addition to the radio transmission, some messages have been sent using space probes.

In 1972, two space probes were launched to scout the path for the Voyager probes, *Pioneer 10* and *11*. Their mission was to explore and test the possibility of sending probes to the outer planets. Carl Sagan convinced NASA to put, on those probes, a plaque that would be a message from Earth to a potential alien civilization.

The plate shows a man and a woman in front of the probe. The top shows the hyperfine structure of the hydrogen atom (the two circles). The bottom shows the position of Earth in the Solar System. The star-like structure in the center of a list of 14 pulsars that could be used to locate the Sun in the Galaxy. On each branch of the star, there is a binary number that indicates the period of those pulsars.

The Pioneer probes discovered that the magnetic field of Jupiter was stronger than anticipated. This gave NASA time to modify the Voyagers to be able to survive the encounter with Jupiter.

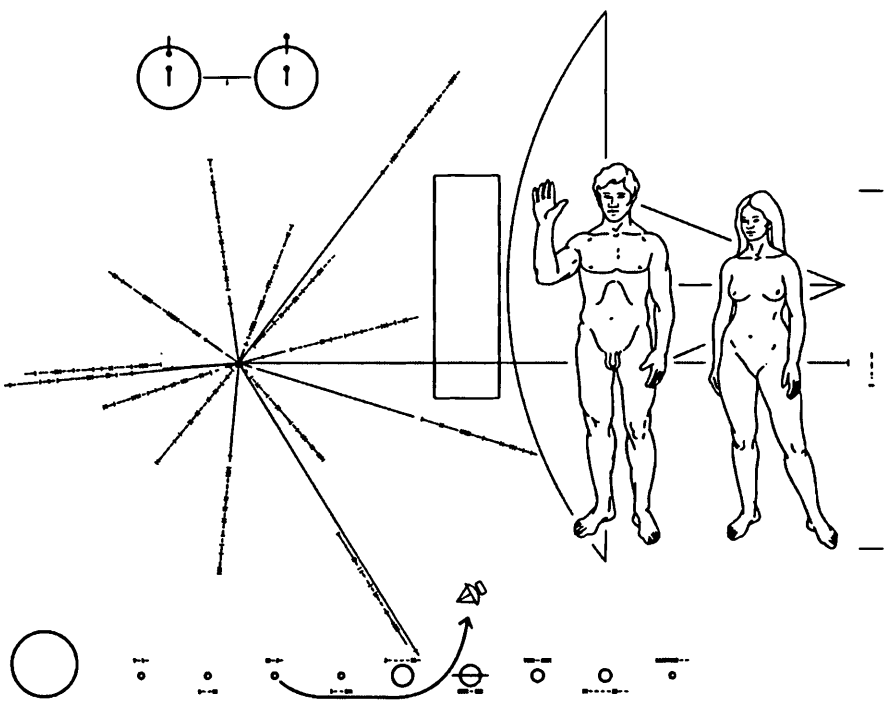


Figure 15–2: Illustration of the Pioneer plate. Credit: Designed by Carl Sagan and Frank Drake; artwork by Linda Salzman Sagan.

In 1977, two more probes were sent exploring the outer planets, *Voyager 1* and *2*. Following the success of the Pioneer plaque, Carl Sagan was able to put a disc containing digital recordings on each probe. The record contains 115 images, over 6 minutes of spoken greetings in several languages, and 90 minutes of music.

The *New Horizon* spacecraft received a digital message to be stored in a small portion of the main memory. This METI experience will be performed after the probe mission to Pluto is completed.

V. Unintentional METI Experiences

There are other METI experiments that could be classified as "unintentional." Even if those experiments' first goal is not to attract attention to Earth, they could still be detected from any alien civilizations with sufficient technology.

Nuclear Explosion Signatures

X-rays are not appropriate as a means of transmitting a continuous stream of information because of their high quantum noise [4]. When a nuclear weapon explodes, about 70 percent of the energy is released in the form of kilovolt X-rays and this X-ray pulse is formed in less than a microsecond. If the explosion occurs above 80 km, the X-rays are not absorbed by the atmosphere and are free to propagate.

The quiet Sun, in the microsecond time of a nuclear explosion produces about 9×10^{17} ergs of X-rays in the 1 to 10 keV range. However, a 1.4-megaton bomb yields about 3×10^{22} ergs.

A "starfish" nuclear bomb (i.e., 1.4 megatons) could be detected by a probe at 400 astronomical units (AU, 1AU = 150 million km). The largest nuclear device built by humankind is the Russian TSAR bomb with a yield of 50 megatons. Its explosion could be detected as far as 0.03 light-years (about 2,000 AU) away.

Detonating most of the nuclear arsenal (1,973) would amount to an energy of 2×10^4 megatons and a detection range of 190 light-years.

The detection range is based on our current technology. Any alien civilization more advanced than us could have better capacities that would translate into a long detection range.

Earth Atmosphere

A signal sent from Earth to the stars does not necessary mean a radio, or optical signal. Using spectroscopy, one can detect biomarkers (i.e., presence of life) in our atmosphere. Observations show that there are several candidate exoplanets that could have liquid water on the surface. It is possible to detect water vapor in the atmosphere on exoplanets [5].

This biological signal is visible as far as the alien receiver technology permits it.

There are even proposals to search for industrial pollution in exoplanet atmospheres [6]. This can be achieved with our own level of technology.

Radio Leakage

There is a lot of broadcasting in the radio range of the electromagnetic spectra (40 MHz to 240 MHz). Those transmissions could be detected by any advanced civilization.

A study [7] revealed that television and military radar are the main contributors (150–500 MHz) to the leakage. An antenna like the Arecibo radio telescope could detect us at a range of 30 light-years while an antenna like the Cyclops [8] could extend this to 500 light years. Using a radio antenna at the focal point of a star, the range could be extended even farther [9].

The alien scientists may not be able to understand the meaning of any talk show or the afternoon soap from television, or even decode the NTSC signal. He will however know the signal to be artificial in origin.

VI. Writing a Letter to ET

Communication between two civilizations that do not know each other is difficult. Any method of communication requires a common ground, some reference material to be used. On Earth, a glass of water, an orange, and a chair are recognized by everyone even if the name is changed. But sending a message to an alien civilization is even harder since we do not have physical contact with them.

A Metalanguage

Before learning a language, the interlocutors need to establish a referential. This referential is often called a "metalanguage." Before learning a language, young humans first establish a contact with their environment. Then, other humans teach them how to properly communicate using written and vocal proto-

cols. Those humans use a metalanguage to teach the young by associating words to objects and concepts.

The problem with establishing a communication channel with an extraterrestrial civilization is that, a priori, we have nothing in common except the universe with which to establish a reference ground. Therefore, the message should be self-explanatory and contain in itself the metalanguage.

The first part of the interstellar message should be written using a metalanguage created for this purpose. No human language could be used as the base of this Interstellar Language. Natural human languages are too ambiguous and complex to be used in an interstellar communication. Using the English as an example, one can propose the following sentence: "What disturbed John was being disregarded by everyone." This can be interpreted in two ways: (1) John is disturbed because everyone disregarded him, (2) everyone disregarded what is disturbing John. Similar ambiguities exist in all human languages.

All we known about them is they live in the same universe as us and more specifically, in the same neighborhood of the Milky Way. We assume that the laws of physics are the same everywhere in the Universe. Those laws could be used as a common ground for a discussion. Furthermore, mathematics is more fundamental than Physics and may be more common. Any civilization capable of building devices to listen to radio waves must know some sort of engineering which implies knowing mathematics. Starting from mathematics and building up to physics may seem a good approach to begin our conversation.

The mathematics should be the metalanguage, the primer of the message, used to teach the interstellar language. Once a common referential between human and alien has been established, it is time to introduce an interstellar language.

Synthetic Languages

Synthetic, or auxiliary, languages are not a new idea and a few were created during the last century. They have been created by design and did not evolve naturally from human society. While keeping most of the cultural fingerprints of our society, they nevertheless may offer a good base for an interstellar language.

Latino Sine Flexione

In 1903, Guiseppe Peano [10] published a paper in the *La Revue de Mathematiques*, in which is described one of the first synthetic languages. The Latino Sine Flexione is similar to Latin but without the heavy grammar, inflexion, double root, and so forth. This would be closest to a real human language but still

dependent on social context. The Latino sine flexione (Latin without flexions) is also known as Interlingua.

Interlingua is based on elements of seven major European languages (e.g., English, French, German, Italian, Portuguese, Spanish, and Russian). As such, its vocabulary is mostly of Greco-Latin origin. Its grammar is very simple.

This language focuses on word families built around roots like currer (run), prender (take), caper (grasp), and a common set of prototypic affixes (ad-, pre-, pro-, -ion, -ive, -ura, etc.).

The Peano's Interlingua is not to be confused with the IALA's Interlingua. The former favored the abolition of grammar while the later reduced it to a minimum. They both use a common Latin base.

Langua Cosmica

Lincos [10] was created by Hans Freudenthal in 1960 as a language to be used in extraterrestrial communication. It is fully explained in a book titled, *Lincos: Design of a language for Cosmic Intercourse.*

Lincos primitives must be defined and taught to the reader prior to being used. It is not a self-teach communication system and it brings the problem of the metalanguage. Preceding the Lincos text with a preamble to teach it could be solution.

The following example illustrates the used of the Lincos.

Ha inq Hb ?x 10x=101

Hb inq Ha 101/10

Ha inq Hb ben

In summary, Ha asks Hb what is x for 10x=101. Hb answer 101/10 and Ha says it is good. Ha and Hb can be interpreted as humans A and B inq means inquit (say) and ben mean bene (good). The dialogue form is another example of structure to present the reader the information without entering into too complex descriptions of the concept.

Lincos lacks the structure and flexibility for complex discussions. However, it could be used in some intermediary stage between a pure mathematical beginning and the more complex language.

The work started by Freudenthal has been taken up by Alexander Ollengren, who is working on developing those concepts.

Lambda Calculus

Lambda Calculus [12] was created by Alonzo Church in 1930. It relies heavily on the use of function (i.e., mathematical functions). It is considered as

the first computer language. From this a pseudo-computer language can be created to describe processes and concepts.

Lambda Calculus is closer to Mathematics than a human language. It is an example of how to use mathematics to create structure for communication. This language uses a logic syntax and the use of functions. This example shows how the numbers may be introduced by defining 1, then 2, as the successor of 1, and so on.

1 = sz.s(z)
2 = sz.s(s(z))
3 = sz.s((s(z)))

Astraglossa

In 1963, Lancelot Hogben, in his essay "Science in Authority," defined a common field of semantic reference (common concepts and common experience) and proposed: "Number will initially be our common idiom of reciprocal recognition; and astronomy will be the topic of our first factual conversation." The author still believed in the idea of inhabitants on Venus and Mars. He proposed to send a light signal to those planets, like Morse, a series of dashes and flashes.

The following is an example of the signaling system described by Hogben. If the sender wants to present the addition of three values (1, 2, and 3).

(i) 1..Fa..1.1..Fa..1.1.1..Fb..1.1.1.1.1.1

(ii) 1..Fa..1.1..Fa..1.1.1..Fb..Fs..Fb..1.1.1.1.1.1

The gaps (.) are interpreted as a signal full stop and the 1s are dashes. In this set-up, the flash (Fa) signifies the operation of addition, the flash (Fb) the relation of identification and the flash (Fs) as the introduction of the cipher symbol for six.

Interstellar Rosetta Stone

This artificial language was created, by Stéphane Dumas and Yvan Dutil, for the Evpatoria messages of 1999 and 2003. It draws its root from Lincos. It was designed to be sent via digital images (black and white). The transmitter would send 1 and 0 using a Frequency Modulated signal.

Each group of pixels forms a symbol, like a letter. There are 90 different symbols in the alphabet. Some represent digits (0 to 9), other more complex ideas, such as mass and length.

The 1999 Evpatoria message is made from 23 images of 123 x 123 pixels. Each page contains a list of symbols that communicate ideas and information.

The 2003 Evpatoria message has a slightly different list of symbols. It is a long page of 127 columns x 2078 lines of pixels.

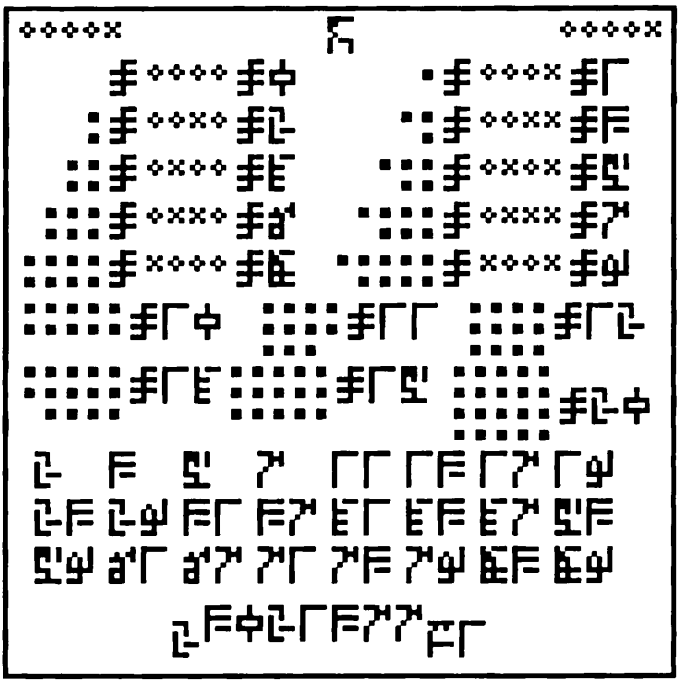


Figure 15–3: Page 1 of the 1999 Evpatoria message.

VII. Conclusions

Sending messages to inhabitants of other worlds is not a new endeavor of humanity. The idea has been around in scientific and fantasy literature since the Greeks.

Following the exploration of the Solar System, the focus of those transmissions shifted from the Moon, Venus, and Mars to the stars. Even if the search for life is still going strong for the planets nearby, the idea of intelligent life has been forgotten.

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