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Introduction

During the 1970s, the United States of America launched four spacecraft with Solar System escape trajectories (Pioneer 10 & 11, Voyager 1 & 2). Because designers took into consideration the possibility that extraterrestrial intelligence (ETI) might in the distant future recover these craft, items intended to communicate cultural and technical information about us were included.

Significant scientific effort went into the development of these prominent, engineered cultural features. Designed to be universally translatable by a hypothetical ETI, these items varied from engraved plaques affixed to the spacecraft's exterior to audio recordings on engraved records stored inside the craft.

This communication method is a modern variant of the classic "message in the bottle" concept. The cultural feature serves as the message with the spacecraft as its bottle, ferrying the feature's embedded information across the deep ocean of interstellar space to a potential technologically-advanced recipient capable of interpreting it.



The Carl Sagan and Frank Drake-designed extraterrestrial communication plaque as positioned on the Pioneer 10 spacecraft. [Credit: NASA Ames Research Center]

The Problem

From an archaeological perspective, the attempt to create a trans-stellar, translatable artifact is tenuous. The consideration of past analogues is highly relevant where suspected language or cultural elements exist but without the necessary context to make confident interpretations. Ancient art forms, such as petroglyphs and geoglyphs, were created to convey information in a specific cultural context. However, recovering this information has proved elusive in most cases, even after years of documentation and analysis of thousands of such sites. Similarly, the function of single megalithic stones, known as Menhirs, is still the subject of speculation, even though there are more than 1,000 of these in northern France alone.

These examples are particularly poignant when considering that the same species that created this past cultural material has struggled to understand its message and purpose centuries to millennia later. Under the presumed spacecraft-as-artifact ETI recovery scenario, case logic implies translation and interpretation by an ETI would be rendered even more elusive due to a much greater span of elapsed time, the lack of underlying planetary and historic cultural context, and the absence of information regarding the originating species.

Bottle as the Message

In an extraterrestrial context, historic analogues highlight archaeological wisdom overlooked by astronomers: The informational value of engraved writing on an artifact, such as a coin, may be inconsequential compared to the cultural and informational value of the coin artifact itself, e.g., its metallurgy, design, production, and weathering.

With these concepts in mind, it is proposed that a spacecraft itself – the "bottle" – provides more data about us and is of greater informational value than the intended communication medium of the "message" – in the form of a plaque or record.



Pioneer 10 in the final stage of construction at the TRW plant in Southern California. [Credit: NASA Ames Research Center]

Example: Pioneer 10

The Pioneer 10 spacecraft, launched in March of 1972, was the first to explore the outer solar system and the first human artifact sent into space with a solar system escape trajectory.

Besides the engineered extraterrestrial communication feature, (i.e., the plaque depicted at left), the Pioneer 10 spacecraft itself communicates a tremendous amount of information about Earth and the human species. An initial archaeological assessment of some of the spacecraft materials produces the following examples regarding the embedded information about us and where we live in the universe:

- Remnant uranium-234 found in four SNAP-19 radioisotope generators indicate advanced isotopic separation, irradiation, and mining technology as well as a terrestrial parent world.

- Four thrusters contain at least trace remnants of hydrazine, a synthesized molecule demonstrating industrial-revolution grade chemical technology.
- Support struts and the total mass of the spacecraft reflect the gravitational environment of the parent world (encompassing both construction and launch environs).
- The presence of machined components (e.g., screws) implies not only technological capability of the creating culture, but it also helps to confine the gravitational (shear stress) and thermal range of the parent environment (e.g., the melting point of materials).
- Isotopic ratios of spacecraft elemental material can confine the age of the originating star system as well as the range of orbital distances from which the material was obtained with respect to its parent star.

Conclusion/Remarks

By applying archaeological methodology to the analysis of the interstellar spacecraft, it is apparent that physical attributes of our spacecraft themselves convey a rich narrative about our civilization typically ignored in technical and academic considerations of extraterrestrial communication, including the temperature, pressure, gravity, atmospheric, chemical, and even geological environment from which the spacecraft was derived. Further, when considering these attributes in combination with a technological assessment of a given spacecraft's components, extrapolations not only about our degree of technological sophistication (i.e., metallurgy, machining technology) but also about our bio-morphology may be reasonably performed. Therefore, the informational value of any so-called "messages in a bottle" efforts that have and continue to receive so much focus as objects of future extraterrestrial communication pale in comparison with the informational value of the "bottle" – the spacecraft – itself.

References

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