

We produce garbage, therefore, we exist!

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The past few centuries were testimonies of an increasing power of mankind over nature. The industrial revolution was the breakdown of a new era, bringing comfort, speed, welfare and civilization. Although this new era also present side effects, mankind, as the rulers of planet earth, are definitely proud of their achievements. This proudness can be observed in the attempts to contact and identifies other civilizations in the universe, like one that wants to shout to the stars: Hey, is there someone out there? Come to see our civilization and what we are doing.

Since mankind realize that our planet is not the center of the universe, understanding how small we are in comparison with the universe, we search for life outside our planet. There are many different reasons to do so: to mitigate our loneliness, to understand better how life and the universe started, to identify other sources of raw material that we could use, or to find a new planet to inhabit.

In Mark twain's words: "a favorite theory of mine— that no *occurrence* is sole and solitary, but is merely a repetition of a thing which has happened before, and perhaps often". It means that, as many believes, history repeats itself. Humans have searched for new frontiers many times in history. Advancing from Africa to reach Asia in the first steps to spread all over the world; facing the dangerous sea in pre-historic boats to reach Australia, or in ships from Europe to the new world of Americas. The new frontier, now, is the far off space, and the attempts to find new civilizations are called SETI (Search for extra-terrestrial intelligence), and METI (Messaging to Extra-Terrestrial Intelligence).

The modern SETI/METI Era started in 1959, when Cornell physicists Giuseppe Cocconi and Philip Morrison published an article in *Nature* in which they pointed out the potential for using microwave radio to communicate between the stars (*Nature*, Vol. 184, Number 4690, pp. 844-846, September 19, 1959). In this paper they define the basics to a successful communication with other planets, like which electromagnetic band and channel should be used in order to send a clear message, and go beyond, indicating how to evaluate the position in space of an hypothetical answer.

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In the spring of 1960, the astronomer Frank Drake conducted the first microwave radio search for signals from other solar systems. Drake pointed his antenna in the direction of two nearby Sun-like stars. Unfortunately he couldn't detect any signal of extraterrestrial origin. His experiment, however, was able to trigger the interest (let's not forget that it were during the cold war) of the Russians. In the 1960's, the Soviet Union dominated SETI/METI, trying to communicate not only with nearby stars, but also using they're antennas to screen large pieces of sky, counting on the existence of at least a few very advanced civilizations capable of understand our signals and also radiating enormous amounts of transmitter power in our direction. One more time, no signal were detected.

At the beginning of the 1970's, NASA decide to start searching for our possible neighbours. A team of experts, from the most different backgrounds produced a comprehensive study known as Project Cyclops, that provided an analysis of SETI/METI science and technology issues that is the foundation upon which much subsequent work is based. The first attempt to contact other civilizations outside from electromagnetic or microwave waves was the pioneer plaques.

The Pioneer plaques were a pair of gold-anodized aluminium plaques which were placed on board the 1972 *Pioneer 10* and 1973 *Pioneer 11* spacecraft. It is especially interesting because it is the real first attempt of contact that features a pictorial message. The plaques show the nude figures of a human male and female along with several symbols that are designed to provide information about the origin of the spacecraft. The problem with the Pioneer Plaque is that, as it is not an electromagnetic wave, it cannot remain echoing in the distance space, making it extremely difficult to be in fact found by other civilizations. They could only be found in case of the Pioneers 10 or 11 interception by extraterrestrial life. Another criticism is that the pictorial representation of mankind in the Pioneer plaque is of very difficult interpretation. If, only within the human race, we can find more than 6.000 different languages (6.912, to be precise, according to the Ethnologue compendium), is it feasible to believe that we will be able to actually communicate with other form of intelligent life? Every language presupposes the understanding of a previous

code, and we have no reason to believe that someone else in the universe would share the same codes with us.

In 1974, during the inauguration of the newly remodeled Arecibo Radio telescope, the so called Arecibo message was broadcast into space a single time via frequency modulated radio waves. It was aimed at the globular star cluster M13 some 25,000 light years away from us. The message consisted of 1679 binary digits, approximately 210 bytes. The Arecibo message was the second attempt to contact in a pictorial way, because its information could be decoded as a draw message. Once decoded, it results on a rectangular arrangement of 73 rows by 23 columns, with a draw consisting of seven parts: the numbers one to ten, the atomic numbers of the elements hydrogen, carbon, nitrogen, oxygen, and phosphorus (components of DNA), the formulas for the sugars and bases in the nucleotides of DNA, the number of nucleotides in DNA, and a graphic of the double helix structure of DNA, a graphic figure of a human, the dimension (physical height) of an average man, and the human population of Earth, a graphic of the Solar System, and finally, a graphic of the Arecibo radio telescope and the dimension (the physical diameter) of the transmitting antenna dish.

One third attempt to make contact was the Voyager Golden Record, a much more complex and detailed message using state-of-the-art media, an attached to the Voyager spacecraft launched in 1977. They are phonograph records which were included aboard both Voyager spacecraft, which were launched in 1977, containing sounds and images selected to portray the diversity of life and culture on Earth, and are intended for any intelligent extraterrestrial life form who may find them. Once again, the possibilities that the Golden records reach its goals are remote. Carl Sagan noted that "The spacecraft will be encountered and the record played only if there are advanced space-faring civilizations in interstellar space. But the launching of this 'bottle' into the cosmic 'ocean' says something very hopeful about life on this planet."

Although those attempts to make contact with another intelligent civilization are all very interesting, they share the same weakness: extremely small possibility of success, both because the message will probably never be find, and, if against all odds it is finally found, the message itself will probably never be deciphered. Fortunately, they might be our most famous initiatives to make contact, but they are definitely not the only ones. Everyday an army of students, researchers and volunteers can be found seated in front of a computer screen in many different labs and observatories around the globe, carefully observing radio signals captured by telescopes. It seems, at a first sight, a very boring

occupation, and most of the times it really is. But from time to time, every now and then, something strange can appear, and when it happens all the lack of emotion is compensated. Whoever is lucky enough to be on duty during those rare moments see themselves, suddenly, on the verge of an extraterrestrial contact.

That's exactly what happened in August 15, 1977, with astronomer Jerry R. Ehman. While reviewing data recorded by Ohio State University's Big Ear radio telescope (then used to support the search for extraterrestrial intelligence) he discovered an anomaly in the radio signal. He was so impressed by the intensity of the signal that he circled the reading on the computer printout and wrote the comment **Wow!** on its side, and that is why we call it "the **Wow! Signal**" until today. The signal appeared to come from the constellation Sagittarius and bore the expected hallmarks of extraterrestrial origin. The entire signal sequence lasted for the full 72-second window during which Big Ear was able to observe it, but has not been detected since, despite several subsequent attempts by Ehman and others. Many hypotheses have been advanced on the origin of the emission, including natural and man-made sources, but none of them adequately explains the result. In a recent re-analysis of the Wow! signal, Antonio Paris from the Center for Planetary Science at St. Petersburg College in Florida provides further evidence that the signal was most likely caused by a natural source such as a comet. Paris and co-author Evan Davies believe that the comet 266/P Christensen, which was discovered nine years after the Wow! signal, was in the celestial vicinity of the signal at the time it was detected, and might in fact have been the source. They reached that conclusion after extrapolating the comet's trajectory back to 1977. Despite this possible explanation, the Wow! signal remains the strongest candidate for an alien radio transmission ever detected.

There are protocols for dealing with a potential extraterrestrial discovery. You perform followup observations of the same source, or the same area of space, and you ask other observatories to perform their own observations. SETI observations have gone down this path many times, and in all cases, no evidence of extraterrestrial intelligence was found. Sometimes, signals have come from aircraft. But an increasing source of strange signals comes from our own fleet of satellites.

Recently, the red dwarf star Ross 128 was the subject of one such incident. Astronomers from the Arecibo radio telescope picked up weird transmissions from the directions of this star, even though they were not actively conducting a SETI search. They alerted other astronomers and even published news of these investigations on the Arecibo Telescope Web page.

It was quickly shown that extraterrestrials were not beaming messages into space from Ross 128. But something else was certainly transmitting. The most likely cause, it seems, was a satellite orbiting the Earth. It just happened to be passing over the telescope's field of view when these observations were taken.

There's a tremendous amount of artificial radio transmissions on Earth and in space. That's how we sustain our information society. But the widespread use of radio waves causes problems for radio astronomers, SETI or otherwise. In the future, astronomers may need to go deeper into space, perhaps to the far side of the Moon, to escape the radio noise of Earth. That's a luxury SETI astronomers can't afford right now. All they can do is check any strange signals carefully, and accept that there will probably be more interference from satellites in the future.

Ironically, while all those communication attempts were tried troughs the years, another event was secretly happening, in the surface of our planet. An event that, even as a negative side effect of industrialization, might be the best way to show other intelligent civilization that here, in this small planet, there is a ruling civilization.

The Great Pacific Garbage Patch was predicted in a 1988 paper published by the National Oceanic and Atmospheric Administration of the United States. Alaska-based researchers noticed, during the 80's, that the level of plastic debris in the North Pacific Ocean was increasing, specially in regions governed by ocean currents. According to those predictions, one specific region of the oceans show a high possibility of plastic accumulation: North Pacific Gyre, between Japan and Hawaii.

North Pacific Gyre is a region of the North Pacific ocean where the northern jet stream and the southern trade winds, moving in opposite directions, create a vast, gently circling region of water. Due to those conditions, tons of plastic garbage are slowly accumulating on it. Media around the world gave a lot of space and attention to this history in the latest years. In fact, some pictures of the amount of plastic floating in the ocean, forming a gigantic island quickly spread around the web, even reaching important newspapers worldwide. Fortunately, the trash island pictured is not real,... yet.

The reality about the Pacific Garbage Patch is that there are indeed millions of small and microscopic pieces of plastic accumulating over some 5000 square km area of the Pacific, in an amount that has increased significantly over the past 40 years. Most of this plastic are microscopic, but slowly some big parts are becoming more and more

frequently. Although they are still far from becoming an island, it can really happen in the future, if we keep producing garbage in the same rates that we do nowadays. Recent measurements in the Pacific Ocean indicate that "Microplastic debris in the North Pacific increased by two orders of magnitude between 1972–1987 and 1999–2010 in both numerical and mass concentrations." (Goldstein et al, *Biology Letters*, Published online before print May 9, 2012, doi: 10.1098).

The Pacific Garbage Patch is the result of a highly industrialized society that fully dominates ways of production in large scales, but still doesn't know how to deal with its own remains. A picture of our society that were not included in the messages that we sent to space describing ourselves.

Some scientists call the attention to the fact that all those floating plastics might be killing not only sea life, but also many birds that accidentally eat small pieces of garbage. If this is true, and what is the extension of that effect still remains a matter of debate. On the other hand, however, we have a class of creatures who are actually thriving as a result of the plastic influx. These are "water skater" insects, small crabs, and invertebrates called bryozoans, who live on hard surfaces in the water. Usually, these creatures have a hard time to find hard surfaces, which are limited in the ocean. But now, with all the plastic floating around, these creatures are enjoying a boom time. The plastic accumulation is not yet an island, but is causing already a clear imbalance in this ecosystem. And this is one of the most striking characteristics of the Anthropocene: Human fingerprints over the planet frequently run out of control, causing unpredictable consequences.

Now let's imagine that there is indeed an intelligent civilization, or many of them, in the far off space. If we believe that those civilizations are developed enough to find, recognize and understand our communication attempts, it is also possible that they, as we are already doing for centuries, are looking to the skies trying to understand the universe. Imagine what they might think when, while looking for our small and lost planet, observe the development of a new continent, formed not by geological dynamics, and not during a geological period of time, but the emergence of a garbage continent, during the course of only decades or centuries.

Finally, the pictorial symbols that we were searching for decades, able to summarize who we are, seems innocuous when compared with the image of the geological event of a new continent made exclusively of our industrial waste. This civilization that can be observing us right now will for sure realize: We are not alone: someone is producing

garbage out there! And from this single observation, they will learn a great deal about who we are.