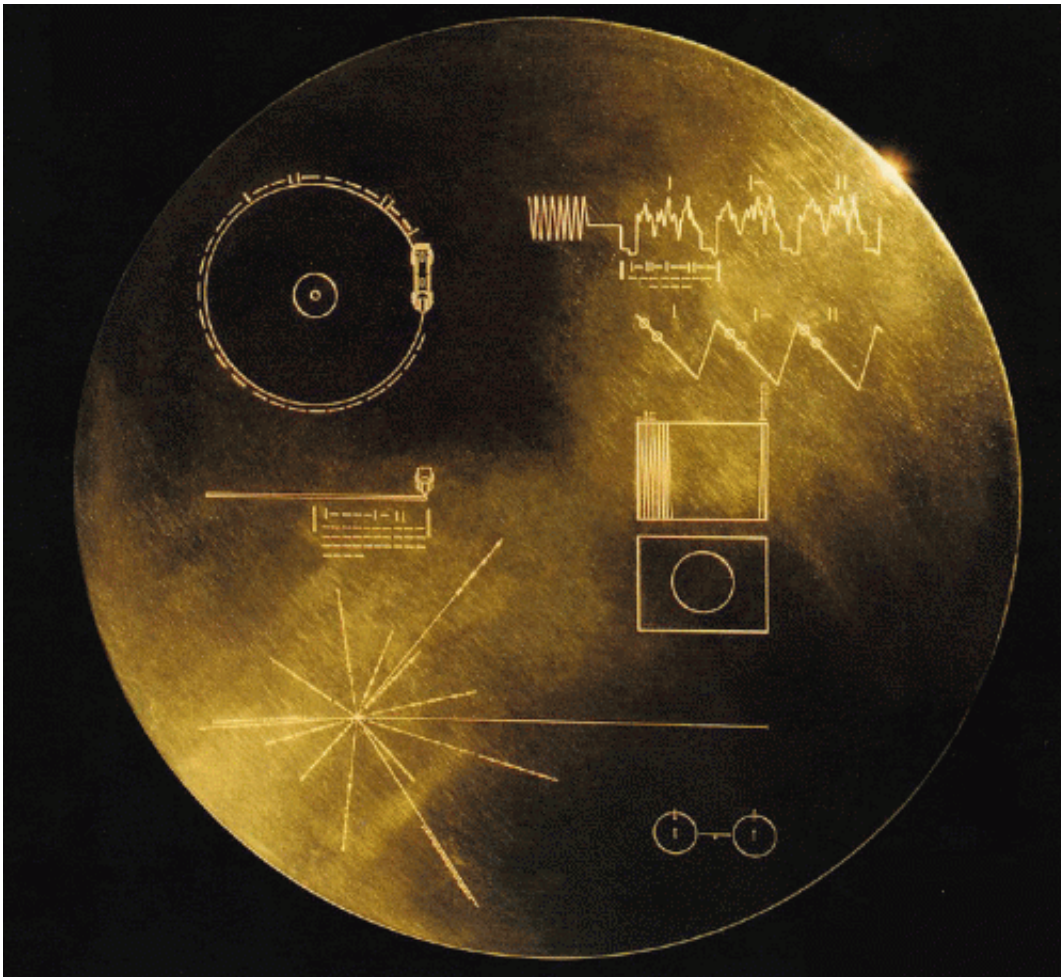


The Rio Scale: Quantifying the consequences of an ET discovery

May 3 2013, by Bruno Martini, Astrobio.net



In 1977 NASA's Voyager 1 and 2 spacecraft launched into space carrying phonographs called the Golden Records containing pictures and sounds meant to show extraterrestrials a glimpse of life on Earth. Credit: NASA

Among the mysteries of the Universe that are able to be investigated by science, the possibility of extraterrestrial intelligence remains one of the most fascinating.

Ancient cultures around the globe have already speculated on that possibility, but we may now finally have the right tools to conduct serious research.

Probably the best example of this present-day capability is the [Search for Extraterrestrial Intelligence](#) (SETI) Program, which aims to detect [electromagnetic signals](#) of extraterrestrial technological communication. Another is the Search for Extraterrestrial Artifacts (SETA), which looks for space probes or stellar-energy orbital plants (so-called "Dyson spheres"). Finding an unmistakable sign of alien technology would be evidence for alien intelligence, even if we never found any living species.

Scientists agree that even though the discovery of an [alien civilization](#) is an event of low probability, if it ever happens it would have deep social, political, religious, intellectual and scientific consequences. But can we quantify the severity of such an event? Can we compare the effects of different alien contact situations?

Aiming to quantify and compare events, scales are a familiar scientific tool. For instance, scales such as Celsius, Fahrenheit or Kelvin are used to quantify temperature. The Beaufort scale expresses the strength of storms by wind speed, while the Saffir-Simpson scale classifies the power of hurricanes and Fujita does the same for tornadoes.

Iván Almár from Konkoly Observatory in Budapest, Hungary and Jill Tarter from the SETI Institute in California developed a similar scale to quantify the potential significance of any announcement of the discovery of extraterrestrial intelligence.



What if we detected city lights on an alien world? In this image, the International Space Station (ISS), shows how the night skies on Earth are illuminated with light from many sources. Credit: Expedition 29 crew/Johnson Space Center

Their scale was initially presented at the 51st International Astronautical Congress, 29th Review Meeting on the Search for Extraterrestrial Intelligence, in October 2000. The event was hosted in Rio de Janeiro, Brazil, so it was called the Rio Scale. The actual scientific paper was published in 2011 in *Acta Astronautica*. Later that year, another paper by Almár and Margaret Race from the [SETI Institute](#) reported in the *Philosophical Transactions of the Royal Society* a few improvements on the Rio Scale, after thorough discussions within the scientific community during the last decade.

The Rio Scale is somewhat similar to the two-dimensional [Torino Scale](#) published in 1997, which quantifies the consequences of an encounter

with an approaching asteroid. The Torino Scale takes into account the potential damage of an asteroid impact and the probability of its collision with the Earth. It was the first attempt to combine on an ordinal scale the effects of two equally important parameters, resulting in a range of 0 (no hazard for mankind) to 10 (certain collision inducing global catastrophe).

The Rio Scale index (RSI) was originally described as: $RSI = Q \times \delta$

Where Q is an estimated level of consequences obtained from the sum of three parameters: class, discovery type and distance of the phenomenon, δ represents the discovery credibility, a more subjective factor likely to vary with time. High values always represent potentially more important consequences.

Q						δ	
Class of phenomenon	Index	Type of Discovery	Index	Distance	Index	Reliability	Index
Earth-specific Message	6						
Omni-directional Message	5	Result of SETI/SETA – Steady	5			No doubt	4/6
Earth-specific Beacon	4	Result of other kind of obs. – Steady	4	Within the Solar System	4	Probable	3/6
Omni-directional beacon	3	Result of SETI/SETA – Transient	3	Within 50 Light-years	3	Possible	2/6
Leakage Radiation	2	Result of other kind of obs. – Transient	2	Within the Milky Way	2	Uncertain	1/6
Astroengineering Activity	1	Re-evaluation of Archival Data	1	Extragalactic	1	Fake	0

Table of the three parameters which result on a Q value and the reliability factor δ . The class of phenomenon has six indices, the type of discovery has 5 indices

and the distance of the claimed extraterrestrial intelligence or artifact has 4 indices. Finally, the reliability factor possesses 5 possible indices. Credit: Table based on Almár and Race (2011)

In the table shown below, the Rio Scale has a value for each of the three categories of Q , which have a number ranging from 3 to 15. The estimated reliability of the claimed discovery, δ , has five possible values and it may decrease or increase with time and among different observers. A claim verified by many experts in multiple and unrelated ways is a case of $\delta = 4/6$. An unequivocal fake signal means $\delta = 0$.

The product of Q and δ is the potential effect on humankind of an announcement of the discovery of an extraterrestrial intelligence. It ranges from 0 to 10 (for eleven levels total).



How would we react if we encountered an alien civilization? Image from the movie, "Close Encounters of the Third Kind." Credit: Columbia Pictures

The difference between the class of "Earth-specific" versus "omni-directional" messages indicates whether the extraterrestrial intelligence knows about our planet Earth.

While SETI and SETA aim to hunt for signals of aliens, other observations may include serendipitous detections made inadvertently (more likely by astronomers). For the classes "leakage" and "astroengineering," the former means electromagnetic radiation that escapes out into space, while the latter means any other kind of technological activity.

Transient phenomena are those verified once but never repeated, while steady phenomena can be verified by repeated observation or investigation. Re-evaluation of archival data would come from old collections of data, and such accounts may be hard to verify. The 50 light-years distance is an arbitrary distance to allow round-trip communication through the speed of light during a human lifetime.

Rio	Importance
10	Extraordinary
9	Outstanding
8	Far-reaching
7	High
6	Noteworthy
5	Intermediate
4	Moderate
3	Minor
2	Low
1	Insignificant
0	None

The Rio Scale addressing the potential consequences of an announcement about the discovery of an extraterrestrial civilization. Credit: IAA SETI Permanent Committee

Even when we face an event of possible huge consequences (high Q value), if the claim of detecting an extraterrestrial civilization is not credible (low δ value), this will drop the actual significance of the discovery.

The International Academy of Astronautics (IAA) SETI Permanent committee adopted the Rio Scale with a decennial level of significance, taking the example from the more famous Richter Scale that quantifies an earthquake's magnitude. On the IAA SETI Permanent Committee website, you can calculate the Rio Scale for different scenarios by yourself: www.setileague.org/iaaseti/riocalc.htm

Iván Almár and Jill Tarter noted "the discovery of [extraterrestrial intelligence](#) as a high-consequence, low-probability event" and suggested their Rio Scale could be used by the media as a tool to avoid misinterpretation and sensationalism over claims about extraterrestrial intelligences. It will be the task of a group of independent experts to calculate the Rio Scale index for any putative discovery.

More information: Original work from Almár & Tarter (2011): www.sciencedirect.com/science/.../ii/S0094576509003683

Original paper from Almár & Race (2011): rsta.royalsocietypublishing.or.../36/679.full.pdf+html

Source: Astrobio.net

Citation: The Rio Scale: Quantifying the consequences of an ET discovery (2013, May 3)
retrieved 25 June 2024 from <https://phys.org/news/2013-05-rio-scale-quantifying-consequences-discovery.html>

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