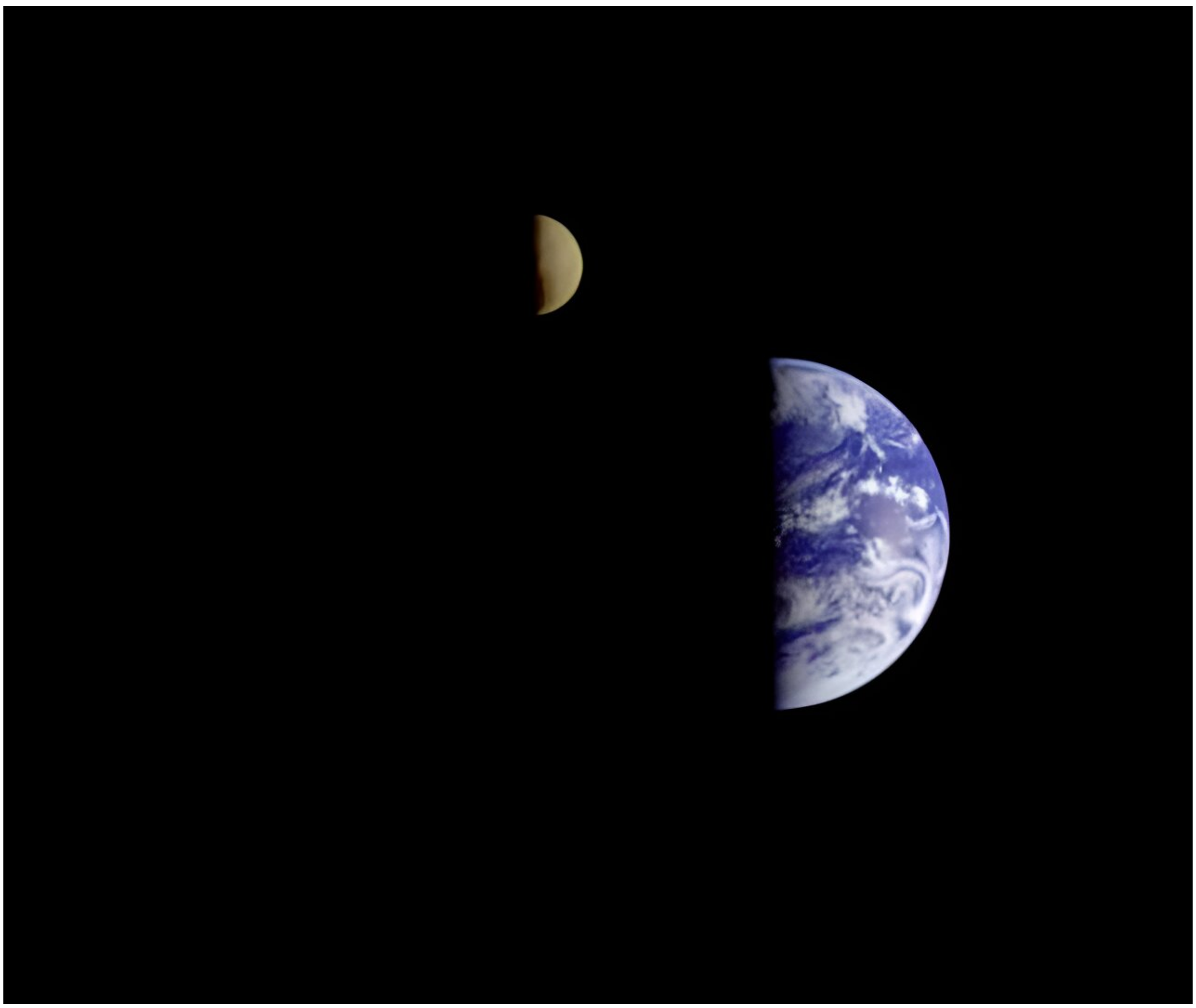
Carl Sagan detected life on Earth 30 years ago—here's how his experiment is helping us search for alien species today

October 23 2023, by Gareth Dorrian



Earth and moon as seen by the Galileo spacecraft from a distance of 6 million km away. Credit: NASA

It's been 30 years since a group of scientists led by Carl Sagan found evidence for life on Earth using data from instruments on board the Nasa Galileo robotic spacecraft. Yes, you read that correctly. Among his many pearls of wisdom, Sagan was famous for saying that science is more than a body of knowledge—it is a way of thinking.

In other words, how humans go about the business of discovering new knowledge is at least as important as the knowledge itself. In this vein, the study was an example of a "control experiment"—a critical part of the scientific method. This can involve asking whether a given study or method of analysis is capable of finding evidence for something we already know.

Suppose one were to fly past Earth in an alien spacecraft with the same instruments on board as Galileo had. If we knew nothing else about Earth, would we be able to unambiguously detect life here, using nothing but these instruments (which wouldn't be optimized to find it)? If not, what would that say about our ability to detect life anywhere else?

Galileo launched in October 1989 on a six-year flight to Jupiter. However, Galileo had to first make several orbits of the inner solar system, making close flybys of Earth and Venus, in order to pick up enough speed to reach Jupiter.

In the mid-2000s, scientists took samples of dirt from the Mars-like environment of Chile's Atacama desert on Earth, which is known to contain microbial life. They then used similar experiments as those used on the NASA Viking spacecraft (which aimed to detect life on Mars when they landed there in the 1970s) to see if life could be found in Atacama.

They failed—the implication being that had the Viking spacecraft landed on Earth in the Atacama Desert, and performed the same experiments as they did on Mars, they might well have missed signatures for life, even though it is known to be present.

Galileo results

Galileo was kitted out with a variety of instruments designed to study the atmosphere and space environment of Jupiter and its moons. These included imaging cameras, spectrometers (which break down light by wavelength) and a radio experiment.

Importantly, the authors of the study did not presume any characteristics of life on Earth ab initio (from the beginning), but attempted to derive their conclusions just from the data. The near infra-red mapping spectrometer (NIMS) instrument detected gaseous water distributed throughout the terrestrial atmosphere, ice at the poles and large expanses of liquid water "of oceanic dimensions." It also recorded temperatures ranging from -30°C to +18°C.

Evidence for life? Not yet. The study concluded that the detection of liquid water and a water weather system was a necessary, but not sufficient argument.

NIMS also detected high concentrations of oxygen and methane in the Earth's atmosphere, as compared to other known planets. Both of these are highly reactive gases that would rapidly react with other chemicals and dissipate in a short period of time. The only way for such concentrations of these species to be upheld were if they were continuously replenished by some means—again suggesting, but not proving, life. Other instruments on the spacecraft detected the presence of an ozone layer, shielding the surface from damaging UV radiation from the sun.

One might imagine that a simple look through the camera might be enough to spot life. But the images showed oceans, deserts, clouds, ice and darker regions in South America which, only with prior knowledge, we know of course to be rain forests. However, once combined with more spectrometry, a distinct absorption of red light was found to overlay the darker regions, which the study concluded was "strongly suggestive" of light being absorbed by photosynthetic plant life. No minerals were known to absorb light in exactly this fashion.

The highest resolution images taken, as dictated by the flyby geometry, were of the deserts of central Australia and the ice sheets of Antarctica. Hence none of the images taken showed cities or clear examples of agriculture. The spacecraft also flew by the planet at closest approach during the daytime, so lights from cities at night were not visible either.

Of greater interest though was Galileo's plasma wave radio experiment. The cosmos is full of natural radio emission, however most of it is broadband. That is to say, the emission from a given natural source occurs across many frequencies. Artificial radio sources, by contrast, are produced in a narrow band: an everyday example is the meticulous tuning of an analog radio required to find a station amidst the static.

An example of natural radio emission from aurora in Saturn's atmosphere can be heard below. The frequency changes rapidly—unlike a radio station.

Galileo detected consistent narrowband radio emission from Earth at fixed frequencies. The study concluded this could only have come from a technological civilization, and would only be detectable within the last century. If our alien spacecraft had made the same flyby of Earth at any time in the few billion years prior to the 20th century then it would have seen no definitive evidence of a civilization on Earth at all.

It is perhaps no surprise then that, as yet, no evidence for extra-terrestrial life has been found. Even a spacecraft flying within a few thousand kilometers of human civilization on Earth is not guaranteed to detect it. Control experiments like this are therefore critical in informing the search for life elsewhere.

In the present era, humanity has now discovered over 5,000 planets around other stars, and we have even detected the presence of water in the atmospheres of some planets. Sagan's experiment shows this is not enough by itself.

A strong case for life elsewhere will likely require a combination of mutually supporting evidence, such as light absorption by photosynthesis-like processes, narrowband radio emission, modest temperatures and weather and chemical traces in the atmosphere which are hard to explain by non-biological means. As we move into the era of instruments such as the James Webb space telescope, Sagan's experiment remains as informative now as it was 30 years ago.

Provided by The Conversation

Citation: Carl Sagan detected life on Earth 30 years ago—here's how his experiment is helping us search for alien species today (2023, October 23) retrieved 29 April 2024 from https://phys.org/news/2023-10-carl-sagan-life-earth-years.html