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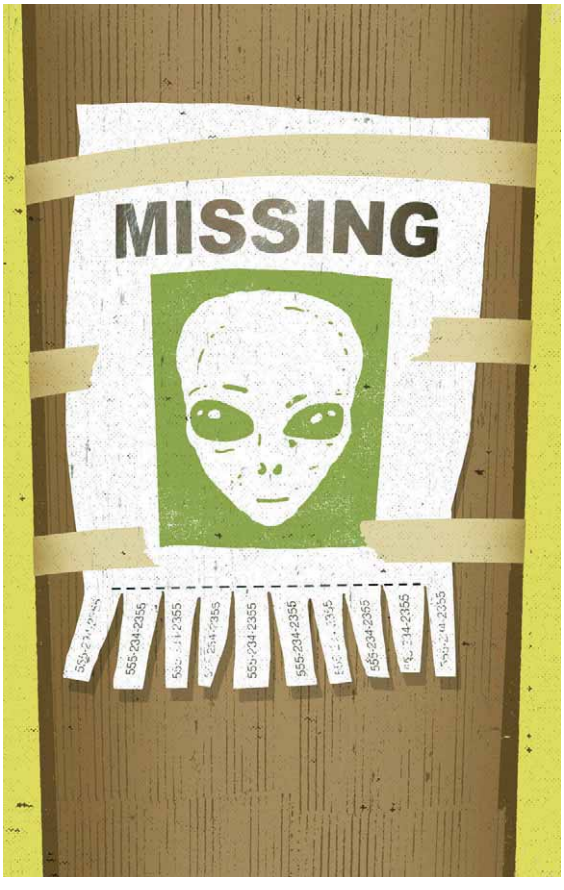
Where Have All the Aliens Gone?

The problem of sustainability may explain the absence of extraterrestrials.

For ages, humanity has looked to the skies and pondered whether intelligent life ever developed elsewhere. In 1950 physicist Enrico Fermi made a back-of-the-envelope calculation to estimate the time required for a technological civilization to spread throughout our galaxy. Fermi realized that a civilization expanding exponentially at even 1% of light speed could colonize the entire galaxy in just 10 million years. Following his reasoning, we now know that the Milky Way Galaxy is approximately 10 billion years old, whereas life on Earth arose around 4 billion years ago. Plenty of time has elapsed for intelligent life to develop elsewhere. So if any technological extraterrestrial society exists, then they should have visited us by now. Known today as the *Fermi paradox,* this apparent contradiction between observations and expectations raises the question: Where are they?

Many explanations have been proposed to account for the conspicuous absence of extraterrestrials. Perhaps life as found on Earth may be a cosmic anomaly that only arises once or twice in an entire galaxy. A more cynical perspective maintains that civilizations inevitably destroy themselves, facing nuclear winter rather than interstellar domination. Then again, members of an extraterrestrial galactic club could already be observing us, following a Prime Directive to remain hidden until they deem us worthy of contact.

We revisited Fermi's original assumption that civilizations spread exponentially throughout the galaxy. For example, a civilization that deploys colonists to 10 planets, each of which expands to another 10 new planets, will quickly colonize the entire galaxy. This premise is based on observations of the human population, such as our growth from about 1 million to nearly 7 billion people over the last 10,000 years. But we are now learning that, despite the seeming vastness of Earth's resources, this rapid expansion frequently proves unsustainable because it consumes resources faster than they are replenished. If growth outstrips resources, human civilization may collapse. This could also explain the absence of extraterrestrials: despite the seeming vastness of the galaxy, perhaps exponential expansion is also unsustainable on a galactic scale.



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If this *Sustainability Solution* explains the paradox, then rapidly expanding civilizations face severe issues upon complete colonization of the galaxy. With no new available resources and no room left to grow, unsustainably growing galactic civilizations may inevitably collapse. Because this process occurs over millions of years — compared to the multi-billion-year history of the Milky Way — if any extraterrestrial civilization successfully expanded through the galaxy, we would not have seen any signs of them. Their rise and fall would have been too quick for us to notice. We may be able to detect the aftermath of their expansion and collapse, but such "civilization graveyards" would escape our notice much more easily than the civilizations themselves.

The galaxy may be filled with sustainably living extraterrestrials that grow within the carrying capacity of their environment, expanding too slowly to have yet reached Earth. But if unsustainable rapid growth led to the demise of past galactic civilizations, then perhaps the challenge rests with human civilization to become responsible consumers and ensure our own long-term survival. ✦

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