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Are We Alone in the Universe?

By PAUL DAVIES

TEMPE, Ariz. — THE recent announcement by a team of astronomers that there could be as many as 40 billion habitable planets in our galaxy has further fueled the speculation, popular even among many distinguished scientists, that the universe is teeming with life.

The astronomer Geoffrey W. Marcy of the University of California, Berkeley, an experienced planet hunter and co-author of the study that generated the finding, said that it "represents one great leap toward the possibility of life, including intelligent life, in the universe."

But "possibility" is not the same as likelihood. If a planet is to be inhabited rather than merely habitable, two basic requirements must be met: the planet must first be suitable and then life must emerge on it at some stage.

What can be said about the chances of life starting up on a habitable planet? Darwin gave us a powerful explanation of how life on Earth evolved over billions of years, but he would not be drawn out on the question of how life got going in the first place. "One might as well speculate about the origin of matter," he quipped. In spite of intensive research, scientists are still very much in the dark about the mechanism that transformed a nonliving chemical soup into a living cell. But without knowing the process that produced life, the odds of its happening can't be estimated.

When I was a student in the 1960s, the prevailing view among scientists was that life on Earth was a freak phenomenon, the result of a sequence of chemical accidents so rare that they would be unlikely to have happened twice in the observable universe. "Man at last knows he is alone in the unfeeling immensity of the universe, out of which he has emerged only by chance," wrote the biologist Jacques Monod. Today the pendulum has swung dramatically, and many distinguished scientists claim that life will almost inevitably arise in Earthlike conditions. Yet this decisive shift in view is based on little more than a hunch, rather than an improved understanding of life's origin.

The underlying problem is complexity. Even the simplest bacterium is, at the molecular level, staggeringly complex. Although we have no idea of the minimal complexity of a living organism, it is likely to be very high. It could be that some sort of complexifying principle operates in

nature, serving to drive a chaotic mix of chemicals on a fast track to a primitive microbe. If so, no hint of such a principle has been found in laboratory experiments to re-create the basic building blocks of life.

On the other hand, if life arose simply by the accumulation of many specific chemical accidents in one place, it is easy to imagine that only one in, say, a trillion trillion habitable planets would ever host such a dream run. Set against a number that big — and once you decide a series of unlikely accidents is behind the creation of life, you get enormous odds very easily — it is irrelevant whether the Milky Way contains 40 billion habitable planets or just a handful. Forty billion makes hardly a dent in a trillion trillion.

So we are stuck. Life may indeed pop up readily in Earthlike conditions, or it may be a fluke, unique in the observable universe. Because we are a product of this cosmic accident, we cannot conclude that Earth is typical. No statistical evidence can be drawn from a sample of one.

The easiest way to settle the matter is to find a second sample of life, one that arose from scratch independent of known life. The inventory of extrasolar planets being discovered is an extremely useful first step. In the future, our telescopes should be able to analyze the atmospheres of some of these planets for telltale signs of biological activity.

But evidence favoring life's high probability could exist closer to home. No planet is more Earthlike than Earth itself. If life does pop up readily in Earthlike conditions, then it should have started many times, right here on our own planet. It could be that intermingled among the seething microbes all around us are some that are so biochemically different they could be descended only from a separate origin. You couldn't tell by looking, only by delving into their molecular innards and finding something weird enough to rule out a common precursor. The discovery of just a single "alien" microbe under our very noses would be enough to conclude that the universe was indeed teeming with life.

It would also address a deep philosophical question. Although the pathway from microbes to complex thinking beings like humans may still be a very difficult one, at least we know the mechanism whereby it happens — Darwinian evolution. If microbial life is widespread in the cosmos, we can expect that, at least here and there, sentient beings will evolve. We would then be much closer to answering that age-old puzzle of existence: Are we alone in the universe?

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