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Books in Review

Stephen Webb

If The Universe is Teeming with Aliens... Where is Everybody? Seventy-Five Solutions to the Fermi Paradox and the Problem of Extraterrestrial Life
Second Edition.
Springer Science and Fiction, 2015, pb, xv + 434 pp, $29.99
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Reviewed by **Alexander Cendrowski**

It was the summer of 1950 (second only to the summer of '69), and Enrico Fermi was on lunch break from his work at the Los Alamos National Laboratory. Born in 1901, Fermi had been awarded the Nobel Prize for physics in 1938, in part due to his development of a technique to probe atomic nuclei. In 1942, at the University of Chicago, Fermi and his team successfully created the first self-sustaining nuclear reaction. In 1945, he was a key component of the Manhattan Project. And on that 1950 summer's day, Fermi was joined by Edward Teller, Herbert York, and Emil Konopinski for a bite to eat. The topic of conversation? Recent reports of flying saucers.

Originally light and joking, the conversation turned serious with a discussion about whether flying saucers would be able to exceed the speed of light. Fermi asked Teller what he thought the probability might be of finding evidence for faster-than-light travel by 1960. Teller said one-in-a-million. Fermi thought it was more like one-in-ten. The conversation trailed off. The four began to eat. Then, after a separate conversation had already begun, Fermi suddenly exclaimed: "Where is everybody?"

So began the Fermi Paradox.

So too begins the second edition of *If the Universe is Teeming with Aliens... Where Is Everybody? Seventy-Five Solutions to the Fermi Paradox and the Problem of Extraterrestrial Life*, which make up Stephen Webb's response to Fermi's question. The method for examining the paradox makes use of the Drake Equation (named for Frank Drake, a radio astronomer who was the first to make explicit use of it), which attempts to estimate the number of intelligent, communicative civilizations in the universe: take the total number of stars, multiply it by how many planets each one has on average, then multiply by the fraction of planets that have the necessary conditions for life and, finally, by how many of those are likely to reach advanced status. While an enormous amount of guesswork is involved in the equation, scientists have speculated that there must be millions of extraterrestrial civilizations, even by the most conservative estimates. But if that's true, where are they? And why haven't we heard from them?

Stephen Webb hopes to answer these very questions. As with many of the entries in Springer's Science and Fiction Series, *Where is Everybody?* employs a wide range of science-backed thought and speculation—from breakdowns of potential doomsday events to explorations of particle horizons—to explain where these civilizations might have gone and why we haven't heard from them. The second edition of Where is Everybody? brings to the table twenty-five more potential solutions than did the first edition, with the additional possible answers being at least partially justified by advancements in astrophysics, evolutionary biology, and interstellar com-

munication over the last fifteen years. Nor does Webb turn only to real-world science with these questions. Indeed, as the foreword to the second edition notes, "[Science Fiction] authors have contributed at least as much to the debate as professional scientists," an acknowledgement by Webb that the Fermi Paradox is as much about philosophical speculation as it is about scientific speculation. After all, if it turns out that humans are alone, that Homo sapiens truly are the universe's only intelligent lifeform, then our species is entitled to reduced modesty on the scale of cosmic importance. And if we're not, well, we have science fiction writers to thank for preparing us for what lies ahead.

Webb divides his seventy-five solutions into three categories: the first ten proposals are based around the idea that extraterrestrial civilizations have already visited Earth; the next thirty on the idea that extraterrestrial civilizations exist, but we haven't found evidence of them yet; and the last twenty-five, including Webb's own suggestions, on the idea that human beings really are alone in this great, big universe after all. While this method of categorization makes sense at first glance, it privileges those last twenty-five solutions since, although Webb generally takes care to give each proposal fair consideration, he ends the majority of the preceding sections with a note that he personally isn't quite convinced by the solutions presented.

Where is Everybody? becomes an interesting mix of analysis and commentary with these notes in mind. On the one hand, Webb does well to look into probability equations, analyze the science cultivated over centuries by astronomers and physicists and science fiction writers, and even to give space to philosophical and sociological ideas with which he clearly disagrees. On the other hand, Webb's commentary on those proposals can sometimes leave large sections of the book without clear purpose, at least when read straight through. If the reader knows—and Webb is quick to mention it—the author is not thoroughly convinced by over three quarters of the book he has written, then that reader is much more likely to just skip to solution seventy-five, the culmination of Webb's research. Webb even conveniently titled the section "The Fermi Paradox Resolved." (At the beginning of the section, he reveals that this is meant in jest—but jest isn't always clear when reading an index.)

The arrangement of Where is Everybody? becomes masterful only when understanding that how the work is intended to be used, a suggestion Webb makes in the very first chapter. While the sections are arranged so that a straight-forward read is possible, each solution is self-contained, allowing readers to pick out those answers that are most interesting to them and explore their historical and scientific contexts. The book, then, offers at least this advantage: when the first solution doesn't quite convince, there are still another seventy-four to go.