



"The heavens declare the glory of God" (Psalm 19:1)

REASONS TO BELIEVE - SEATTLE AREA CHAPTER

NEWS AND VIEWS

NOVEMBER 2007

What's Happening?

Science News Flash

Reasons To Believe has a new podcast, offering a unique Christian perspective on headline-grabbing scientific discoveries. You can subscribe to it now on iTunes. For more information, go to the RTB homepage (www.reasons.org).

Chapter Meeting

The next Seattle Chapter meeting is scheduled for Saturday, January 26th, 9:00 A.M at Calvin Presbyterian Church in Shoreline. David Marshall, of Christ the Tao Ministry, will speak on his ministry and his new book on worldview apologetics. This is a great opportunity to get involved with the chapter. Please plan to join us!

We Do Presentations

The Seattle chapter does presentations on wide range of topics ranging from the scientific evidences for God, to the age of the earth debate. If your church or group is looking for speakers, contact us at seattle@reasons.org.

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The Search for Extraterrestrial Life

DR. JOHN MILLAM

In the last 40 years, there has been a tremendous surge in popular belief about life residing on planets outside our solar system. While such speculation used to be frowned upon, it is now commonly greeted with enthusiasm. Life on other planets is now popularly believed to be not just possible but virtually certain. Carl Sagan, among others, led the campaign to popularize this idea and gave it scientific credibility. In particular, the movie Contact based on the book by Carl Sagan has done much to popularize to the public the notion of looking for and communicating with extraterrestrial civilizations. Science fiction movies (e.g. Star Wars and Star Trek) and books have also lent support to such notions and have helped these ideas to cross over from dry academic discussions into popular culture. NASA's spectacular success of putting a man on the moon and the robotic exploration of other planets in our solar system has brought many of these ideas right into people's homes and has made believing in other life sites seem more plausible.



This emerging popular culture belief in the existence of extraterrestrial life can be traced in large part to developments within astronomy. Until this century, the possibility of life on other planets outside our solar system was seldom seriously considered even recognizing the vastness of the universe. Much of the skepticism was based on the prevailing view that planet formation was very unusual. If there were few other planetary systems, then the possibility of life on other planets would likewise be small. This began to change in the 1950's as models of planet formation became more robust and reliable. There soon was a growing consensus among astronomers that as many as half of all the stars in our galaxy might harbor planets. This reopened the possibility of life on other planets. In September 1959, Cocconi and Morrison published the first paper discussing rudimentary ideas on how to detect and communicate with possible life forms on other planets using existing technology.¹ Frank Drake led the first actual systematic search for extraterrestrial signals in 1960.² Dubbed Project Ozma,³ Drake examined two nearby stars (Epsilon Eridani and Tau Ceti) but found no extraterrestrial signals. The following year, Frank Drake and J. Peter Pearman organized the first ever SETI (Search for Extra-Terrestrial Intelligence) conference of ten interested scientists. In attendance were Carl Sagan and Nobel Prize winning chemist, Melvin Calvin.

In preparation for this first conference, Drake developed his now famous Drake Equation⁴ (see below) to help focus the participants on deciding which stars might be the best candidates for study. Using this equation, Drake estimated that there should be at least 1,000 to 10,000 intelligent communicating species within our galaxy alone. If these civilizations were evenly distributed throughout the galaxy, then the nearest civilization would be no more than 1,000 light years away. Given such optimistic estimates, the chance of actually detecting a signal would be very high. SETI projects to detect extraterrestrial signals include Harvard's Project META⁵ and Project BETA,⁶ UC Berkeley's Project SERENDIP⁷ and SETI@Home,⁸ and SETI Institute's Project Phoenix.⁹ More detailed descriptions of SETI's mission and philosophy can be found elsewhere.^{10,11,12,13}

Why is the question of extraterrestrial life so important? Aside from the scientific question itself, which most likely cannot be answered definitively anytime soon, there is an ongoing debate in our culture concerning man and man's place in the universe. Is man "special" in some way or is life trivial and common? Are our planet, solar system, and galaxy "specially created" or is our favorable solar system virtually guaranteed to exist? These are deep questions that were once the realm of theology and philosophy only but now scientists are weighing in on the issue. Many of the scientists who are shaping the public debate do not have a strong theological or philosophical background. To make matters worse, reporters, philosophers, theologians, and other spokesmen for popular culture often lack the necessary scientific background and knowledge to properly assess the reliability of these scientific claims. It is important that we get solid information about this issue so that we can stand on a solid foundation and not be tossed back and forth by the winds of popular culture.

Of great concern is a growing lack of skepticism toward claims of extraterrestrial life. This is well illustrated by the discovery in 1996 of possible remnants of life in a Martian meteorite.^{14,15,16} Before the scientific community could respond, the discovery was hailed by President Clinton and the newspapers were filled with many grand statements about the possible evidence for life on Mars. Some even used the initial report to support their own personal philosophical ideas.^{17,18} Enthusiasm over the Mars rock has since quieted down as evidence has accumulated against the original conclusion.^{19,20,21} The Mars rover and other studies indicating that Mars may have had liquid water in the past are popularized as evidence that Mars may have had life in the past. Similarly, the finding of evidence suggesting the possible presence of liquid water on Europa, one of Jupiter's moons, has led to wild speculation about the possibility of life there.²² Even the comets, like Hale-Bopp, have been promoted as playing a role in the origin of life by pro-extraterrestrial enthusiasts.^{23,24} This is in addition to the daily deluge of claims of UFO sightings and abductions, which thrive on the public's lack of knowledge and skepticism about extraterrestrial life. The growing UFO movement, which claims that extraterrestrials are currently visiting our planet, has argued for the notion of life on other planets in order to gain scientific credibility for its own beliefs.

Before moving on, it is important to point out the difference between the SETI movement and the UFO movement. While both affirm a belief in the existence of extraterrestrial life, they are radically opposed over the notion of whether or not we

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In the **NEWS...**

[Antony Flew Interview](#)

For the last half century, Antony Flew was the world's most famous atheist. Now Flew is the world's most famous convert to a belief in God. In this tothesource interview, Flew describes his incredible journey to God.

Go to: http://www.tothesource.org/10_30_2007/10_30_2007.htm.

[A Response to Dawkins](#)

This Discovery Institute article by Casey Luskin debates Richard Dawkins claim that new genetic information, new genes, arise through various kinds of duplication. According to Luskin, gene duplication is incapable of increasing the information content in the genome. Go to <http://www.discovery.org/a/4278>.

[An Emboldened 'Compass'](#)

This Breakpoint article by Tom Gilson discusses the dark material in the new movie, *The Golden Compass*, and how curriculum resources based on the anti-Church, anti-Biblical elements of the book are being distributed to schools at no charge. Go to: <http://www.breakpoint.org/listing/article.asp?ID=7254>.

[Why the Heathen Rage](#)

This Breakpoint article by Regis Nicoll discusses the new anti-God movement. As Nicoll points out, while naturalists criticize the shortcomings of religion, they fail to recognize that evolution has no morality, only survival of the fittest. Go to: <http://breakpoint.org/listingarticle.asp?ID=7117>.

[NOVA's "Judgment Day"](#)

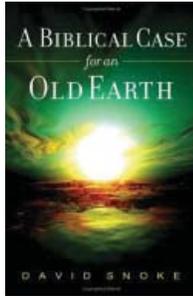
This Discovery Institute article discusses the NOVA special "Judgment Day: Intelligent Design on Trial." What the show didn't state is the Dover Trial did not consider the testimony of scientists actively pursuing the theory of intelligent design. Go to: <http://www.discovery.org/scripts/viewDB/index.php?command=view&id=4300&program=CS%20-%20Views%20and%20News>.

Book Reviews

A Biblical Case for an Old Earth

David Snoke
Baker Books, 2006

Reviewer: John Battle



David Snoke is an associate professor of physics and astronomy at the University of Pittsburgh and an elder and preacher in the Presbyterian Church in America (PCA).

The PCA has gone through a struggle between young earth and old earth creationists, with many young earth creationists declaring that those holding to an old earth should not be allowed to preach or hold office. The PCA has decided against this exclusive policy, but the controversy continues. Snoke has written this book as a defense of the old earth position.

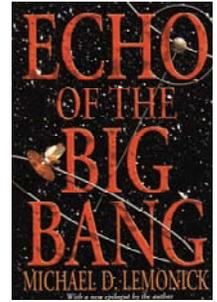
Snoke spends some time with the scientific arguments for an old earth, which he summarizes quite well. He also spends some time showing how flood geology will not account for the geological layers we observe. However, most of the book, deals with biblical and theological arguments. Snoke demonstrates how it is necessary to use our experience in the world, including our observations, when interpreting the Bible—the Bible was not written in a vacuum. The most helpful discussions, in my opinion, describe the very good creation of Genesis as containing both positive, helpful, parts, and dark, dangerous parts. Snokes is very convincing in showing that the “very good” creation included danger and death in the plant and animal kingdom, and danger for the human kingdom. This “dark side” also glorifies God in many OT texts.

Somewhat detracting is the lengthy appendix consisting of his own translation of Genesis 1-11. Snoke’s translation is indiosyncratic, and his linguistic procedures are poor when handling idioms or handling the same Hebrew term in contexts where it has different meanings. He admits not being a Hebrew expert. A better procedure would have been to take a standard translation and suggest changes or make clarifications in parentheses. Yet, in spite of this anti-climactic appendix, the book is very valuable showing how the Hebrew and the OT world would have understood the text much differently than modern young earth creationists do.

Echo of the Big Bang

Michael D. Lemonick
Princeton University Press, 2003

Reviewer: Mike Brown



Michael Lemonick is a senior science writer at Time magazine, where he has written more than forty cover stories on a wide range of science-related topics.

This book is available through Reasons to Believe. From the brief description provided at the RTB website, I got the impression the book was about the development of and evidence for the theory of the Big Bang. To a certain extent it is. However, the book was written to tell the story of the WMAP satellite and the team that developed it.

The first three chapters deal with the early development of the Big Bang model leading up to the discovery of the cosmic microwave background by Penzias and Wilson in 1965. The second three deal with the story of the COBE satellite that gave us more detailed information about the CMB in 1992. The remaining eight chapters focus on the detailed story of the WMAP team and satellite which provided us even more detailed information beginning in 2003.

The book is well written and easy reading for a general audience. Although I have been citing the discoveries by COBE and WMAP as confirming evidence for the Big Bang, I didn’t really have an appreciation for what they accomplished. I also enjoyed learning more about the people involved—especially George Smoot, who is quite a character.

In the introductory chapter Lemonick made the following statement which I thought impressive:

“With all this information hidden within it, the cosmic microwave background radiation, or CMB, was the astronomical equivalent of the human genome. Just as the genome bears all of the data required to manufacture and operate a human being, the microwave background encodes all of the information—all the initial conditions and physical laws—for making and operating a universe.”

At around two-hundred pages, it is a fairly quick read. It can be purchased either in hardback or paperback at RTB.

have been visited or contacted by these beings. SETI proponents will point out the enormous difficulties for an advanced civilization trying to travel to Earth. These problems include enormous distances to cross, inability to even approach the speed of light, long-term radiation exposure, multi-generational travel, and stellar hazards.²⁵ Given these considerations and the lack of real scientific evidence for visitation by extraterrestrial spacecraft, SETI proponents conclude that we should look for extraterrestrial signals rather than spacecraft. Also the SETI movement is widely viewed as a scientific movement whereas UFO investigation is viewed as pseudo-science.

THE COPERNICAN PRINCIPLE (PRINCIPLE OF MEDIOCRITY)

One thing is certain; SETI proponents are firmly convinced that we will eventually find extraterrestrial life. For example, Frank Drake stated, “At this very minute, *with almost absolute certainty*, radio waves sent forth by other intelligent civilizations are falling on the Earth” (Emphasis mine).²⁶ In explaining his initial conviction about the existence of extraterrestrials, Drake writes, “I could see no reason to think that humankind was the only example of civilization, unique in the universe.”²⁷ Carl Sagan was no less vehement about the certainty of extraterrestrial life. He writes, “Given sufficient time and an environment which is not entirely static, the evolution of complex organisms is, in this view, *inevitable*. The finding of even relatively simple life forms on Mars or other planets in our solar system would tend to confirm this hypothesis” (Emphasis mine).²⁸ And again, we read, “There can be *little doubt* that civilizations more advanced than the earth’s exist elsewhere in the universe” (Emphasis mine).²⁹

Why are SETI astronomers so convinced that alien civilizations must exist and hence that habitable planets must be abundant? What is really at the heart of these claims? In an article examining the possibilities of extraterrestrial civilizations, the associate editor of Astronomy magazine, Robert Naeye, explained that the unstated assumption underlying SETI and their optimistic projections is a belief in the Copernican principle.³⁰

“On the surface, the most obvious evidence bearing on these questions [about the existence of extraterrestrial life] is the fact that our home world and host star seem so ordinary. Nicholas Copernicus shattered the prevailing notion that the Earth was seated at the center of creation. Succeeding generations of astronomers steadily reinforced the Copernican view as they discovered the true nature of the stars, the remote location of our home world within our Galaxy, and the existence of galaxies far, far beyond our own. So pervasive is this view that in the world of modern science, it is almost heresy to assert any special qualities to our solar system, our planet, and to ourselves. With an estimated 200 billion stars in the Galaxy ... scientists and laymen naturally conclude that we could not be alone.” (Emphasis mine)³¹

The Copernican principle is the belief that we are cosmically mediocre and thus no special distinctions can be applied our sun or planet. It is as if Earth is just a single grain of sand on a giant cosmic beach and there is nothing to distinguish our grain of sand from any other grain of sand. If the Earth is cosmically average yet has life; then there should be millions of “Earths” each with its own intelligent life forms.

THE DRAKE EQUATION

The embodiment of the Copernican principle and SETI thinking is the Drake equation.⁴ Starting with the Darwinian paradigm, Drake assumed that life is virtually guaranteed to spontaneously arise as long as certain basic conditions are present. Considering that there are an estimated 100 billion stars in our galaxy, Drake realized that it would be critical to narrow the focus of their search to only those stars that had the reasonable probability of supporting life. Drake developed his equation for the first SETI conference as an attempt to consider factors that would make a planet inhospitable for life and hence reduce the number of sites in which SETI astronomers should focus their efforts. One such factor comes from the almost universally agreed upon prerequisites for life – carbon and liquid water. This criterion eliminates from contention stars that are either too hot or too cold and planets that are either too close or too far from their parent star. Extending this idea a little farther, Drake developed his equation to express in measurable terms the probability of finding intelligent life on planets elsewhere in the galaxy and making contact with them. Based on his work, it was estimated that the galaxy should be teeming with life. Estimates ranged from thousands to even millions of possible extraterrestrial civilizations in our galaxy alone thus lending legitimacy to SETI plans. While these original estimates are now considered wildly optimistic, many still believe that intelligent extraterrestrial civilizations are abundant.

The Drake equation expresses the number of extraterrestrial civilizations (N) in our galaxy that we could potentially make contact with as:

$$N = R_* \times f_s \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

where:

R_* is the rate of star formation in our galaxy.

f_s is the fraction of stars that are suitable for life.

f_p is the fraction of suitable stars with planetary systems.

n_e is the number of planets in a solar system with an environment suitable for life.

f_l is the fraction of suitable planets containing living organisms.

f_i is the fraction of planets containing intelligent living organisms.

f_c is the fraction of planets containing intelligent beings capable of communicating.

L is the lifetime of communicating civilizations.

Each of these symbols represents a factor that affects the predicted

number of intelligent communication civilizations in our galaxy. Let us look at each factor in the Drake equation to see how Drake, Sagan, and other SETI enthusiasts come up with their very optimistic projections.

R_* represents the rate of star formation in our galaxy. Of all the variables in the Drake equation, only R_* can be stated with a high degree of certainty and is estimated at 5-20 stars/year.³² While this number may seem small, the cumulative number of stars formed over the lifetime of our galaxy is staggering. Astronomers estimate that our galaxy alone contains roughly 200 billion stars. This number is so large that it boggles the mind. Some would argue that this number alone virtually guarantees the existence of life elsewhere in our galaxy since even highly improbable events, such as someone correctly picking all of the numbers in a lottery, can be probable if there are enough tries. As we will see later, there are many factors that must be weighed before we can make any reliable conclusions.

f_s is the fraction of stars that are suitable for life. This factor represents the fraction of stars that are suitable suns for planetary systems. Some stars must be rejected because they are too small (such as type M stars) and others because they are too short-lived (such as stars of type O and B). Using these criteria, only about 10% of stars would be classified as suitable for life.

f_p is the fraction of suitable stars with planetary systems. Only suitable stars that contain planetary systems need to be considered, since life certainly requires planets for life to grow on. Hubble telescope observations of the Orion nebula has been able to see stars with proto-planetary disks that will eventually condense into planets. Very recently, there has been confirmed detection of a few actual planets (giant Jupiter-like gas planets) around other nearby stars and the even the detection of a star in the middle of planet formation. Because of these discoveries in conjunction with the modeling of planet formation using modern high-speed computers, there is a growing consensus that planetary systems can form relatively easily. It was estimated that about half of all stars might contain planetary systems.

n_e is the number of planets in a solar system with an environment suitable for life. It is generally agreed that any conceivable life form must have liquid water. While water is abundant in the galaxy, liquid water is scarce. We know that planets that are too close to the sun (e.g. Mercury and Venus) are too hot to maintain liquid water and planets too far from the sun (e.g. Mars, Jupiter, and Saturn) are so cold that any water would be frozen.³³ Between these two extremes is the Continuously Habitable Zone (a.k.a. the "Goldilocks" zone) where the planet is at just the right distance from the star to maintain liquid water. For our solar system, typically only the Earth is viewed as being in the Goldilocks zone ($n_e \approx 1$), however, some would also consider Mars and Venus as being included in this zone ($n_e \approx 3$).

f_l is the fraction of suitable planets containing living organisms. Given

a planet that is kept at the right temperature for liquid water and contains simple organic molecules, it is believed by SETI enthusiasts that life will spontaneously arise. The discovery of organic molecules in space is considered as evidence that organic molecules are sufficiently abundant and hence is taken as an evidence for a large value of f_l . Since life appears suddenly and early on Earth under very harsh conditions, then perhaps life can form elsewhere under similarly harsh conditions. The discovery of extremophiles (bacteria capable of living under extremely conditions) living in salt-saturated water, under high temperatures and pressures, and even in solid ice suggest to many that life can exist in many more places than originally believed. The value of f_l is unknown but SETI enthusiasts generally consider it to be very significant, 50% or higher.

f_i is the fraction of planets containing intelligent living organisms. If any planet other than our own contains life, there is no guarantee that any of the organisms will possess sufficient intelligence to communicate with us. (Since most animals and even some insects can display signs of rudimentary intelligence in their behavior, we must restrict our use of the term intelligence here to mean the ability to comprehend and communicate.) Some believe that intelligence is a natural consequence of evolution and so f_i could be as high as 20%-100%. Again, this value is unknown and is very speculative.

f_c is the fraction of planets containing intelligent beings capable of communicating. The term "communicating" here refers to the ability to send signals to other solar systems. Almost certainly, the communication would be in the form of electromagnetic radiation. A civilization with advanced electronics (or similar technology) would almost certainly emit detectable signals (such as radio and TV broadcasts) even if they were not intentionally trying to broadcast a message. Cocconi and Morrison¹ proposed radio waves as the best place to search for extraterrestrial signals but SETI astronomers are also looking in the microwave and even the optical portion of the electromagnetic spectrum. The value of f_c is unknown but is believed by SETI proponents to be very high (perhaps 20%-50%).

L is the lifetime of communicating civilizations. Even if intelligent beings with the ability to communicate with us were to evolve elsewhere in the galaxy, there may only be a brief window of opportunity for us to make contact with them. Some note that for life here on Earth, development of nuclear weapons occurred concurrently with the availability to send and receive extraterrestrial signals. This suggests that advanced civilizations might destroy themselves before they could make contact with other civilizations. Severe environmental pollution and large asteroidal collisions are additional dangers that could devastate an advanced civilization to the point that they were no longer able to communicate. As such, pessimists might argue for a small value of L , perhaps only a few hundred years. However, Carl Sagan, Frank Drake, and most SETI proponents opt for a very optimistic view that most advanced beings will manage to avoid destroying themselves

and might last thousands or even millions of years. Some even take this one step farther and suggest communicating civilizations that do survive self-destruction might be able to guide less advanced civilizations and help them avoid self-destruction.³⁴ In the absence of any real information about other beings, the best we can do is set a minimum value for L of about 60 years, the length of time that we have had the technology to communicate with extraterrestrials.

Some of the earliest estimates of the number of advanced extraterrestrial civilizations come from Frank Drake's 1965 paper and a book by Iosef Shklovskii and Carl Sagan in 1966. Their optimistic appraisal has diminished little over the last 40 years as is illustrated by the comparison to estimates taken from three contemporary web sites.

Value	Frank Drake ³⁵	Carl Sagan ³⁶	Active Mind ³⁷	SEDS ³⁸	Other ³⁹
R_*	1	10	10	20	3-5
f_s				10%	10%
f_p	50%	100%	20%	50%	20%
n_e	2-3	1	3-5	1	.05-0.5
f_l	100%	100%	50%	50%	100%
f_i	100%	10%	20%	100%	?
f_c	100%	10%	10-20%	50%	0.1-1%
L	1,000-10,000	10 million	10,000	>60	10,000-100,000
N	1,000-15,000	1 million	600-2,000	>15	?

FERMI'S PARADOX: SO WHERE ARE THEY?

Given the bold assertion by SETI proponents that there might be 10,000 or even a million advanced civilizations in our galaxy alone, how can we test this claim? The ultimate test would be to travel to each and every possible solar system and look for life. This is impossible now and will remain so for the foreseeable future. The next obvious test is to scan the heavens in hopes of intercepting a broadcast from one of these civilizations, which is the cardinal idea behind the SETI program. For the last 40 years, SETI has been listening but has failed to confirm even one genuine extraterrestrial signal.^{40,41,42,43,44} The central drawback to the SETI search is that it is effectively unfalsifiable, that is, a failure to detect extraterrestrial signals is never sufficient to rule out the possibility of extraterrestrial civilizations. For the most part, SETI astronomers remain as upbeat about the prospects of finding signals as they were 40 years ago despite a failure to produce any evidence.

In the summer of 1950, Nobel physicist Enrico Fermi came up with a simple yet remarkable challenge to the belief that the universe is full of advanced beings. On the way to lunch at Los Alamos National Labs, Fermi, Edward Teller, Herbert York, and Emil Konopinski were talking about the possibility of flying saucers, faster-than-light travel,

and extraterrestrial beings. During the lunch-time conversation with his three friends, Fermi interjected the question, "Where is everybody?"⁴⁵ Everyone immediately understood that the "everybody" referred to in the prior conversation about extraterrestrial beings. Fermi had reasoned that if extraterrestrial civilizations were as abundant as expected, then many of them would have technology far beyond our own and would have spread out from their original solar system by colonizing other planets. Eventually, even the distant colonies would eventually feel the pressure to spread out to even more distant solar systems. The first such civilization to colonize the stars would have the advantage of facing no opposition to their expansion. Thus, given some reasonable assumptions, this would lead to an exponential expansion that would eventually colonize the entire galaxy within a few million years, which is a cosmically brief period of time.^{46,47} This immediately leads to Fermi's paradox—if extraterrestrial civilizations are abundant in our galaxy then they (or their robotic probes) should have reached Earth by now. Thus, if there is no evidence that we have been visited, we should logically conclude that advanced extraterrestrials are rare or non-existent. Looking around, we see absolutely no evidence that Earth or our solar system has been visited. Our asteroid belt would be a prime target for extraterrestrials to come and mine large quantities of valuable metals (such as nickel and iron), yet it remains untouched and our solar system remains in totally pristine condition. Nor have UFO investigators confirmed even one extraterrestrial visit. Given the existing evidence, Fermi's paradox leads us to believe that we might be alone in the galaxy and hence that at least some of SETI's assumptions are wrong.

While Fermi's question has drawn much criticism, it has yet to receive an adequate answer in the last 50 years. Some have argued that traveling to other stars would remain too expensive or too difficult and hence that aliens would simply never reach much beyond their own solar system. Others have argued that advanced creatures are likely to destroy themselves or be destroyed by a large asteroidal bombardment before they can spread out to other solar systems. And still others suggest that aliens may have already visited Earth but either we haven't noticed them or they are cleverly keeping themselves hidden. All of these solutions to Fermi's paradox seem improbable and contrived. Even worse, such arguments would have to apply equally to all extraterrestrial civilizations, since if even one had the capacity of spreading through the galaxy, it would have already reaching us.^{45,48} So, Fermi's argument against the prevalence of extraterrestrial civilizations remains strong even after 50 years.

[NOTE: This concludes Part 1 of this article. Part 2 will appear in the December Chapter Newsletter.]

Dr. John Millam has a Ph.D. in theoretical chemistry from Rice University. He is a trained RTB apologist and has written many articles on science and the Bible.

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7. SERENDIP stands for Search for Extraterrestrial Emissions from Nearby Developed Intelligent Populations. More information on Project SERENDIP can be found at <http://seti.ssl.berkeley.edu/serendip/>.
8. SETI@Home is project whereby individual computer owners can allow radio telescope data from Project SERENDIP to be automatically downloaded onto their computer, processed, and sent back using only unused computer time. By harnessing Internet-connected computers all over the country (this is referred to as distributed computing), SETI is able to fully analyze the enormous amount of data being collected and allow individual citizens to participate in SETI's search for extra-terrestrials. More information can be found at <http://setiathome.ssl.berkeley.edu/>.
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28. I. S. Shklovskii and C. Sagan, *Intelligent Life in the Universe*, Holden-Day, San Francisco, 1966, p. 411.
29. Carl Sagan and Frank Drake, "The Search for Extraterrestrial Intelligence," *Scientific American*, 232, May 1975, p. 80.
30. The Copernican Principle was actually coined by Immanuel Kant, not Nicholas Copernicus, based on his work that our sun was but one of the myriads of stars that inhabit our galaxy. Kant was philosophically opposed to the idea that God intervened in any way in the formation of the solar system, our planet, or even earth life, hence neither the sun nor the Earth could be "special" in any way since they would have been produced by the exact same laws of physics as other planets and stars. Thus the Copernican Principle is really a philosophical principle rather than a scientific one. Copernicus would certainly have rejected this principle that bears his name.
31. R. Naeye, "OK, Where Are They?" *Astronomy*, July 1996, p. 38.
32. R_s is the rate of star formation in the past when stars like our own sun were forming, rather than the current rate of formation. Star formation was more common earlier in the galaxy's history.
33. There has been some speculation that Europa, a moon of Jupiter, has a layer of liquid water under its icy exterior and hence could be a possible sight for life even though Jupiter and Europa both lie outside the "Goldilocks" zone of our sun. While this is an unsettled question, it is not relevant for our discussion here since we are specifically concerned only with "intelligent communicating" life.
34. I. S. Shklovskii and C. Sagan, pp. 413.
35. F. Drake, "The Radio Search for Intelligent Extraterrestrial Life," *Current Aspects of Exobiology*, edited by G. Mamikunian and M. Briggs, Pergamon Press (1965), pp. 323-345.
36. I. S. Shklovskii and C. Sagan, pp. 408-413.
37. Values taken from http://www.activemind.com/Mysterious/Topics/SETI/drake_equation.html (as of Nov. 9, 2002). This site organized the Drake equation in a slightly different way and so the numbers were adjusted to fit the format used here.
38. Values taken from <http://www.seds.org/~rme/drake.html> (as of Nov. 9, 2002). SEDS stands for Students for the Exploration and Develop-

ment of Space.

39. Values taken from <http://www.lifeinuniverse.org/noflash/Drakeequation-07-02.html> (as of Nov. 9, 2002). Not all of their values were stated clearly but are presented as fairly as possible.
40. Eleven “events” were been detected by project META that satisfy most of SETI’s criteria for possible extraterrestrial communication but none of these signals were subsequently redetected and so cannot be considered genuine signals. P. Horowitz and C. Sagan, “Five Years of Project META: An All-Sky Narrow-band Radio Search for Extraterrestrial Signals,” *Astrophysical Journal*, 415 (1993), pp. 218-235.
41. R. Dixon, “The Ohio SETI Program--The First Decade,” *The Search for Extraterrestrial Life: Recent Developments* (Dordrecht: Reidel, 1985), pp. 305-314.
42. In 1977, Ohio State University detected a signal known as the “WOW!” signal (because someone scribble this word next to the signal). This signal has been scrutinized but never redetected. R. H. Grey, “A Search of the ‘WOW’ Locale for intermittent Radio Signals,” *Icarus*, 112, 1994, pp. 485-489.
43. C. F. Chyba, “Life Beyond Mars,” *Nature*, volume 382, 1996, pp. 577.
44. A. J. LePage, “Where They Could Hide: The Galaxy Appears Devoid of Supercivilizations, but Lesser Cultures Could Have Eluded the Ongoing Searches,” *Scientific American*, July 2000, p. 40-41.
45. S. Webb, *If the Universe is Teeming with Aliens ... Where is Everybody? Fifty Solutions to the Fermi Paradox and the Problem of Extraterrestrial Life*, Copernicus, New York, 2002.
46. I. Crawford, “Where Are They?” *Scientific American*, July 2000, pp. 38-43.
47. Numerous variations on this argument have been proposed in the literature. Because of the enormous difficulties in sending and maintaining living beings for stellar distances, civilizations might just send embryos or simply their DNA, which could then be brought to maturity at the destination. This is also known as panspermia. An alternative possibility is self-replicating robots (also known as Von Neumann machines). An example of this later position is given in F. J. Tipler, “Extraterrestrial Intelligent Beings Do Not Exist,” *Physics Today*, April 1981, pp. 9, 70-71; and associated commentary in *Physics Today*, March 1982, pp. 26-38.
48. M. H. Hart, “An Explanation for the Absence of Extraterrestrials on Earth,” *Quarterly Journal of the Royal Astronomical Society*, 16, (1973), pp. 128-135.



Seattle Chapter Reasons To Believe

Who Are We?

The Seattle Chapter of Reasons To Believe is a local extension of the worldwide, interdenominational Reasons To Believe ministry. We exist to support our parent organization and foster local involvement in the ministry. We serve the Puget Sound area and are composed of Christians of different ages and backgrounds.

It is our conviction that the same God who created the universe inspired the Bible. Therefore, what God says through His word must agree with the facts of nature. We reject the notion that science and the Bible are at odds and provide a scientifically-sound and Biblically-faithful alternative to Darwinism and young-Earth creationism.

What Do We Do?

Our mission is to remove the doubts of skeptics and strengthen the faith of believers. We provide scientific, historical and philosophical evidence that supports the Christian worldview and helps remove barriers to a belief in God, the Bible and the Gospel of Jesus Christ. We carry out this mission by:

- Helping people access RTB and other scientifically and biblically sound resources.
- Bringing nationally-known speakers into the area to promote the scientific reliability of the Bible.
- Assembling a team of local apologists to address questions about science, the Bible and related topics.
- Working with teachers and homeschoolers to achieve a balanced approach to the teaching of origins.
- Building alliances with local churches, ministries and groups to maximize the exposure of the RTB ministry.
- Reaching out to unbelievers with gentleness and respect, encouraging them to evaluate their worldviews.

We welcome your involvement and support. For more information, contact us at seattle@reasons.org. Tax-deductible donations can be sent to: Seattle RTB, PO Box 99683, Seattle, WA 98139-0683.

Questions? Get Answers.

Whether you are looking for scientific support for your faith or answers to questions about God, the Bible, and science, contact us at seattle@reasons.org. You can also call the RTB hotline seven days a week, 5:00 to 7:00 PM at 626-335-5282.