Chance versus Intelligent Design:

Has Modern Science Proven the Existence of God?

by

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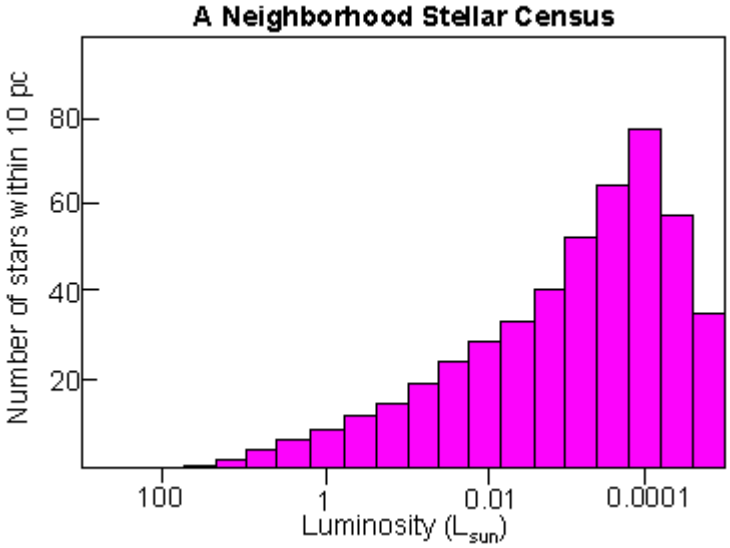

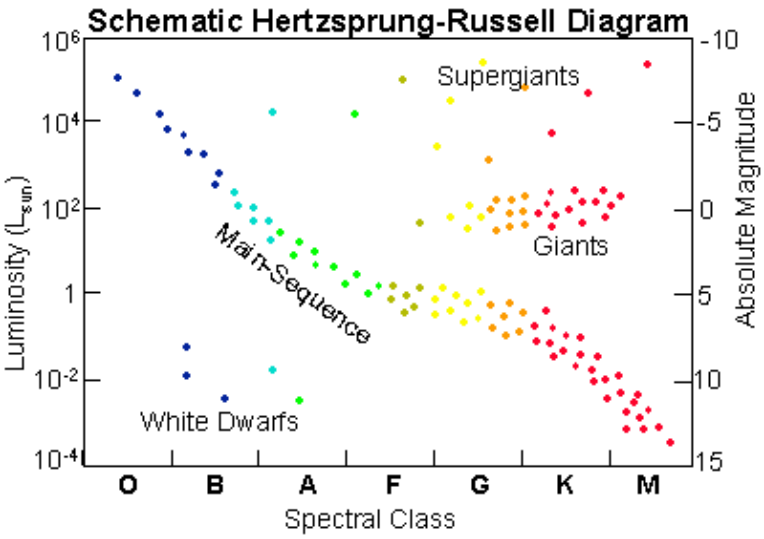

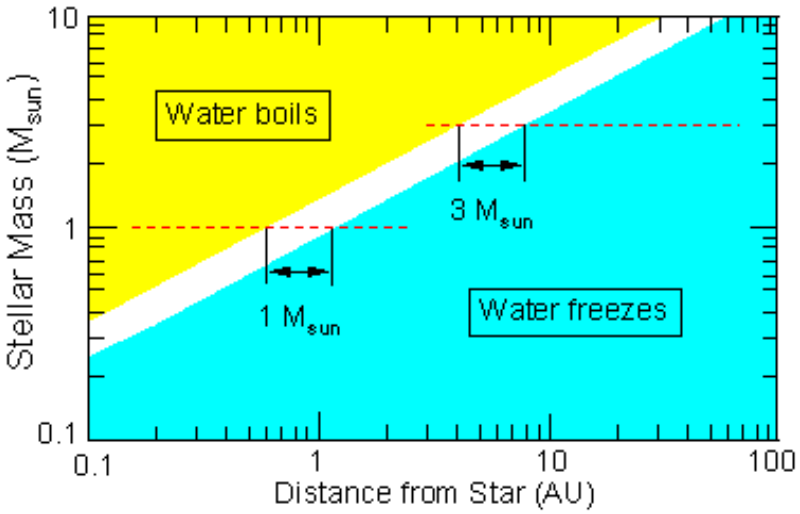

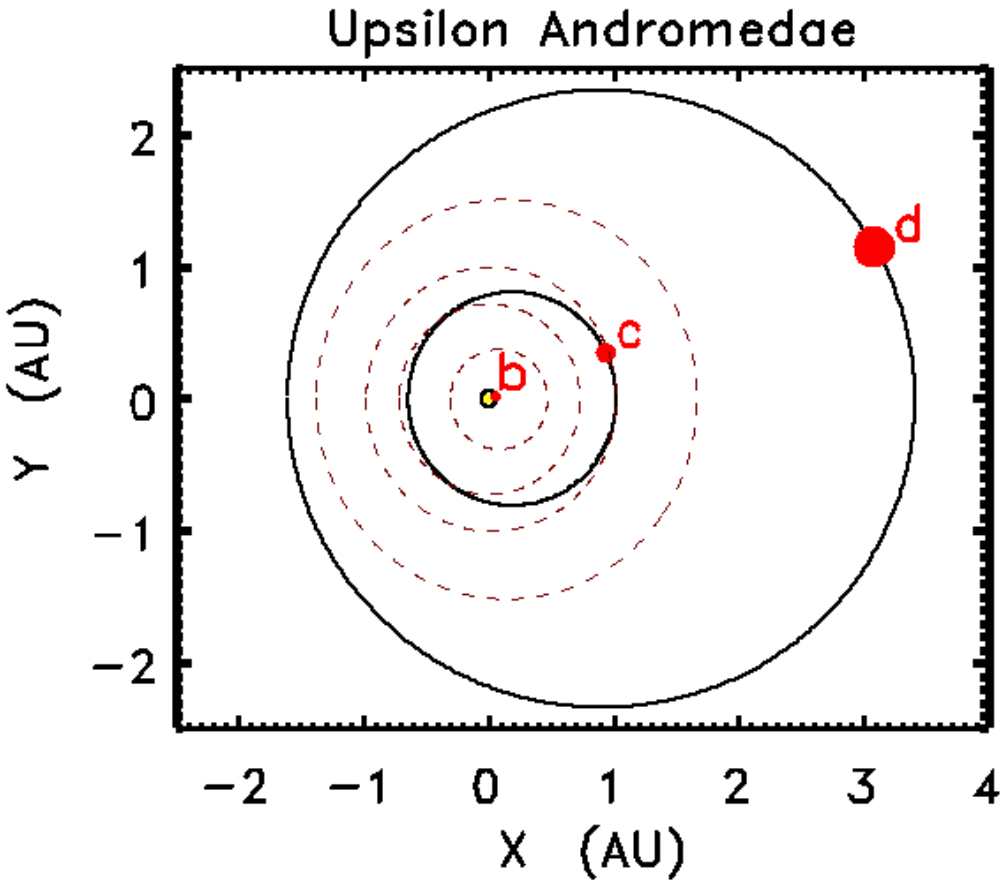

Orbits of extrasolar planets show a high degree of eccentricity compared with our solar system.

Stellar Lifetimes

Summary of Main-Sequence Stellar Properties

Spectral Class	Mass (M_{sun})	Luminosity (L_{sun})	Temperature (K)	Radius (R_{sun})	$T_{main\ sequence}$ (10^6 yrs)
O5	40	400,000	40,000	13	1.0
B0	15	13,000	28,000	4.9	11
A0	3.5	80	10,000	3.0	440
F0	1.7	6.4	7,500	1.5	3,000
G0	1.1	1.4	6,000	1.1	8,000
K0	0.8	0.46	5,000	0.9	17,000
M0	0.5	0.08	3,500	0.8	56,000

Worldview and science

What is a worldview, and why is it important? Most intellectuals recognize that a person's worldview is critically important to the way he lives his life. For example, the Japanese worldview of their divine right to rule and their superiority over other nations led them to commit terrible crimes against the Chinese people during World War II. The Christian worldview in the United States caused many nineteenth century American Christians to oppose slavery, which they believed was evil and wrong. This eventually led to a civil war which ended slavery in the United States. Many other examples of the importance of worldview exist in history. So just what is a worldview? A worldview is the system into which a person organizes and understands what he learns about the world around him. It is the reference point from which he measures truth and makes decisions.

For those people who desire to base their worldview on objective reality, an excellent place to begin is the science of cosmology. Cosmology is the study of the universe as a whole – its structure, origin, and development. It is not just a study for astronomers. Cosmology is for everyone who wants a true understanding of the universe and wants his or her worldview to align properly with it. In the words of American historian and college president Dr. George Roche, "It really does matter, and matter very much, how we think about the cosmos"[1] Roche's point is that our concept of the universe shapes our worldview, our philosophy of life, and therefore, our daily decisions and actions.

For example, it can be argued that if the universe was not created, then it has no objective meaning. If life, including human life, is accidental, then it has no real purpose. If a mechanical chain of events brought mankind into existence, his views of morality and truth are based only upon his own opinions and are completely arbitrary. This is the logical conclusion based upon the worldview of the atheist. On the other hand, if the universe was created, there must be reality beyond the confines of the universe. The Creator is that ultimate source of reality. If that Creator is the source of life, the Creator establishes its meaning and purpose. This is the worldview of the Christian.

The scientific worldview one hundred years ago

At the beginning of the twentieth century, many scientists embraced atheism (also called materialism), as the worldview which best fit the scientific data. In his introduction to the film series "Cosmos", American astronomer Carl Sagan summarized this worldview with his famous statement; "The cosmos is all there ever was, or is, or ever will be." Modern materialism was based upon the philosophy and cosmology of the respected German philosopher Immanuel Kant (1724-1804).[2] From his conclusion that the universe must be infinite both in age and extent, Kant proposed a strictly mechanistic model based upon Newton's laws of motion. Kant reasoned that an infinite universe gives rise to the possibility of an infinite number of random chances. Therefore, even such highly improbable events as atoms self-assembling into human beings would be possible.

Astronomers had accepted the infinite universe model as fact for over 100 years. Observational support for the infinite universe model continued to increase as astronomers looked deeper and deeper into space. More powerful telescopes revealed more and more of the same kinds of stars

and nebulae that they had already seen up close. They found that many of the nebulae were actually vast galaxies like our own Milky Way. There were millions and millions of galaxies, each of which contained billions and billions of stars. It indeed did seem endless. Further support for Kant's model came from the amazing accuracy of Newton's laws of motion. As astronomers documented the motions of planets, of moons orbiting the planets, of binary stars, and of stars in star clusters, everything matched what those laws predicted.

Astronomers had provided powerful observational support for a vast universe with no apparent limits. The observational and theoretical data all supported the infinite universe model. Given this data, along with the strictly mechanistic explanation for the origin of mankind that Charles Darwin provided, the worldview of the materialist indeed conformed to the best of nineteenth century science. But would it hold up to the much more intensive scrutiny of twentieth century science?

The scientific worldview at the end of the twentieth century

At the dawn of the twenty-first century, many respected scientists no longer embrace materialism, but instead are embracing theism, especially Christianity, as the only worldview that fits the current scientific data. This is particularly true of astronomers and astrophysicists, who best understand the implications of the recent discoveries about the universe. Materialism is no longer consistent with the scientific record. As we will see in the following sections, this new evidence is truly compelling. This data falls into four specific areas: the origin of the universe, the design of the universe, the design of the earth, and the origin of life.

The big bang theory and the space-time theorem of general relativity indicate that the universe (all mass and energy, the dimensions of space, along with time itself) had its origin beyond the known dimensions of space and time. Therefore, it is reasonable to conclude that it was created by a pre-existing entity greater than the universe. Second, it appears that the physical properties of the universe were specifically chosen to make life possible. Third, it seems apparent that the Earth was designed as a fit habitat for life. Fourth, current research and calculations show that there is no known viable mechanism for life to have arisen spontaneously on Earth. The odds that any of these events could have happened by chance are extremely remote. This is not just rhetoric. These are mathematically quantifiable, verified scientific facts. Indeed, it is the process of quantification and verification of these observations that provide the most compelling evidence for the existence of God. At the close of the twentieth century, it is theism, not atheism, which is grounded in objective reality.

The creation of the universe

As mentioned earlier, astronomers had accepted Immanuel Kant's infinite universe model as fact for many years. It seemed to fit all the observations. However, the destruction of the infinite universe model began very early in the twentieth century. The Michelson-Morley experiments on the speed of light in 1876 showed that the velocity of light was constant, regardless of the velocity of the observer.[3] This observation began a process that led to Albert Einstein's papers on special relativity in 1905[4,5] and later to his papers on general relativity in 1915 and 1916.[6,7] The equations of general relativity showed that the universe must be expanding, and that

expansion could be traced back to a singularity, where the universe had zero volume. In addition, the beginning of the universe could be traced back to an explosion-like event at a single point in time (hence the term “big bang”). General relativity led to a direct contradiction of the infinite universe model and pointed instead to a creation event, and by implication, a Creator.

Most astronomers and cosmologists, including Einstein himself, rejected this conclusion, and they devised all kinds of mechanisms and concepts to avoid it. In 1917, Einstein proposed a factor called the “cosmological constant”, which was a new force of physics that would exactly cancel out the expansion of the universe and salvage the infinite universe model.[8] He held this view until 1929, when Edwin Hubble published his measurements on 40 different galaxies.[9] These measurements showed that the galaxies are indeed expanding away from one another in just the way Einstein’s original equations predicted. Einstein was forced to agree with Hubble and reluctantly acknowledged “the necessity of a beginning” and “the presence of a superior reasoning power” which had created the universe.[10,11]

A number of additional arguments (for example, the resulting existence of an infinite gravitational potential everywhere,[12] or Olber’s paradox of the dark night sky[13,14]) were developed which also proved that the universe could not be infinite in size. The infinite universe model of Immanuel Kant had to be abandoned. Other attempts were made to salvage at least some form of the infinite universe model. If the universe was indeed finite in size, one could still eliminate the need for a Creator if the universe was infinitely old. Statements like those of British cosmologist Arthur Eddington illustrate why so many tried so hard to find a workable infinite-age model. He stated "Philosophically, the notion of a beginning of the present order of Nature is repugnant to me...I should like to find a genuine loophole...We allow evolution an infinite time to get started".[15,16]

Various hesitation models, steady-state models, and creation-field models were attempted. The best known of these models were the steady-state models, which were proposed by Bondi, Gold, and Hoyle in 1948.[17,18] In these models, matter was spontaneously self-created to fill the void left by the expanding galaxies. No explanation was given for either the expansion of the universe or the creation of new matter. Despite the complete lack of observational or theoretical support, many atheists embraced the steady-state model because it avoided the “repugnance” of the big bang. It was not abandoned until 1976, when it fell under the weight of at least a dozen separate arguments.[19-21] The other attempts to overturn the big bang have also failed.[22,23] Eddington’s loophole does not exist. The universe is truly finite in both space and time. The hot big-bang model is now one of the best-established facts in science.

If the big bang was indeed correct, there was one hope left for an infinite-age universe - the Hindu concept of continuing cycles of birth, death, and rebirth. Physicist John Gribbin, editor of the British journal Nature published this statement in 1976: “The biggest problem with the Big Bang theory of the origin of the universe is philosophical – perhaps even theological – what was there before the bang. This problem alone was sufficient to give great impetus to the Steady State theory. But with that theory now sadly in conflict with the observations, the best way around this initial difficulty is provided by a model in which the universe expands from a singularity, collapses back again, and repeats the cycle indefinitely.”[23]

Gribbin's editorial advocated the oscillating universe model, with an infinite progression of big bang explosion, contraction, collapse, then another big bang. This model requires the universe to have sufficient mass to stop the current expansion of the universe and force it to collapse. Some totally unknown mechanism would then cause it to expand again. The oscillation model was advocated as late as 1986. However, it has been discredited by several lines of evidence. The latest measurements show that the universe does not appear to contain enough mass to stop the expansion, even when exotic matter is taken into account.[24-32] Thermodynamic considerations involving the curvature of space also eliminate the possibility of a bounce even if a collapse did occur. Gribbin's own journal, Nature, published a paper by Alan Guth and Mark Sher in 1983 entitled "The Impossibility of a Bouncing Universe".[33] The oscillating model, like the infinite, hesitation, and steady-state models, has been abandoned by almost all scientists.[34,35]

Roger Penrose, Steven Hawking, and George Ellis published the space-time theorem of general relativity in a series of papers from 1966 to 1970.[36,37] In terms of its impact on our understanding of the universe, this is one of the most significant scientific discoveries of all time. Assuming only that the equations of general relativity accurately describe the universe, they extended Einstein's work and provided powerful theoretical support for the big bang theory. This theorem established that time itself, as well as the dimensions of space, were created at the big bang. The universe was created by something outside of space and time.

Many astronomers believe that if general relativity and the big bang are true, then a theistic conclusion is inevitable. Great efforts were made to determine if there were any deviations from general relativity that could provide a loophole. Measurements of the bending of light by the sun's gravity had verified general relativity to an accuracy of 10% by 1920.[38] Measurements on the perihelion advance of Mercury improved the accuracy to within 1% by 1972, but this was not sufficient to convince all the skeptics.[39] In 1979, measurements of the gravitational effects on radio signals had reduced the uncertainty down to 0.1%.[40] In 1980, a hydrogen maser clock aboard an American rocket confirmed general relativity to better than 0.001%.[41] Measurements of the orbital period of binary pulsar PSR 1913+16 extending from 1974 through 1994 have confirmed general relativity to an accuracy of better than one part in one hundred trillion.[42-44] In the words of Roger Penrose, "This makes Einstein's general relativity, in this particular sense, the most accurately tested theory known to science."[45]

What does it all mean? Simply this: reluctant cosmologists have been forced to accept the big-bang model. The space-time theorem of general relativity indicates that time itself, as well as the dimensions of space, had its origin outside of space and time. Apparently, the Creator is much greater than the universe itself, operating in spatial and time dimensions beyond those found in the universe. Current objections to these conclusions, usually involving quantum tunneling, a proper theory of quantum gravity, or a proposed breakdown of the laws of physics, have no scientific credibility, are only opinion, and have no basis in any actual scientific theories or observations. Some of these ideas are so speculative that they will never be able to be tested, or have any scientific affirmation. As these hypotheses are fully explored, it is nearly assured that the above conclusions will not change since they are solidly based on known scientific facts.[46-49]

The Design of the Universe

Human existence is possible because the constants of physics and the parameters for the universe lie within certain highly restricted ranges. Astronomers were not aware of this fact before 1960, and simply assumed that the universe was automatically capable of forming the molecules required for life. Since that time they have been investigating the physical parameters of the universe, and they have been amazed at how narrow the limits are for these parameters.[50-53] First, they have discovered that the elements required for life can exist as atoms and can form molecules only because the four fundamental forces of physics are precisely tuned. Very small changes in these forces would either prevent the formation of the right kinds of atoms or would keep them from bonding into molecules. Second, the ability of the universe to manufacture elements by nuclear fusion also requires careful adjustment of many additional parameters and physical constants. Third, these elements must be distributed by supernovas from the giant stars in which they are formed into interstellar space so they can be used to form new stars and planets. This can happen only if even more physical constants are precisely balanced. Fourth, the ability to form molecules from those elements requires still more fine-tuning. Without all of this precision and balance, life would be impossible any place in the universe.

The astronomers and physicists involved in these studies are unanimous in acknowledging these apparent design characteristics of the universe. The term they utilize to describe this apparent design is the “anthropic principle”. The "just-right" values of the constants of physics and the parameters of the universe point clearly to a designer who transcends the dimensions and limits of the physical universe. The small range of values necessary for many of these parameters is amazing. [54-66] For example, if the strong nuclear force was 0.3% stronger, there would be no hydrogen in the universe, just heavy elements.[64,66] If it was 2.0% weaker, protons and neutrons would not bond and there would be no elements heavier than hydrogen.[66] Either way, the universe would never be able to support life. In another example, the ground state energies for ^{4}He, ^{8}Be, ^{12}C, and ^{16}O cannot be higher or lower by more than 4% without yielding a universe with insufficient oxygen or carbon for any kind of life.[63] Carbon is formed in significant quantities only because ^{12}C has a nuclear energy level very slightly above the sum of the energy levels of ^{4}He and ^{8}Be. The nuclear energy level of ^{16}O is just right for converting some of the carbon to oxygen while insuring that both elements are abundant. A slight change in the ratio of energy levels in either direction would make life impossible. A third example of precisely tuned parameters is the mass ratio of the nucleons.[65,66] The neutron is 0.138% heavier than the proton. This led to the formation of 1 neutron per 7 protons in the big bang. If this mass ratio was reduced by just 0.1%, too many neutrons would be formed, resulting in the production of only heavy elements. No normal stars would form, and life would be impossible. If the mass ratio was increased by 0.1%, very few neutrons would be formed, and there would be no carbon, oxygen, or other heavy elements available for life.

Approximately thirty parameters of the universe have been identified that must be carefully fixed in order for any kind of life to exist at any time in the history of the universe.[66] (Carbon is the only element on which any form of life could be based. The only other elements that might conceivably be able to form the long chains necessary to store and reproduce the information necessary for life would be silicon or boron. However silicon can only form chains that are about a hundred atoms long and boron is a very rare element. Consequently, any possible life in

the universe must be carbon-based.) A partial list of these fine-tuned parameters and their importance is shown below.

Strong nuclear force coupling constant
If weaker, no protons and neutrons bond, only hydrogen exists
If stronger, all protons and neutrons bond, no hydrogen or light elements exist
Weak nuclear force coupling constant
If weaker, insufficient heavy elements form, heavy elements are not expelled from stars
If stronger, too much helium formed in big bang, not enough light elements survive
Electromagnetic coupling constant
If weaker, atoms don't retain electrons, insufficient chemical bonding
If stronger, atoms don't share electrons, insufficient chemical bonding
Gravitational coupling constant
If weaker, stars don't burn, no heavy element production
If stronger, stars burn too hot and too fast
Mass ratio of neutron to proton
If smaller, protons decay into neutrons, stars collapse into neutron stars
If larger, insufficient heavy elements form
Mass ratio of electron to proton
If smaller, insufficient chemical bonding
If larger, insufficient chemical bonding
Ratio of number of protons to electrons
Unless the charges are precisely balanced, electromagnetism would dominate gravity, preventing star or planet formation
Decay rate of ^{8}Be
If slower, heavy element fusion generates catastrophic explosions in all stars
If faster, no elements heavier than beryllium are formed
Ground state nuclear energy ratio of ^{12}C to ^{16}O
If smaller, insufficient carbon is formed
If larger, insufficient oxygen is formed
Polarity of the water molecule
If smaller, liquid water is too poor a solvent for life to exist, ice would not float, leading to runaway freezing of planet
If larger, the heat of fusion and the heat of vaporization are too great
Mass of universe
If smaller, insufficient deuterium and helium formed in big bang, no heavy elements formed
If larger, too much deuterium formed in big bang, stars burn too fast and are too unstable
Expansion rate of universe
If slower, universe collapses before stars like our sun reach their stable-burning phase
If faster, galaxies never condense, no stars are formed

Many scientists have been amazed that the characteristics and parameters of the universe are set at the precise values that are required to support life. They see these precisely tuned parameters as an indication that the universe has a purpose. This was clearly expressed by Arno Penzias, who shared the Nobel Prize for physics for his discovery of the cosmic background radiation. Penzias stated "Astronomy leads us to a unique event, a universe which was created out of

nothing, one with the very delicate balance needed to provide exactly the conditions required to permit life, and one which has an underlying - one might say supernatural - plan". [67] This statement by Penzias is exactly how the Bible describes God: a transcendent Creator who created the universe from nothing and who has an underlying purpose and plan which includes mankind.

The Design of the Earth

A planet fit for life is a rare and wonderful thing. Frank Drake, Carl Sagan, and Iosef Shklovsky were among the first astronomers to concede this point when they attempted to estimate the number of planets in our galaxy with environments favorable for the support of life.[68] In the early 1960's they recognized that only a certain kind of star with a planet just the right distance from that star would provide the necessary conditions for life. Based on just these two parameters, Shklovsky and Sagan claimed that 0.001% of all stars could have a planet upon which advanced life resides. [69]

Their analysis was a first step in the right direction. However, they overestimated both the range of permissible star types and the range of permissible planetary distances. For example, Drake's "just right" distance from our sun covers a huge range from inside the orbit of Venus to beyond the orbit of Mars. They also ignored many other significant factors that must be satisfied for a planet to have the capacity to support life. The reluctance of Drake, Sagan, and some others to evaluate these factors appears to be due, at least in part, to their strong advocacy of a search for radio signals from alien civilizations (the SETI program, Search for Extra-Terrestrial Intelligence). A more thorough analysis that demonstrates the futility of such a search will obviously meet resistance from supporters of the SETI program.

To date, over 50 parameters necessary for a life-sustaining planet have been identified.[70-88] Although not all scientists agree on the importance of all of these parameters, any serious study of the ingredients necessary for life to exist must consider all of them. For example, first generation stars and their surrounding gas clouds contain only hydrogen and helium from the big bang. Life is obviously impossible on a planet containing only hydrogen and helium. Second generation stars will contain perhaps 1 or 2% heavy elements from first generation supernovas along with their hydrogen and helium. However, this is not enough to form planets like the Earth. Only third generation stars with a concentration of at least 3% heavy elements will be able to form rocky planets. [89] Less than 20% of the stars in the Milky Way are third generation stars. Furthermore, only spiral galaxies will form a significant number of third generation stars. Elliptical galaxies are elliptical because their spiral structure collapsed and star formation ceased long ago.[90] Large irregular galaxies have active nuclei that spew out vast amounts of life-destroying radiation, while small irregular galaxies appear to have insufficient quantities of heavy elements. [91] Only 5% of the galaxies in the universe are spirals.[92] The other 95% are either elliptical or irregular, and are not candidates for life.

Most stars in the universe have been eliminated because they can't form acceptable planets. Of those that are left, only 0.1% will be a main sequence Class G star like the sun, which will have the right mass to sustain life on its planets. Larger stars burn too quickly and too erratically, and would exterminate any life that did exist.[84] Stars smaller than our sun are very stable, but they require that the planet be too close to the star. The tidal interactions that the star exerts on a planet are proportional to the inverse fourth power of the distance between the star and that

planet, so the tidal forces it would experience would be dramatically higher than those experienced by the Earth. This would quickly lead to very long rotation periods (months instead of hours) like those of Venus or Mercury. Extreme temperature differences between day and night would make life impossible on such a planet.

Once you have the right kind of star in the right kind of galaxy, a number of additional parameters must be satisfied. For example, the star must be the right distance from the galactic center. If it is too close, radiation from the galactic center would be too intense for life and the stars would be packed together too closely for stable planetary orbits. If it is too far away, not enough supernova debris is available to make rocky planets.[89] Only 20% of stars fall within the acceptable distance tolerances. A second example parameter is the number of stars in the system. Binary stars and globular clusters are not candidates for life because the gravity of a nearby star will disrupt planetary orbits and make a life-supporting climate impossible. Only bachelor stars are suitable. Less than 20% of the stars in the Milky Way are bachelors and could possibly be suitable for life.

A much more restrictive parameter is the requirement for a comet shield virtually identical to Jupiter. If Jupiter were smaller, or farther away, it is very likely that life would be obliterated quickly. As Carnegie Institute planetary scientist George Wetherell said, if it were not for Jupiter, "we wouldn't be around to study the origin of the solar system." [93] An excellent illustration of the danger of comets and asteroids was provided by the 1994 Shoemaker-Levy comet. This comet struck Jupiter with impacts that caused explosions as large as the Earth. Simulations done at Sandia National Laboratories (one of America's major scientific laboratories) showed that if just one fragment of this comet had struck the Earth, the impact would have devastated our planet with an explosion of 300 Gigatons TNT equivalent.[94] Jupiter protects us from the vast majority of comets, but if it were significantly bigger or closer, it would disrupt Earth's orbit.[93] This comet shield requirement eliminates at least 99% of remaining candidate planets.

The implicit assumption astronomers have historically made is that other solar systems would look similar to ours. The planets were assumed to have nearly circular orbits, with rocky planets like the Earth and Mars near to the star and gas giants like Jupiter and Saturn much farther from the star. However, Jupiter-sized planets appear to be much more uncommon than originally thought. The few extra-solar planets that have been detected to date all have highly elliptical orbits, and are all much closer to their star than Jupiter is to our sun.[95] Life is impossible in these systems. The recent discoveries suggest that our solar system is very unusual indeed.

Table 1 describes 24 parameters along with their associated probabilities. The overall probability of a given planet being habitable is 10^{-33}. The maximum possible number of planets in universe is only 10^{22}, so the probability of finding even one Earth in the entire universe is extremely small (far less than one in a billion, given the estimates in Table 1).

Table 1: Some of the parameters of the galaxy-sun-earth-moon system necessary for advanced life. The probability of each parameter falling within the required limits is also shown.[66]

1. Galaxy type 0.1
   if too elliptical: star formation ceases before sufficient heavy elements are formed
   if too irregular: radiation exposure is too severe; insufficient heavy elements are available
   if too large: inflow of gas and stars disturbs sun's orbit and ignites too many eruptions
   if too small: inflow of gas is insufficient to sustain star formation
2. Supernovae rates and locations 0.01
   if too close, too frequent, or too late: life on the planet will be exterminated by radiation
   if too far away, too infrequent, or too early: not enough heavy elements are present for the formation of rocky planets
3. Parent star distance from center of galaxy 0.2
   if farther: quantity of heavy elements is insufficient to make rocky planets
   if closer: galactic radiation is too great; stellar density disturbs planetary orbits
4. Number of stars in the planetary system 0.2
   if more than one: gravitational interactions disrupt planetary orbits
   if less than one: temperatures are too low for life
5. Parent star birth date 0.2
   if more recent: star has not reached stable burning phase; star contains too many heavy elements
   if less recent: stellar system does not contain enough heavy elements
6. Parent star maturity 0.4
   if too old: luminosity of star changes too quickly
   if too young: luminosity of star changes too quickly
7. Parent star mass 0.001
   if greater: luminosity of star changes too quickly; star burns too rapidly
   if less: range of planet distances for life would be too narrow; tidal forces disrupt the planet's rotational period; ultraviolet radiation is inadequate for plants to make sugars and oxygen
8. Parent star color 0.4
   if redder: photosynthetic response is insufficient
   if bluer: photosynthetic response is insufficient
9. Parent star luminosity increase relative to speciation (for removal of CO_2) 0.001
   if CO_2 removed too late, luminosity increases too soon: runaway greenhouse effect occurs
   if CO_2 removed too soon, luminosity increases too late: runaway glaciation occurs
10. Surface gravity of the planet 0.001
   if stronger: atmosphere retains too much methane and ammonia (molecular weights 16, 17)
   if weaker: atmosphere loses too much water (molecular weight 18)
11. Distance from parent star 0.001
   if farther: planet is too cold for a stable water cycle
   if closer: planet is too hot for a stable water cycle
12. Orbital eccentricity of planet 0.3
   if too great: seasonal temperature differences are too extreme
13. Axial tilt of planet 0.3
   if greater: surface temperature differences are too great
   if less: surface temperature differences are too great
14. Rotation period of planet 0.1
   if longer: day to night temperature differences are too great
   if shorter: atmospheric wind velocities are too great for advanced life

15. Age of planet 0.5
    if too young: too much volcanic and seismic activity; rotation too rapid for advanced life
    if too old: planet will rotate too slowly for any life at all
16. Magnetic field of planet 0.01
    if stronger: electromagnetic storms are too severe
    if weaker: ozone shield is inadequately protected from hard stellar and solar radiation
17. Thickness of planetary crust 0.01
    if thicker: too much oxygen will be transferred from the atmosphere to the crust
    if thinner: volcanic and tectonic activity will be too great
18. Albedo (ratio of reflected light to total amount of light falling on surface) 0.1
    if greater: runaway glaciation will develop
    if less: runaway greenhouse effect will develop
19. Asteroidal and cometary collision rate with planet 0.1
    if greater: too many severe impacts would exterminate advanced life
    if less: the crust would be too depleted of materials essential for advanced life
20. Carbon dioxide level in atmosphere 0.01
    if greater: runaway greenhouse effect will develop
    if less: plants are unable to maintain efficient photosynthesis
21. Water vapor level in atmosphere 0.01
    if greater: runaway greenhouse effect will develop
    if less: rainfall is too meager for advanced life on the land
22. Oxygen and ozone level in atmosphere 0.01
    if greater: surface temperatures will be too low
    if less: surface temperatures will be too high; too much UV radiation at the surface
23. Gravitational interaction with a moon 0.01
    if greater: tidal effects on the oceans, atmosphere, and rotational period would be too severe
    if less: orbital obliquity changes would cause climatic instabilities; movement of nutrients in oceans would be insufficient; magnetic field of planet would be too weak
24. Jupiter mass and distance from Earth 0.01
    if Jupiter-like planet is more massive or closer: Earth's orbit would become unstable
    if less massive or farther away: too many asteroids and comets would strike the Earth

Dependency factors (recognizes that not all variables are independent) 1,000,000,000.
Longevity requirements (conditions maintained for billions of years) 0.0001

Probability for occurrence of all 24 parameters within necessary limits 6×10^{-32}
Maximum possible number of planets in the entire universe 1×10^{22}
Probability of occurrence of one habitable planet in the entire universe 6×10^{-10}

The probabilities listed above are intended to be very generous. A more rigorous analysis would almost certainly make the odds of finding a habitable planet like the Earth far worse. Several dozen more parameters, such as the atmospheric transparency, pressure, and temperature gradient, and the mass and orbital eccentricities of other planets in the system, are currently being researched for their sensitivity in the support of life. However, just those listed in Table 1 lead safely to the conclusion that far fewer than a trillionth of a trillionth of a percent of all stars could have a planet capable of sustaining advanced life. Since the universe contains only about

one trillion galaxies, each averaging about one hundred billion stars, we can see that not even one planet would be expected, by natural processes alone, to possess the necessary conditions to sustain us. It comes as no surprise that many astronomers have surmised that intelligent life exists only on the Earth. It seems quite clear that the Earth, in addition to the universe, was designed to support life.

Increasing knowledge of the Earth, the moon, and the solar system continues to reveal additional variables that have to be "just right", so these odds will continue to become more incredible. A recent example is the unique earth-moon system and how it came into being. The Earth, which is larger than Venus and farther from the sun, would have originally had an even denser atmosphere. Although the Earth should not have conditions quite as extreme as Venus (90 atmospheres pressure, almost 500°C), it should have an atmosphere 100 times its current density with surface temperatures far above the boiling point of water. Life should be totally impossible on Earth. So what happened? Apparently, the Earth was directly impacted about 4.3 billion years ago by an object larger than Mars which shattered our planet and blew most of the early atmosphere into space. The moon was formed out of the lighter debris from the impact. At the time it formed, the moon was within 50,000 kilometers of the Earth's surface. The odds of such a rare but essential event occurring to remove the proper fraction of our atmosphere and leave us such a large moon in such close proximity to the Earth are mind-boggling. Without yet another amazing "coincidence", we could not be here.

The Origin of Life

Could living organisms form out of inanimate matter, which did not initially have molecules, much less systems, capable of replicating? Did life arise on Earth as a product of chance and random natural processes? There are four aspects of the origin of life that we want to examine.

1. The conditions on the early Earth
2. The requirement for homochirality
3. The complexity of life processes
4. The current status of origin-of-life research

Conditions on the early Earth

Many scientists assume that large quantities of life's "building-block" molecules, such as amino acids, were formed and accumulated in the oceans of the early Earth. This "primordial soup", which became concentrated in a "warm little pond", then assembled into increasingly complex molecules until a "self-replicator" was formed. Stanley Miller, whose famous experiments provided the basis for this theory, stated

> "Arguments concerning the composition of the primitive atmosphere are particularly controversial. It is important, therefore, to state our own prejudice clearly. We believe that there must have been a period when the earth's atmosphere was reducing, because the synthesis of compounds of biological interest takes place only under reducing conditions." (The Origins of Life on the Earth (1974), p. 33.)

Miller presents no evidence for a reducing atmosphere and, in fact, none is known. Yet, a reducing atmosphere is absolutely necessary for Miller's experiment to work. If the atmosphere

is either neutral or oxidizing, synthesis of the building-block compounds is essentially impossible. Miller himself demonstrated that the yield of "prebiotic chemical compounds" from electric charges and ultraviolet light in neutral atmospheres is very small or nonexistent.[96] The primeval atmosphere can contain no oxygen, because oxygen attacks amino acids in the same way it rusts iron. The presence on the early Earth of a reducing atmosphere dominated by methane and ammonia is only an assumption required to make the theory work. Unfortunately for this theory, recent findings suggest that Earth's atmosphere at the time of life's origin was not reducing but neutral, composed mainly of carbon dioxide, nitrogen, and water vapor. [97,98]

There is also considerable geological evidence that our atmosphere has always contained oxygen. Oxygen is very abundant in most of the rocks and minerals found in Earth's crust. The giant planets, notably Jupiter and Saturn, have thick reducing atmospheres, but Mars, the most earth-like planet, has a thin oxidizing atmosphere. Oxygen, with a molecular weight of 32, is firmly held by Earth's gravity, but methane (molecular weight 16) and ammonia (molecular weight 17) are too light to be retained and will eventually escape to outer space. Photochemical effects provide additional evidence against an early reducing atmosphere. For example, the sun's ultraviolet light breaks down water molecules to release free oxygen at such a rate that the ancient atmosphere could not be free of oxygen for long. Recent research is providing more and more evidence indicating that the Earth's atmosphere has been oxidizing for at least 4.0 billion years.[99] Since the surface of the Earth was molten before that time, the atmosphere has apparently been oxidizing for the entire span of time that life could possibly have originated. This has become a very serious problem for origin-of-life researchers, who have no viable mechanism for assembling and preserving biopolymers in an oxidizing environment. As William Hagan Jr. of the NASA Specialized Center of Research and Training for the Study of Origins of Life recently explained, "A fundamental issue of mutual concern is how a somewhat oxidized environment on the early Earth can be reconciled with the presumed requirement for reducing conditions in prebiotic organic synthesis," THE SCIENTIST, Volume 12, #17 (1998).

Sunlight provides another very serious problem for the primordial soup. The ozone layer in our present atmosphere stops the sun's ultraviolet rays. These rays quickly destroy amino acids.[100] Without the ozone protection, an unprotected living cell would absorb a lethal dose of ultraviolet radiation in less than one second. However, without oxygen there could be no ozone layer high in the atmosphere. This presents the following dilemma: if there is oxygen present, the amino acids are destroyed by oxygen, but if oxygen is absent, the amino acids are destroyed by ultraviolet light.

Further difficulties for the "warm little pond" scenario are found when considering the turbulent conditions on the Earth when life appeared almost 4 billion years ago. The moon was much closer, and the Earth also rotated much faster (with roughly an 8 hour day). Because of these factors, the tides were huge and the winds were very violent (up to several thousand kilometers per hour). The continents had not yet formed, and both volcanic and seismic activity (driven by radioactive decay) were extreme. The "warm little pond" with a concentrated supply of building-block components simply would not have existed. It was a chemical-rich, turbulent, well-mixed, oxidizing world that was extremely hostile to the proposed organic soup. [101] As reported in the Journal of Molecular Evolution, "it is now generally accepted that the concentration of the soup was probably too small for efficient synthesis, particularly of biopolymers". [102]

The final blow to the primordial soup theory is the complete lack of inorganic kerogen. Miller's experiments, like those of subsequent researchers, produced large amounts of long-chain carbon molecules along with the modest volumes of amino acids. This inorganic kerogen (bitumen, or tar) is very stable, and its occurrence in these reactions is unavoidable. This inorganic kerogen would have existed in vast quantities if the soup was real. Carbon isotope analysis can easily determine if kerogen was produced by normal inorganic processes or by biological processes, because biologic activity discriminates in favor of the lighter, more reactive isotopes. Kerogen has been found even in the most ancient sedimentary rocks, but it is all organically formed. Inorganic kerogen has never been found, despite its chemical stability. In the absence of such an occurrence, it is virtually certain that the primordial soup never existed.[98]

It has been assumed until recently that billions of years were available for life to arise spontaneously. However, the time available for creating life is very much smaller than previously thought. Organic limestone has been found in abundance in sediments as old as 3.8 billion years.[103,104] Ancient rock from Akila Island, off Greenland, yielded the oldest organic remains yet, at 3.86 billion years.[105] It seems that life and the oceans appeared at virtually the same time. An additional problem is the fact that both the Earth's surface and its oceans seem to have been repeatedly sterilized during the period 3.9 to 3.5 billion years ago. It was during this time frame that many of the existing craters on the Moon and Mars were formed. Major asteroid strikes on the Earth (each impact yielding thousands of times more energy than all of the world's nuclear arsenals combined) blew craters hundreds of kilometers across, vaporized the oceans, and blocked all light from reaching the Earth's surface for decades at a time. Recent estimates are that such huge impacts occurred perhaps 50 times during this interval.[106] Given the frequency of these deadly blasts, origin-of-life scientists like marine biologist John Hayes are beginning to realize that life must have begun "with breathtaking rapidity." [107]

Homochirality

A key requirement for life is the feature called "homochirality." Organic molecules don't have hands, but they do have a configuration referred to as being right- or left-handed. Amino acids and sugars are asymmetric. All of the amino acids in proteins (except for glycine, which is symmetric) have configurations skewed to the left. The sugars in DNA and RNA all have configurations skewed to the right. Proteins and DNA are homochiral (same-handed) systems, despite fairly even numbers of left- and right-handed amino acids and sugars occurring in nature. Without homochirality, genetic material cannot copy itself. Although the compounds are chemically identical for inorganic reactions, a "wrong-handed" acid or sugar cannot participate in life processes. Assembling a working cell when half of the building blocks are "poisoned" simply won't happen.

The apparent necessity for homochirality has led to decades of research to discover chemical conditions and mechanisms that would transform random assortments of left- and right-handed molecules—called "racemic" mixtures—into mixtures that show at least some favoritism toward left- or right-handedness. However, all experiments have failed to demonstrate any such favoritism.[108] Rather, they have proven that the principle of entropy (the tendency for order and complexity to degrade through time as a consequence of the second law of thermodynamics) guarantees that even collections of molecules that begin with some favoritism will degrade to racemic mixtures. During a 1994 conference on homochirality, the world's leading homochiral

researcher, Stanford University's organic chemist William Bonner, gave this summation: "Terrestrial explanations are impotent and nonviable." [109]

Complexity of life processes

The production of molecules such as protein, RNA and DNA from a prebiotic soup is extremely difficult to imagine. The amino acids which are often called "building blocks of life" are in reality very simple molecules containing a central carbon molecule which is linked to an amine group (NH2) on one end and a carboxylic acid group (COOH) on the other end. In different amino acids, the central carbon also has different groups of atoms connected to it. Forming amino acids in a soup gets you no closer to life than manufacturing rivets, the "building blocks of the space shuttle," gets you to outer space. The simplest amino acid, glycine, has only 10 atoms. The simplest living cell requires billions of precisely arranged atoms.

It has been suggested by many that the first "self-replicators" of course had to be simpler than living cells today. However, the simplest organism that is theoretically capable of existing and reproducing would actually not be simple at all. An average of 400 amino acids in a distinct combination are required to form a single protein in the simplest living organism. In a minimal cell, molecular biologist Harold Morowitz calculated that 239 protein molecules of at least 124 different types are required.[110] The simplest possible living cell would require at least the following: (1) 124 different complex protein molecules, (2) long-chain DNA and RNA molecules to store and transmit information, (3) four different nucleotide molecules, (4) various lipid (fat) molecules, (5) sugar molecules, (6) at least twenty different amino acid molecules, (7) chemical machinery to assemble the large complex protein, RNA, and DNA molecules from the building block molecules, (8) a very accurate, information transmission and translation system like that described above, (9) efficient error correcting systems to correct errors(mutations) that occur when DNA is copied during cell division,(10) chemical machinery to capture energy from outside the cell and use it inside, (11) a cell membrane to hold the parts together and separate the inside from the outside, (12) while allowing the right substances to pass into and out of the cell, (13) suitable supplies of phosphorous, calcium, sodium, potassium and other inorganic elements, (14) and chemical and physical conditions suitable for the accumulation and proper chemical combination and structural arrangements of all of these parts.[111]

Obviously, this is mind-boggling complexity. In light of these and other considerations, many researchers have effectively given up any hope of explaining the origin of life on Earth by any chemical processes we currently understand. This conclusion has become obvious to those who have considered random self-assembly and attempted to quantify the chemical reactions necessary to initiate life processes. [112-118] This conclusion can be demonstrated by the following calculation of the creation of even one average protein by chance.

Assume that all of the matter in the universe, including neutrinos and other exotic matter, is converted into just the 20 bioactive amino acids in the right proportions for life. Assume that the acids are all left-handed. Assume that the amino acids are randomly placed into bins that contain 400 acids each, and that the amino acids in each bin are somehow combined into chains. Assume that this happened one million times a second for the entire 15-billion year age of the universe. We want to have only a single functional protein formed during this timeframe. Although no

known protein could possibly be functional with half of it amino acids wrong, we are demanding that only 200 of the 400 acids in the protein be correct.

Table 2: The probability of assembling by chance one single protein molecule.

Mass of universe in atomic mass units (AMU)	$1x10^{80}$
Average molecular weight of an amino acid, AMU	100
Total number of amino acids	$1x10^{78}$
Amino acids per protein	400
Bins of amino acids formed	$2.5x10^{75}$
Age of universe (15 billion years), seconds	$4.7x10^{14}$
Combinations per bin per second	$1x10^{6}$
Total combinations attempted	$1.2x10^{96}$
Number of amino acid combinations possible (20^{400})	$2.7x10^{520}$
Number of "half-right" amino acid combinations possible (20^{200})	$1.6x10^{260}$
Odds of getting a single given protein half right	$7.4x10^{-165}$

The entire universe is clearly incapable of forming even a single functional protein by chance. Obviously, only a tiny fraction of the mass in the universe could be amino acids in our oceans, and only a tiny fraction of the age of the universe is available for forming life on Earth. If we impose the requirements for homochirality and for using only the bioactive amino acids (20 of the 100 amino acids found in nature), the odds get dramatically worse. If we account for the unavoidable chemical reactions with inorganic compounds in the oceans, the odds degrade far more. We encourage you to perform similar calculations, using whatever assumptions and numbers you feel are reasonable. Where does all this data lead? It leads to one inescapable conclusion: the origin of life on Earth by any natural process we have ever seen is statistically impossible. As Nobel Prize winner Francis Crick stated, "An honest man, armed with all the knowledge available to us now, could only state that, in some sense, the origin of life appears at the moment to be almost a miracle" {LIFE ITSELF, ITS ORIGIN AND NATURE, 1981, p. 88}

Current status of origin-of-life research

Researchers have acknowledged that the simultaneous appearance of proteins, DNA, and RNA, which are required for all life on Earth, is impossible. Some have embraced the concept of "RNA world", where RNA performs the function of all three molecules, as a way around the problem. However, the requirements for assembling a "super-RNA" molecule, which contains the information necessary to fulfill all three roles, is even more daunting than the current reality of three simpler molecules doing the job. This kind of speculation can survive only in an environment where people have not performed the "quantification and verification" analysis which real science demands. Those researchers who have actually performed the statistical

analysis of assembling complex molecules by chance see no real hope that it could have ever happened.

Other issues, including the hostile, oxidizing environment of the early Earth, the absence of any evidence supporting the existence of a primordial soup, and the rapid appearance of life, have also led many researchers to abandon the traditional origin-of-life theory. The most recent speculations suggest that life originated within subsea volcanic vents, or was actually alien life carried to Earth by meteorites from other star systems. Such implausible speculations were not seriously entertained in past decades. The current popularity of these alternate scenarios is a reflection of the serious difficulties the traditional theory has encountered. The following chronology of quotes by noted scientists illustrate this sense of hopelessness that most of them feel for discovering a believable naturalistic explanation for the origin of life.

"The spontaneous formation of such an atomic arrangement in the protein molecule would seem as improbable as would the accidental origin of the text of Virgil's 'Aeneid' from scattered letter type." {A. I. Oparin, THE ORIGIN OF LIFE, 1953 ed., pp. 132-133}

"Thermodynamic calculations . . . present the most serious obstacle, if indeed it is not fatal, to the theory of spontaneous generation." {D. Hull, NATURE, vol. 186, 1960, pp. 693-694}

"We must give up the idea that an organism could have been produced in the past, except by a similar pre-existing organism or by an agent, natural or supernatural, at least as intelligent as ourselves, and with a good deal more knowledge." {J.B.S. Haldane, THE ORIGINS OF PREBIOLOGICAL SYSTEMS & THEIR MOLECULAR MATRICES, ed. S.W. Fox, 1965, p.12}

"It is generally agreed that atmospheric conditions on the primitive earth, especially the high flux of energetic ultra-violet rays, would destroy any form of life . . . Even if we were to accept the assumption that each of these reactions pre-existed in the 'soup,' the chance assembly of all of them into a functioning unit is inconceivable." {J. Keosian, THE ORIGIN OF LIFE, 1968, p.77-78}

"If life really depends on each gene being as unique as it appears to be, then it is too unique to come into being by chance mutations." {F. B. Salisbury, NATURE, vol. 224, 1969, p.342}

"The probability that at ordinary temperatures a macroscopic number of molecules is assembled to give rise to the highly-ordered structures and to the coordinated functions characterizing living organisms is vanishingly small. The idea of spontaneous genesis of life in its present form is therefore highly improbable, even on the scale of the billions of years during which pre-biotic evolution occurred." {I. Prigogine, G. Nicolis & A. Babloyants, PHYSICS TODAY, vol. 25, Nov. 1972, p.23}

"With regard to the appearance of a single molecule of the cytochrome c family, one needs 10^{36} 'acceptable planets' with just the right conditions for 10^{9} years... One who finds the chance appearance of cytochrome c a credible event must have the faith of Job...." {H.P. Yockey, "A Calculation of the Probability of Spontaneous Biogenesis by Information Theory," J. THEOR. BIOLOGY (1977) 67, pp.393}

“The ‘warm little pond’ scenario was invented ad hoc to serve as a materialistic reductionist explanation of the origin of life. It is unsupported by any other evidence and it will remain ad hoc until such evidence is found. Even if it existed, as described in the scenario, it nevertheless falls very far short indeed of achieving the purpose of its authors ... One must conclude that, contrary to the established and current wisdom, a scenario describing the genesis of life on earth by chance and natural causes which can be accepted on the basis of fact and not faith has not yet been written.” {H.P. Yockey, “A Calculation of the Probability of Spontaneous Biogenesis by Information Theory,” J. THEOR. BIOLOGY (1977) 67,pp 396}

“With the development of microbiology in the second half of the 20th century it became overwhelmingly clear that . . . biochemical systems are exceedingly complex, so much so that the chance of their being formed through random shufflings of simple organic molecules is exceedingly minute, to a point indeed where it is insensibly different from zero.” {Sir Fred Hoyle & C. Wickramasinghe, EVOLUTION FROM SPACE, 1981, p. 2-3}

“We do not understand even the general features of the origin of the genetic code . . . [it] is the most baffling aspect of the problem of the origins of life.” {L. Orgel, NEW SCIENTIST, April 1982, p.151}

“I would say that everything we have learned about life in the past twenty years shows that we are unique, and therefore, special in God's sight.” {University of Virginia astronomers R.T. Rood and J.S. Trefil , ARE WE ALONE? THE POSSIBILITY OF EXTRATERRESTRIAL CIVILIZATIONS, 1983}

“The current scenario of the origin of life is about as likely as a tornado passing through a junkyard beside Boeing airplane company accidentally producing a 747 airplane.” {Sir Fred Hoyle, THE INTELLIGENT UNIVERSE, 1983}

“More than 30 years of experimentation on the origin of life in the fields of chemical and molecular evolution have led to a better perception of the immensity of the problem of the origin of life on Earth rather than to its solution. At present all discussions on principal theories and experiment in the field end in stalemate or in a confession of ignorance.” {Dose, K., “The Origin of Life: More Question than Answers,” INTERDISCIPLINARY SCIENCE REVIEWS, (1988) 13, pp. 348}

“The origin of life appears to be almost a miracle, so many are the conditions which would have had to be satisfied to get it going.” {Sir Francis Crick (Nobel Prize winner - discoverer of the DNA double helix), SCIENTIFIC AMERICAN, February, 1991}

“Without the hypothesized atmosphere and medium for life’s self-assembly, materialist assumptions stand without any basis in reality. We can find no evidence to support, only evidence to contradict, a gradual sequence of primeval events and conditions leading to the spontaneous generation of life and an exponentially growing number of copies.” {H. P. Yockey, JOURNAL OF THEORETICAL BIOLOGY, 176, 1995}

“In fact, none of the papers published in JME (Journal of Molecular Evolution) over the entire course of its life as a journal has ever proposed a detailed model by which a complex

biochemical system might have been produced in a gradual step-by-step Darwinian fashion." {M. Behe, DARWIN'S BLACK BOX: THE BIOCHEMICAL CHALLENGE TO EVOLUTION, 1996}

"Miller's work is understood by the origin-of-life research community itself to have little if any relevance to explaining how amino acids, let alone proteins or living cells, could have arisen on the early Earth." {S. C. Meyer, MERE CREATION: SCIENCE, FAITH, AND INTELLIGENT DESIGN, p.26, 1998}

"Prebiotic chemistry would produce a wealth of biomolecules from non living precursors. But the wealth soon became overwhelming, with the "prebiotic soups" having the chemical complexity of asphalt (useful, perhaps, for paving roads but not particularly promising as a wellspring for life). Classical prebiotic chemistry not only failed to constrain the contents of the prebiotic soup, but also raised a new paradox: How could life (or any organized chemical process) emerge from such a mess? Searches of quadrillions of randomly generated RNA sequences have failed to yield a spontaneous RNA replicator." (S. A. Benner (professor of Chemistry at the University of Florida), SCIENCE, Vol. 283: 1999}

Worldview Conclusions

Remember that a person's worldview is the reference point from which he measures truth and makes decisions. If you desire to base your worldview on objective reality, then your worldview must be consistent with the science of cosmology. What scientists have discovered is:

1. General relativity has been verified to an accuracy of better than one part in one hundred trillion, and is now as well proven as any theory in science. The classical space-time theorem of general relativity indicates that time itself, as well as the dimensions of space, were created by something outside of space and time. Current science states that the origin of the universe comes from a source which is not bound by the four dimensions of space-time. This is exactly what the Bible describes: a Creator who is much greater than the universe itself, operating in spatial and time dimensions beyond those found in the universe.
2. Approximately thirty parameters of the universe have been identified that must be precisely tuned to support any kind of possible life. If even one of these requirements had not been met, life would be impossible anywhere and at any time in the universe. The most reasonable interpretation of this data is that an intelligent designer took action to insure that the universe could support life.
3. Based only on the 24 parameters listed in Table 1, fewer than a trillionth of a trillionth of a percent of all stars could have a planet capable of sustaining advanced life. Not even one planet in the entire universe would be expected, by natural processes alone, to possess the necessary conditions to sustain us. Given these tremendous odds, it is fair to conclude that the Earth must have been designed to support life.
4. There is currently no believable naturalistic explanation for the origin of life. The atmosphere has been neutral or oxidizing for over 4 billion years. A "primordial soup" capable of producing proteins, RNA, or DNA, never existed. Life, with all of its current biochemical complexity, appeared "with breathtaking rapidity." There is no known mechanism to obtain the homochiralic chains of amino acids and nucleotides necessary for life. The formation of functional complex molecules like proteins by any chemical process we have ever seen is

statistically impossible. The logical conclusion from this data is that life exists on Earth because it was placed here.

The implications of this data in developing a worldview consistent with science are staggering. Science indicates that the origin of the universe exists beyond the four dimensions of space-time that make up our universe. Science attests that the parameters of the universe are precisely tuned to allow life to exist, and that the Earth itself seems to be unique in its capability to support advanced life. Science has no believable naturalistic explanation for the origin of life on Earth. It is amazing that these conclusions from science exactly correspond to God as described in the Bible. The Bible claims that God is transcendent, that he exists beyond the dimensions of our universe. It further claims that he supernaturally created space and time from nothing and that he created mankind and has a special purpose for him. A logical and compelling conclusion is that the best scientific data to date indicates that the Originator and Creator of the universe is the God of the Bible.

Although atheism was consistent with the science of 100 years ago, it is in serious conflict with science today. The evidence for a transcendent origin and intelligent design is simply too overwhelming. Based upon the experience of the past 100 years, we have every reason to believe that this evidence will become even more compelling as time goes on. Increasing knowledge of the universe, the solar system, and the Earth continues to reveal additional variables that have to be precisely set for life to exist. Increasing knowledge about life continues to reveal its incredible complexity and just how difficult life would be to create by natural processes. At the dawn of the twenty-first century, it is theism, not atheism, which is grounded in objective reality. Worldviews like materialism, which are based on a self-existent universe, cannot be true. Religious worldviews like Hinduism or Buddhism, which are based on the oscillating universe model, cannot be true. New Age and pantheistic worldviews, in which the universe itself is worshipped, cannot be true.

The data presented in the previous sections is intended to be factual, accurate, and verifiable. We encourage you to verify this data in the currently available peer-reviewed scientific literature. A complete list of references has been provided to help you do this. We believe that it is the process of quantification and verification of these observations which provides the most compelling evidence for the existence of God.

Acknowledgments

A good deal of the technical material in this paper has been extracted from the book CREATOR AND THE COSMOS by Hugh Ross. We encourage you to read this book for a much more in-depth analysis of twentieth century cosmology. Dr. Ross is a Canadian radio astronomer and astrophysicist with a Ph.D. degree in astronomy from the University of Toronto. The National Research Council of Canada sent him to the United States for postdoctoral studies at the California Institute of Technology in Pasadena, California, where he researched quasi-stellar objects, or "quasars," some of the most distant and energetic objects in the universe. Dr. Ross currently serves as president of an organization called Reasons to Believe (RTB), which is a Christian ministry dedicated to identifying and communicating the theological significance of the latest scientific discoveries. RTB has an excellent internet website at www.reasons.org, which contains numerous technical papers and resources for additional study. Both authors are affiliated with this organization.

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A Personal Note

I first visited China in 1992, when I was invited to present a technical paper at the International Petroleum Engineering Symposium in Beijing. During this trip, my wife Sylvia and I spent several weeks touring around the country, seeing many famous sites and riding the railroads. We learned a lot about China, enjoyed the excellent food, and made many Chinese friends. We had a wonderful time, and have grown to love China. We returned to Beijing as tourists, and then went on to Yunan Province in October of 1998. The inspiration for writing this booklet came while I was staying in Kunming. I have several very good Chinese intellectual friends who are either

currently pursuing an advanced degree or who have recently completed their studies. My friends are dedicated Christians who actively tell others about their relationship with God. They told me that many students are very interested in discovering what is true and are receptive to the absolute truth of Christianity. They also told me that it was more difficult for science and engineering students to accept the Christian worldview because of the high value they placed on science and logic.

The teachings of Marx and others, who based their atheistic conclusions on nineteenth-century science, are widespread. Well-written teaching on the compelling scientific evidence for the existence of God, which is based on recent scientific discoveries, is simply not available in China. It bothered me to think that those who hold science in high regard, as I do, would miss knowing the ultimate truth about the universe because they did not have access to good teaching on this information. Dr. Strauss and I wrote this booklet to provide that teaching. Here is the ultimate truth that I want you to understand and experience personally. This is the truth contained in the Bible.

There is a God. He created the universe and all that is in it. Although the universe is vast beyond our comprehension, it was specifically designed as a home for mankind. Man may have the same basic biochemistry as all other life, but he is unique. He is not just a physical being; he is also a spiritual being. Man alone was created for a special purpose, that he might have fellowship with his Creator. He loves us and desires that we live in right relationship with Him. However, God will not force us to love Him. We were given the freedom to choose whether to obey and follow God, or to be independent of Him. We chose to go our own way, even though the result of that choice was separation from Him. The term for our willful independence from God is “sin”, and the term for the resulting separation from Him is “spiritual death”.

The universe is very, very old but it is not eternal. The purpose of this universe is the elimination of human sin and evil. When our sin is finally conquered, our universe will be replaced by a new universe. This new universe will be inhabited by those who freely love God and who have forever renounced sin. The term for this new universe is “heaven”, and the privilege of living in it is called “eternal life”. No corruption or evil will ever mar the beauty of this new creation. God desires that we inhabit heaven with Him, but He will not allow the goodness and perfection of heaven to be degraded by human evil. This perfection demands that eternal life be given only to those who are without sin. Unfortunately, all of us have sin, and none of us can measure up to perfection. We are not worthy to enter heaven.

God’s justice demands that a severe penalty be paid for our sin. That penalty is permanent separation from God. There is no other way we can deal with our personal sin and corruption. We are spiritually bankrupt, with absolutely no hope of paying the spiritual debt we have incurred. In His mercy, God gave us one way, and only one way, out of spiritual death and back into the intimate relationship we were meant to have with Him. In an incredible act of mercy, love, and generosity, God Himself paid the penalty for our sin. He did this by taking the form of a perfect man named Jesus and dying in our place. This was the fulfillment of God's plan to rescue us from our sin, guilt, and shame. This is the plan that was foretold in the Bible hundreds of years before Jesus was born. The penalty for our sin has been paid, if we accept this special gift from God.

The eternal, all-powerful God took on the form of a weak, limited, vulnerable human being in order to show us His character and what He was really like. We could never understand Him as the transcendent, invisible Creator of the universe, but we could understand His goodness, love, mercy, and truth as He lived the human life of Jesus. Jesus lived a perfect life, one without our willful independence from God. He was innocent of sin, while all of us are guilty. We cannot pay our own debt for sin, much less pay for someone else's sin. Jesus had no debt to pay, and had the riches of a perfect life lived in obedience to God. Jesus' death in our place erases our sin and pays our penalty in full, if we are willing to abandon all hope of earning God's favor by our own efforts. All we can do is to gratefully accept His free gift.

God has set a choice before us. We can choose to ignore the overwhelming evidence for His existence and pretend that we are here only by chance. We can acknowledge that He exists, but continue living our lives as though He was not there. We can attempt to be acceptable to God by obeying the rules of man-made religions, and pursue a right standing with Him based on our own efforts. These choices all have the same result; living in spiritual darkness, with permanent separation from God. There is only one right choice. We can accept the fact that we are all guilty, that we all suffer from the disease of sin. We can admit that we will never be worthy to live in His presence unless He cleanses our hearts and forever frees us from our sin. We can acknowledge that we are spiritually bankrupt, and gratefully accept the gift of eternal life He offers through the sacrifice Jesus made on our behalf. We can embrace the processes God uses in our lives as He changes us to become more like Jesus, to understand Him and to live according to His goodness and truth. This is the beginning of what Jesus called eternal life.

This ultimate truth I have just explained to you is called the "gospel", which means good news. It is logical, beautiful, and compelling. The gospel contains nothing that is contradictory or weak or bizarre, like man-made religions do. It is elegant and powerful, and fits together like a fine automobile or a high-performance jet aircraft. As a professional engineer, I find that very compelling. The laws of physics are elegant and are beautifully crafted. Individually, these laws are very simple, but collectively, they allow for the wonderful intricacy and beauty of the physical universe around us. This intricacy and beauty extends from the incredibly tiny world of quantum mechanics up to the vast scale of galaxies. I would expect that the spiritual laws of the universe would show the same elegance and beauty that the physical laws of the universe possess. The same God created them both.

This is the discovery I made during my third year at the university. Knowing God has been the most wonderful experience of my life, both intellectually and spiritually. Can you imagine the satisfaction of actually knowing absolute truth, or of never having to wonder again if your very existence is meaningless? Would you like to know that your life really does matter, and that you are important to the God of the universe? Would you like to get to know this awesome Creator, to develop a personal relationship with Him that will last even after your physical death? This is the reality of the Christian message, the good news of the gospel. It is my fervent desire that Chinese intellectuals, especially scientists and engineers, experience this truth for themselves. This is the reason I am writing to you.

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