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A DESIGNER UNIVERSE AFFIRMED: A RESPONSE TO STEVEN WEINBERG[1]

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In his brief essay, "A Designer Universe," Steven Weinberg challenges the argument for the existence of God based on the apparent design of the cosmos. The heart of Weinberg's article consists of two major objections to the so-called fine-tuning design argument, which will be the focus of this article.

FINE-TUNING

In the past 30 years, physicists have discovered that the basic structure of the universe is set exactly right for the existence of life. If the structure were slightly different, such as the strength of gravity being slightly stronger, life would not be possible. Many people, in turn, have taken this fine-tuning as evidence that the universe was intelligently designed. Weinberg offers two major responses. First, he says he is "not impressed with these supposed instances of fine-tuning"; second, he says, even if there are good cases of fine-tuning, they can be explained by the so-called many-universes hypothesis.

In support of his first claim, Weinberg discusses the purported fine-tuning of the resonance of carbon, one of the earliest purported cases of fine-tuning, which astrophysicist Sir Fred Hoyle discovered in 1954. Weinberg claims that the resonance of carbon on close inspection has a fine-tuning of only one part in five, which is not very impressive, according to him. Weinberg admits, however, that his conclusion is "somewhat controversial."

Although the case of fine-tuning of resonance of carbon is not that impressive, Weinberg ignores other well-established cases of fine-tuning that are far more impressive. I will mention three (elsewhere I have carefully analyzed six such cases).[3]

One impressive case is that of the fine-tuning of the cosmological constant. The fine-tuning is estimated to be at least one part in 1053, that is, one part in a one hundred million, billion, billion, billion, billion, billion. To get an idea of how precise this is, it would be like throwing a dart at the surface of the earth from outer space and hitting a bull's-eye one trillionth of a trillionth of an inch in diameter — less than the size of an atom! Weinberg himself admits that the fine-tuning of the cosmological constant is so impressive that it merits invoking a "many-universes" hypothesis to explain it.

Another significant case is the fine-tuning of the strength of gravity. So far, physicists have discovered four forces in nature — gravity, nuclear electromagnetism, the weak nuclear force, and the strong nuclear force that binds protons and neutrons together in an atom. As measured between two protons in a nucleus (which is the standard reference used for comparing force strengths), gravity is the weakest of the forces while the strong nuclear force is the strongest, being a factor of 1040 (or ten thousand billion, billion, billion, billion) times stronger than gravity.

The strength of gravity must fall in a relatively narrow range in order for complex life to exist. If we increased the strength of gravity a billion-fold, for instance, the force of gravity on a planet with the mass and size of the earth would be so great that human beings would be crushed. (The strength of materials depends on the electromagnetic force via the fine-structure constant, which would not be affected by a change in gravity.) Even a smaller planet of only 40 feet in diameter (not large enough to sustain organisms of our size) would have a gravitational pull of one thousand times that of earth, still too strong for organisms of our brain size, and hence level of intelligence, to exist. As astrophysicist Martin Rees notes, "In an imaginary strong gravity world, even insects would need thick legs to support them, and no animals could get much larger."[4] Of course, a billion-fold increase in the strength of gravity is a lot, but compared to the total range of the strengths of the forces in nature (which span a range of 1040), it is very small, being one part in ten thousand, billion, billion, billion.

The other three forces of nature are also impressively fine-tuned. If the strong nuclear force were decreased by 50 percent, for example, the repulsive electrostatic force between the positively charged protons within atomic nuclei would overcome the attraction between protons and neutrons exerted by the strong nuclear force, thus tearing apart all atoms except hydrogen.[5] Contrary to what one might see on *Star Trek*, an intelligent life form cannot be composed merely of hydrogen: there is simply not enough stable complexity. Once again, relative to the total range force strengths in nature, a 50 percent decrease in the strong force is extraordinarily small, being one part in ten thousand, billion, billion, billion, billion.

MANY UNIVERSES

Besides casting doubt on the evidence of fine-tuning, Weinberg proposes a hypothesis according to which some physical mechanism produces a very large — perhaps infinite — number of distinct regions of space-time ("bubble universes"), with the strengths of the forces, and other fundamental parameters of physics, varying from region to region. It would be no surprise that a universe fine-tuned for life would occur if multiple universes are generated with enough differing values for the fundamental parameters.

Most many-universes models are entirely speculative, having little basis in current physics. Weinberg, however, proposes a model that does have a reasonable basis in current physics — namely, inflationary cosmology, which is a widely discussed cosmological theory that attempts to explain the origin of the universe and has recently passed some preliminary observational tests. It claims that our universe was formed by a small area of pre-space being massively blown up by a hypothesized *inflaton* field, in much the same way as a soap bubble would form in an ocean full of soap. In chaotic inflation models — widely considered the most plausible — various points of pre-space are randomly blown up, forming an enormous number of bubble universes.

In order to get the initial conditions and parameters of physics to vary from universe to universe, as they must do if this scenario is to explain the fine-tuning, a further physical mechanism must cause the variation. Such a mechanism *might* be given by superstring theory, one of the most hotly discussed hypotheses about the fundamental structure of the universe, but it is too early to tell. Other leading alternatives to superstring theory being explored by physicists, such as the currently proposed models for Grand Unified Field Theories (GUTS), do not appear to allow for enough variation — that is, they give only a dozen or so universes, not the enormous number needed to account for the fine-tuning.[6]

THEISM'S RESPONSE

Although these theories are highly speculative at present — for example, superstring theory has no experimental evidence in its favor — simply rejecting the many-universe generator hypothesis is not an adequate response. Not only does the inflationary/superstring scenario have some plausibility, but God also could have created our universe via some many-universe generator, just as God apparently created our planet by the big bang — a sort of many-galaxy generator. A better response is to note that the "many-universe generator" itself, whether of that given by chaotic inflationary models or some other type, seems to need to be "well-designed" in order to produce life-sustaining universes. After all, even a

mundane item like a bread machine, which produces only loaves of bread instead of universes, must be well designed to produce decent loaves of bread. If this is right, then invoking some sort of many-universe generator as an explanation of the fine-tuning kicks the issue of design up only one level to the question of who designed the many-universe generator.

For example, the inflationary scenario discussed above only works to produce universes because of the prior existence of the inflaton field and the peculiar nature of the central equation of general relativity, that is, Einstein's equation. Without either factor, there would neither be regions of space that inflate nor would those regions have the mass-energy necessary for a universe to exist. If, for example, the universe obeyed Newton's theory of gravity instead of Einstein's, the inflaton field would at best simply create a gravitational attraction causing space to contract, not to expand. Moreover, as mentioned above, one needs a special underlying physical theory, such as perhaps superstring theory, that allows for enough variation in the parameters of physics among universes.

Furthermore, the inflationary many-universe generator can produce life-sustaining universes only if the right background laws are in place. For example, without the Pauli-exclusion principle, electrons would occupy the lowest atomic orbit and hence complex and varied atoms would be impossible; or, without a universally attractive force between all masses, such as gravity, matter would not be able to form sufficiently large material bodies (such as planets) for life to develop or for long-lived stable energy sources such as stars to exist. The universe generator hypothesis, however, does not explain these background laws.

Finally, the many-universes generator hypothesis cannot explain other features of the universe that seem to exhibit apparent design, whereas theism can. For example, many physicists, such as Albert Einstein, have observed that the basic laws of physics exhibit an extraordinary degree of beauty, elegance, harmony, and ingenuity, which is naturally explained by theism.[7]

NOTES

1. Steven Weinberg, "A Designer Universe?" Reprinted in *The Skeptical Inquirer*, September–October 2001, 64–68. Originally published in the *New York Review of Books*, 21 October 1999.
2. I wish to thank the Discovery Institute in Seattle, WA, a year-long Pew Evangelical Fellowship, and Messiah College for generous financial support of my research on design arguments from physics and cosmology.
3. See my "The Evidence of Fine-Tuning," in Neil Manson, ed., *God and Design* (New York: Routledge, forthcoming).
4. Martin Rees, *Just Six Numbers: The Deep Forces That Shape the Universe* (New York: Basic Books, 2000), 30.
5. John Barrow and Frank Tipler, *The Anthropic Cosmological Principle* (New York: Oxford University Press, 1986), 326–27.
6. See Andrei Linde, *Particle Physics and Inflationary Cosmology*, trans. Marc Damashek (Longhorne, PA: Harwood Academic Publishers, 1990), 3, and *Inflation and Quantum Cosmology* (New York: Academic Press, 1990), 6.
7. For a presentation of six solid cases of fine-tuning, see Collins. For a more extensive presentation of the case against the many-universes hypothesis, see my "The Argument from Design and the Many-Worlds Hypothesis," in *Philosophy of Religion: a Reader and Guide*, ed. William Lane Craig (Edinburgh: Edinburgh University Press, 2001). For a basic presentation of the fine-tuning argument, see my "The Fine-Tuning Design Argument: A Scientific Argument for the Existence of God," in *Reason for the Hope Within*, ed. Michael Murray (Grand Rapids: Eerdmans, 1999). Also, see my "God, Design, and Fine-Tuning," in *God Matters: Readings in the Philosophy of Religion*, ed. Raymond Martin and Christopher Bernard (New York: Longman Press, 2002). For other discussions of the fine-tuning, see Barrow and Tipler Rees, and John Leslie, *Universes* (New York: Routledge, 1989).