Article

From Gaps to God

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Arguments for the existence of God that are based on design often specify an aspect of our natural world that cannot be explained by our current understanding of the laws of nature. Such a gap of knowledge is construed as evidence for the existence of a supernatural being.[1] Critics of this approach label these arguments as "God-of-the-gaps" fallacies that diminish the case for a Creator God as the gaps are filled in with increasing knowledge.[2] Confident that all such gaps will some day be filled via the scientific method, many people reject design arguments for God. However, gaps of knowledge do exist in nature and the scientific community acknowledges that many cannot be filled, even in principle. This article surveys various types of gaps and considers their role in an argument for God.

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In this article, we will address only naturalistic knowledge rather than spiritual or revealed knowledge, not because the latter is not real or important but because we wish to explore whether the limits of naturalistic knowledge might reveal the existence of the supernatural. The set of all possible naturalistic knowledge can be considered to have two primary subsets: that which is known K, and that which is unknown U.

Set U can be further divided into two subsets. The first subset U_k is that which we know we do not know but which is knowable—the unknown but knowable. A scientific project begins by identifying an area of interest in set U_k. A successful project produces new knowledge that, upon peer review and evidence of reproducibility, becomes accepted by the scientific community as an element of set K. The best research projects also result in the identification of additional relevant areas of U_k. The second set U_u comprises that which we know we do not know and which is unknowable within the context of methodological naturalism.

Controversies surrounding "God of the gaps" arguments typically focus on whether an element is in set U_u or in set U_k. An argument for the existence of God that is based on a claim that the explanation of a phenomenon is a member of set U_u is often refuted by a counterclaim that it is in fact a member of U_k and will eventually move to set K. Until it does become a member of K, it is not always easy to determine whether an element is a member of U_u or of U_k.

The scientific community does acknowledge that set U_u is not an empty set. This article addresses six types of gaps of knowledge and discusses the implications.

1. Statistical

The first category is that which is unknowable due to scope and therefore is knowable only on a statistical basis. Avogadro's number of atoms or molecules in a mole of substance, 6 x 10^{23}, is so inconceivably vast that there is no hope of knowing the attributes of each molecule in even a minute but macroscopic amount of substance. Nevertheless, statistical methods and statistical distributions such as Gaussian and Boltzmann distributions enable us to determine attributes such as pressure, temperature, velocity, etc.

From a classical mechanics perspective, the individual attributes of each molecule are knowable in principle, making this a member of set U_k rather than U_u but in practical terms it will always be unknowable. Practical unknowability, as opposed to unknowability in principle, is usually a result of the limits of the tools we have at our disposal. The ability to store and manipulate vast amounts of data with affordable computers

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has made it practical to generate knowledge previously considered unattainable. Unknowability in principle means that our knowledge is not limited by tools but by fundamental concepts. In this example, we have tools that can measure the attributes of aggregate molecules but are limited in making such measurements of each molecule in a mole of substance.

2. Chaos

The second type is that which is unknowable due to precision and sensitivity. Chaos theory, whose beginnings can be traced to 1960 by Edward Lorenz,[3] tells us that many everyday phenomena have an exceedingly high sensitivity to initial conditions, well beyond any precision that we can bring to its measurement. Classical systems of equations can be shown to lead to random behavior while random behavior can often be found to have an orderly basis. Despite the growing precision of our measurements, this sensitivity will always exceed our abilities.[4] Thus this portion of set U_u may shrink but will never disappear.

3. Quantum Effects

The advent of quantum mechanics in the 1920s opened up a pervasive realm of unknowability in sharp contrast to the confidence of Newtonian mechanics that proclaimed ultimate knowability of all motion. Four types of quantum unknowability are worth exploring in more detail.

A. Uncertainty Principle. Heisenberg articulated the uncertainty principle, or principle of indeterminacy, in 1927.[5] Mathematically, the two relevant relations are:

$$\Delta p \, \Delta q \geq h/4\pi$$
$$\Delta E \, \Delta t \geq h/4\pi$$

where p is the momentum, q is the position, E is energy, t is time, and h is Planck's constant, 6.6×10^{-34} m^2kg/s. Philosophically, Heisenberg realized the implications were enormous. Since momentum and position cannot be simultaneously known, equations of motion cannot have sufficiently accurate input to trace the behavior of the world. The vision of a predictable and knowable world was shattered. For nearly eight decades, the scientific community has acknowledged this inherent limitation of knowledge, making it a clear component of U_u.

B. Quantum States. In contrast to classical mechanics where particles are tracked through space-time in a predictable trajectory, quantum mechanics describes particles in terms of amplitudes of wave functions, the square of which represents the probability that the particle has that particular value. We can know only the probability that a particle has a particular value of some attribute. Furthermore, the measured state of a particle depends on the measurement being done. Knowledge of a particle is therefore statistical in nature but substantively different from the statistical knowledge discussed earlier. Here the statistical aspect is inherent and not simply a limit of our ability to comprehend the vast scope of nature. Attributes of particles and the prediction of events or motion can only be known statistically. For some authors like Kenneth Miller[6] and Robert John Russell,[7] this provides God the opportunity to carry out his providential will without naturalistic detection.

C. Radioactivity. Radioactivity deserves special mention. It is the result of quantum behavior of the weak force that binds nucleons. The rate of radioactive decay of unstable nuclei can be determined with great accuracy but there is no way, even in principle, to predict the moment of decay of any given atom. This unknowability places radioactivity for individual atoms in the set U_u.

D. The EPR Paradox. The Einstein-Podolsky-Rosen paradox was part of Einstein's critique of quantum mechanics.[8] Two entangled particles that are described by a single coherent wave function retain correlated attributes even after traveling a significant distance apart, until the coherence is broken. When measurements are made of these particles, the particles are still correlated. Such "spooky action at a distance," as Einstein ridiculed the result, has been confirmed experimentally but is not at all understood. Whether this is an element of U_u or U_k is yet to be determined.

4. Indistinguishability

Some attributes of particles are unknowable due to the nature of elementary particles. Each particle may be characterized by a set of attributes such as spin, baryon number, energy, etc. but these are not unique and two particles with the same attributes are indistinguishable. Elementary particles, molecules, or any small combination of particles are indistinguishable from each other.

Distinguishability arises only when the number of states at equilibrium exceeds the population. For example, the hydrogen atom has a single ground state, though with various angular momentum orientations, while the number of hydrogen atoms in the universe is more than 10^{50}. The population of hydrogen atoms far exceeds the number of states at equilibrium and these atoms are all indistinguishable. In sharp contrast, a snowflake contains about 10^{20} identical water molecules which can be configured in so many ways that the number of possible states of a snowflake far exceeds the total number of snowflakes which may be on the order of only 10^{24}/year. The population of snowflakes is so much smaller than the possible number of states that the probability of two snowflakes being identical is vanishingly small.

We can also describe differentiation in terms of entropy S which is defined as $S = k \ln N$ where k is Boltzmann's constant 1.38×10^{-23} Joules/Kelvin, and N is the number of states at equilibrium. Unique differentiation of members of a population is possible only when the entropy is high and the size of the population is relatively low.

Individual identity of any substance or being is therefore rooted not in the uniqueness of one's constituent

components but in their structure and dynamic relationship. A substance can be reconstructed or a being can be resurrected by recreating the same configuration without necessarily using the same components.

Distinguishability of elementary, atomic, and molecular particles is clearly in the set U_u. Does God know the identity of each particle? We can only speculate but the answer would have no apparent significance for us.

The age of any substance is the time since its formation. Unless an independent observer records the moment of formation and tracks the identity of that substance over time, age can be inferred only by a known rate of change of any attribute. No elementary particle or simple atom or molecule has any characteristic in the ground state that changes over time. Only agglomerations of particles large enough to have distinguishing features that change over time can have a useful attribute of age. Only God knows the age of an elementary particle while for us such information remains in the set U_u.

The fallacy of the "God of the gaps" arguments is … that gaps do not point us to a Creator God. … The mystery of why our universe is understandable at all may be the ultimate gap that leads us to God. Naturalistic knowledge leads us to infer the existence of the supernatural Creator … because of the very possibility of such knowledge.

5. Cosmology

Considering the vast reaches of space and time, it is amazing that we have learned as much as we have about the origin and evolution of our universe. In recent years, cosmologists have been particularly successful in learning just how much we do not know. At present, there seems to be evidence that only 5% of the mass in the universe can be attributed to normal matter. Another 25% appears to be dark matter and about 70% is dark energy. Dark matter is not just matter that we cannot see but is matter that cannot be attributed to any particles that we know. Its source is a mystery. Dark energy may be equivalent to the cosmological constant that Einstein included in his original general theory of relativity before withdrawing it.[9] Are dark matter and dark energy part of set U_u or of U_k? If knowability is defined solely within the context of forces and particles and laws of nature that we know today, the answer must be U_u. Scientists continue to hold out hope that new dimensions of reality may be discovered that would enable us to consider the origins of dark matter and dark energy to be knowable. Two of the current approaches being debated are loop quantum gravity[10] and M-theory, a superset of five types of string theory.[11] The former is based on the quantization of both space and time while the latter is based on seven additional spatial dimensions beyond our four space-time dimensions. In any case, it is clear that the origin of our universe and of our planet cannot be understood within the context of the current "standard model."

The formation and development of the universe is critically dependent on the value of many physical constants such as the strength of the gravitational and nuclear forces, the fine-structure constant, the speed of light, etc. Although we can measure these parameters, we do not know fundamentally why they have the values they do. Very small changes in any one of these parameters would prevent the universe from developing a planet hospitable for life as we know it. This has led to the anthropic principle, arguing that a designer must have tuned these constants to enable human life.[12] We do not know whether someday a "theory of everything" will be developed from which we can derive the values of all these constants. For now, the reason they have these values is unknown.

6. Biology

Three major unknown areas in biology are the origin of life, the origin of species, and the origin of mind. Darwin's theory of evolution is a fruitful, though yet incomplete in detail, explanation of the origin of species but no widely accepted explanation exists for the origin of life or of mind. Most intelligent design theories proposed today are based on claims that the naturalistic origin of life and of mind is so improbable that it must be in the set U_u and that it is more probable that an intelligent designer is the direct causal agent. Behe points to the apparent irreducible complexity of biomolecules such as hemoglobin and flagella as evidence that their development is not knowable in the context of evolution.[13] Miller[14] counters with possible scenarios whereby those biomolecules could have evolved. Mills[15] objects that Miller hasn't proven that these evolutionary pathways were actually used. Mills misses the point. The actual pathway may not be proven but there is no basis to concede to Behe and Mills that it is unknowable when plausible paths of formation can be defined. Until an element becomes part of set K, it cannot be determined with certainty whether it was in subset U_k or U_u. Proof that a phenomenon belongs in U_u requires evidence that it cannot be known, not merely that current explanations are inadequate.

Dembski claims that information theory proves that the complex structures underlying life and mind could not have arisen from natural means.[16] Exploring notions of complex specificity and specific complexity, he argues that random processes cannot generate specified complex systems. As Ruse points out, this is a false dilemma and does not provide compelling evidence that the origin of life is unknowable.[17]

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Improbability arguments are also frequently put forward to insist that origins of life and mind must be in the set U_u rather than U_k.[18] It is certainly possible to show that the probability of certain events is low enough to assert that they will never occur in the duration of our universe. In reference to past events, however, these calculations merely show that the physical processes and assumptions used in calculating the probability are most likely incorrect rather than demonstrating that the explanation of the phenomenon belongs in set U_u.

Other areas could be discussed such as Gödel's theorem and other areas of mathematics where knowledge can be shown to be inherently limited. Gaps of knowledge do exist, not just because of our limited perception but inherent gaps that the scientific community accepts as unknowable. Most of the gaps cited above, particularly the first four categories, relate to descriptive attributes of matter rather than causal factors. Although God may (or may not) have supernatural knowledge of such attributes, our inability to close these gaps is not generally used to justify the existence of a divine creator. There is no compelling reason to believe that there must exist a being that possesses such knowledge. In cosmology and biology, and to some extent in quantum uncertainty, the gaps tend to concern explanations of phenomena or explanations of why an attribute has a particular value. These gaps are the ones generally used to point to a creator. However, there is no fundamental reason why a gap must be filled, whether by naturalistic means or otherwise.

The fallacy of the "God of the gaps" arguments is not that these gaps may someday all be closed[19] but that gaps do not point us to a Creator God. The strongest argument for the existence of God is indeed a design argument, one that is based on our set of knowledge K rather than U_u.[20] The mystery of why our universe is understandable at all may be the ultimate gap that leads us to God. Such an argument is not a logical, irrefutable scientific proof but rather a display of God's handiwork to those who "believe that he exists and that he rewards those who earnestly seek him."[21] Naturalistic knowledge leads us to infer the existence of the supernatural Creator not because of its inherent limitations but because of the very possibility of such knowledge. The exquisite beauty and elegance of the portion of the universe that we *can* explain, whether by simple observation or by Maxwell's equations or Schrödinger's equations, overwhelmingly display the power and glory of God to everyone, not just to those who are expert enough to identify the elements of U_u. "For since the creation of the world God's invisible qualities—his eternal power and divine nature—have been clearly seen, being understood from what has been made, so that men are without excuse."[22] ◆

Notes

1. For an early history of arguments from design, see R. Thornhill, "The Historical Relationship Between Darwinism and the Biological Design Argument," *Perspectives on Science and Christian Faith (PSCF)* 54 (2002): 249–59.
2. D. F. Siemens, Jr., "On Moreland: Spurious Freedom, Mangled Science, Muddled Philosophy," *PSCF* 49 (1997): 196–9.
3. E. N. Lorentz, "Deterministic Nonperiodic Flow," *Journal of Atmospheric Science* 20 (1963): 130–141.
4. James Gleick, *Chaos* (New York: Penguin Books, 1988) is a very readable popular book on chaos theory.
5. W. Heisenberg, "*Uber den anschaulichen Inhalt der quantentheoretische Kinematik und Mechanik*," in *Zeitschrift fur Physik* 43 (Berlin: Julius Springer, 1927), 172–98.
6. K. Miller, *Finding Darwin's God* (New York: Harper-Collins Publishers, 1999).
7. R. J. Russell, "Special Providence and Genetic Mutation: A New Defense of Theistic Evolution" in *Perspectives on an Evolving Creation,* ed. K. B. Miller (Grand Rapids: Eerdmans, 2003), 335–69.
8. A. Einstein, B. Podolsky, and N. Rosen, *Physical Review* 47 (1935), 777.
9. See, for example, R. P. Kirshner, *The Extravagant Universe: Exploding Stars, Dark Energy, and the Accelerating Cosmos* (Princeton University Press, 2002).
10. L. Smolin, "Atoms of Space and Time," *Scientific American* 290 (January 2004): 66–75.
11. B. Greene, *The Elegant Universe* (New York: W. W. Norton & Company, 1999).
12. W. J. Neidhart, "The Anthropic Principle: A Religious Response," *JASA* 36 (December 1984): 201–7.
13. M. Behe, *Darwin's Black Box* (New York: Free Press, 1996).
14. K. Miller, *Finding Darwin's God*, 129–64.
15. G. C. Mills, "In Defense of Intelligent Design," *PSCF* 54 (December 2002): 260–3.
16. W. A. Dembski, "Intelligent Design as a Theory of Information," *PSCF* 49 (1997): 180–90.
17. M. Ruse, *Can a Darwinian be a Christian?* (Cambridge: Cambridge University Press, 2001), 120–2.
18. See, for example, A. E. Wilder-Smith, *Man's Destiny, Man's Origins* (Wheaton, IL: Harold Shaw Publishers, 1968), 57–70.
19. Snoke, for example, objects to the "anti-God-of-the Gaps" position because it assumes "that the onward steady march of science explains and solves everything." D. Snoke, "In Favor of God-of-the-Gaps Reasoning," *PSCF* 53 (September 2001):152–8.
20. See, or example, H. J. Van Till, "Creation: Intelligently Designed or Optimally Gifted" in *Theology Today* (1998).
21. Hebrews 11:6b, New International Version.
22. Romans 1:20, New International Version.