Stephen M. Contakes

Communication

Logical Pitfalls and Communication Gaps: Frequent Lines of Argument That Dead-End the Origins Conversation

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At a recent conference hosted by our ASA local section, there were many stimulating papers but also misdirections that obscured the issues or damaged the credibility of ideas that, at their core, are worthy of serious engagement. In order to promote more gracious and productive faith-science dialogue, this communication presents five pitfalls[1] that it can be helpful to avoid.[2]

1. *So, what is your argument? Don't worry—I think I just figured it out … well, maybe.*

"God of the gaps" and "either/or" fallacies are so well known that their repeated occurrence in otherwise high-quality presentations at the conference seemed surprising. However, sometimes during the Q&A time, it became apparent that the speakers did not really believe that the absence of plausible scientific explanation in itself constitutes evidence for supernatural intervention or that either God or natural phenomena are mutually exclusive causes for all events.[3] They had simply left important parts of their arguments unstated.

To see how incomplete arguments can obscure important issues consider the following argument, which nominally exhibits the God of the gaps fallacy:

> Origin of life science lacks a plausible overarching model for the origin of the first cell.
>
> Therefore, God or an intelligent designer supernaturally intervened to produce the first life forms.

However, perhaps several propositions were left unstated and the following was intended:

> Origin of life researchers exhaustively ruled out all natural mechanisms that could have produced the first cell.
>
> Since, by definition, all causes are either natural or supernatural, therefore, life could not have arisen by natural causes; a supernatural designer must have been involved.

This possibly clarifies the argument and encourages discussion of whether origin of life science really has exhaustively ruled out natural mechanisms or that claims of supernatural intervention are justified. However, there is no guarantee that the original argument was accurately reconstructed. Maybe it was originally intended to be an inductive argument, perhaps as follows:

> The physics and chemistry which bear on the origin of life are well known.
>
> Origin of life researchers have been unable to develop a plausible overarching model for how the first cell may have arisen using known physiochemical mechanisms.
>
> Notably, origin of life researchers have not been able to explain how highly stereospecific information-bearing homopolymers originated.
>
> Therefore, it seems unlikely that life first arose by normal physiochemical means.

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In everyday experience, highly specific and complex systems like the above-mentioned biopolymers are the product of human ingenuity or of intelligent design.

Given the dearth of natural explanations and the presence of seemingly designed features in nature, it is reasonable to infer that God or an intelligent designer supernaturally intervened to produce the first life forms.

The above reconstruction might helpfully focus attention on additional issues that merit examination; however, it is also more speculative, as it focuses on a particular challenge in origin of life science[4] and assumes specific design arguments that were not mentioned in the original argument. Without more guidance from the argument's original author, it is impossible to be sure what, exactly, was intended.

Based on my experience with student lab reports and presentations, I suspect that most incomplete arguments are a failure of communication rather than a failure of logic. When one has deep convictions or has thought about something a great deal, it is easy to assume that others have a similar level of understanding. Nevertheless, any unstated portions of an argument will leave "logical gaps" that must be interpreted—and will perhaps be misinterpreted—by the audience.[5]

Nevertheless, all acts of communication rely on some level of knowledge and assumptions shared with an audience. Since the extent to which shared assumptions can be reasonably counted on varies from venue to venue, it is important for speakers and authors to carefully consider their audience. For instance, because the ASA encompasses a wider range of views on origins, scripture, and the nature of science than does the BioLogos Foundation or the Christian Scientific Society, arguments which appear plausible in the latter two venues might benefit from a more thorough exposition in ASA meetings and publications.[6]

2. My simple back-of-the-envelope calculation just showed that, without a doubt, 42 is the "Answer to the Ultimate Question of Life, the Universe, and Everything."[7]

Care should also be taken not to overstate the importance of results or make grandiose predictions from speculative theoretical models,[8] particularly when important details of the phenomenon under study are unknown or neglected by the model. For example, consider Levinthal's model for protein folding:[9]

Protein folding occurs as a protein's polypeptide backbone randomly samples possible conformations.

Protein backbones can rotate around two bonds per peptide linkage, or $2^{(N-1)}$ bonds in a peptide containing N amino acid residues.

Although a range of rotational angles is possible, let's generously assume that each bond can exist in only three conformations, for a total of $3^{(N-1)}$ rotational states.

Therefore, a typical protein of 101 amino acids will need to sample 3^{100} or ~5×10^{47} conformational states.[10]

At typical bond rotation rates, the fastest that polypeptides can sample conformations is 10^{13} times per second or ~3×10^{20} per year.

Therefore, proteins should take approximately 10^{27} years to fold, longer than the estimated age of the universe.

As written, the argument seems logically sound, but since most proteins spontaneously fold in under a second,[11] it leads to a false conclusion. One possibility is that protein folding involves the violation of natural law by a supernatural agent. Given the information presented this might be the best explanation; however, it would be wise to first establish that other alternatives are less likely. Levinthal himself suspected proteins might not randomly sample conformations; he thought that stable interactions might help lock properly folded regions into place during the folding process.[12] Indeed, Levinthal's suspicion was supported by subsequent experimental and theoretical work and protein folding is widely considered to occur naturally.[13]

Unfortunately, not all predictive models are subject to reproducible experimental validation. For instance, origin of life science lacks the sort of natural history artifacts needed to determine exactly how life started,[14] whereas predictive climate modelling awaits future validation. In such cases, it is especially important to clarify assumptions and to provide good-faith estimates of uncertainty.[15] When advocates for particular origins positions attempt to draw grand conclusions from simplistic models similar to those used by Levinthal, they can make it more difficult for scientists to give fair consideration to their propos-

als. For example, Michael Behe's grand conclusions about the limits of evolution in *The Edge of Evolution* were widely discounted as based on misused statistics and unwarranted assumptions,[16] even though the arguments he used were qualitatively similar to those in his earlier paper with David Snoke.[17] Had the conclusions in *The Edge of Evolution* been similarly qualified and followed up with an appeal for further work rather than a grand conclusion, the work may have generated more fruitful discussion. Indeed, a significant amount of subsequent ID-motivated research has followed up on Behe's proposals.[18]

3. *The point you raise is difficult to address; let's discuss another one that better fits my interests.*

Red herrings involve redirecting discussion of a pertinent but often challenging issue to an irrelevant but often easier one to argue. Consider the following exchange:[19]

> Cocky Locky: There is no evidence that the sky is falling. The proposal by Chicken Little and his coworkers is unsupported by anything other than his own testimony.
>
> Chicken Little: Cocky Locky seems to be unaware of the progress we've made since that unfortunate incident with Foxy Loxy. For instance, we've shown that air is a fluid through which objects can fall. Furthermore, our work has been critically reviewed in the prestigious *Poultry Farm Journal of Meteorology,* and numerous peer-reviewed papers supporting our theory have been published in *Caelo-Plungexity*, under the editorship of our most devoted supporters.

Notice how the original issue, the alleged lack of experimental evidence for a falling sky, has been replaced with the red herring of Cocky Locky's familiarity with the sky is falling literature. This charge may be related to the main issue (e.g., perhaps one of the papers in question presents the evidence which Cocky Locky claimed does not exist), but nothing Chicken Little says indicates this clearly. Thus Chicken Little's argument is unconvincing, though it may be misinterpreted as a legitimate refutation.[20]

Although the Chicken Little example was intended to be humorous, faith-science discussions can unintentionally take similar turns when a questioner does not keep the discussion on the presentation at hand. For instance, one of the speakers at our section's conference last winter argued that a popular faith-science movement was "disingenuous"—a very serious charge meriting discussion and, if appropriate, refutation. However, constructive exploration of the charge was sidetracked when an adherent of the view in question refocused the discussion on the original presenter's familiarity with the movement's publications.[21]

Red herrings can also result when scientific controversies are not explained in enough detail to properly inform the audience. This is why many biologists consider it misleading to say that they are divided over "evolution"; a casual hearer is likely to assume that the evolutionary biology community has not reached a consensus over whether evolution occurred at all when, in fact, the disagreement is over the mechanisms by which it occurred.[22] Such loose language may be acceptable if the context is clear from the setting or from the rest of the argument; however, for an average audience, unqualified claims of "scientific controversy" might *de facto* result in the inconsistency fallacy, in which differences of opinion about something are used to charge that it is indefensible as a whole.[23]

4. *As everyone knows, "those people" are wrong; none of "us" would ever think that.*

There has been too much name calling in the dialogue over origins. Young earth creationists and intelligent design proponents are sometimes ridiculed as "ignorant," "obscurantist," or "IDiots," while theistic evolutionists are portrayed as "insincere," "compromised," or "counterfeit" Christians who do not take the Bible "seriously." Such name calling quenches genuine dialogue by effectively dismissing the views in question. Worse, it creates a climate in which the adherents of the specific view feel minimized. It can be tempting to think this is not a problem in ASA circles, especially since the ASA "strives to create a safe environment in which dialogue can flourish, and diverse, even contrasting, ideas can be discussed with courtesy and respect."[24] However, the tendency to be dismissive or demeaning in one's attitude and intimations (e.g., by using "us" and "them" language) is more insidious and, indeed, took place at a recent ASA annual meeting.[25]

5. *Dialogue? What dialogue? You finally messed up! Now I've got you.*

This fallacy assumes that just because an argument is fallacious its conclusion is false. The soundness of

an argument's logical structure does not necessarily prove the correctness of its conclusion. Logically sound arguments can lead to false conclusions if one of the premises is false (as in the Levinthal's hypothesis example), while unsound arguments can lead to true conclusions. In other cases, arguments that are logically unsound as deductive proofs can plausibly be reformulated as inductive arguments or abductive inferences to the best explanation.

Indeed, if the faith-science dialogue is to move forward, we should beware of easy "wins." Instead, we should seek to strengthen, reformulate, and otherwise engage the best arguments for those positions with which we disagree. In doing so, we are helping to move the faith-science dialogue forward, not just establishing that our own way is the right one. Indeed, perhaps the greatest prerequisite for fruitful dialogue is a willingness to seek and to follow the truth wherever it leads. These reflections are offered in the hope that a better understanding of logical fallacies and communication missteps can help us avoid two temptations that work against openness—the fear of being deceived and the fear of being wrong. Believers who are equipped to analyze, and if necessary, challenge questionable arguments, can confidently engage opposing views while offering appropriately nuanced arguments to advocate for their own views. It is the author's hope that this will make for more fruitful dialogue over issues of origins.

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Notes

[1]Note that in offering these pitfalls, I am not claiming or intimating that particular speakers at the conference committed these fallacies or even that all of the listed fallacies were committed at the conference. In fact, the list and examples given reflect my training and interest as a chemist and my idiosyncratic interests in the relation of faith and chemistry more than anything else.

[2]Although a number of books and websites treat these issues more rigorously than is done here, the chief novelty of this communication is its focus on contemporary discourse among ASA members. The ASA website contains a page on logical fallacies with links to additional resources at http://www.asa3.org/ASA/education/think/fallacies.htm.

[3]For example, logically fallacious god of the gaps arguments involve assertions based solely on lack of evidence; the label does not strictly apply when a positive argument is offered for why the gap exists. See C. John (credited as Jack Collins) Collins, "Miracles, Intelligent Design, and God of the Gaps," *Perspectives on Science and Christian Faith* 55, no. 1 (2003): 22–9. Such arguments should be carefully examined and not casually dismissed as fallacious. See Robert Larmer, "Is There Anything Wrong with 'God-of-the-Gaps' Reasoning?," *International Journal for Philosophy of Religion* 52, no. 3 (2002), 129–42. Del Ratzsch has pointed out that even "god of the gaps"-type arguments are commonly used in science. See Delvin Lee Ratzsch, *Nature, Design, and Science: The Status of Design in Natural Science*, SUNY Series in Philosophy and Biology (Albany, NY: State University of New York Press, 2001).

[4]The significance of the informational biopolymer problem is acknowledged in both the scientific and intelligent design literature. For an example of the former, see P. L. Luisi, *The Emergence of Life: From Chemical Origins to Synthetic Biology* (Cambridge: Cambridge University Press, 2006). A relatively recent example of the latter is Stephen C. Meyer, *Signature in the Cell: DNA and the Evidence for Intelligent Design*, 1st ed. (New York: HarperOne, 2009).

[5]Logical gaps force the reader to fill in missing information; they can lead to misunderstandings. See George Gopen and Judith Swan, "The Science of Scientific Writing," *American Scientist* 78, no. 6 (1990): 550–8, for a helpful discussion of this issue along with helpful examples illustrating how logical gaps can be detected and avoided.

[6]This is not to denigrate either the BioLogos Foundation or the Christian Scientific Society, whose more monolithic character allows them to serve different roles than the ASA.

[7]In Douglas Adams, *The Hitchhiker's Guide to the Galaxy* (New York: Harmony Books, 1995), the supercomputer Deep Thought ultimately calculates 42 as the "Answer to the Ultimate Question of Life, the Universe, and Everything."

[8]Here it is important to distinguish between models that are somewhat speculative from those that have been validated to the extent that they can be used to challenge experimental conclusions. For instance, computational chemistry has advanced to the point that its results can be used to challenge questionable experimental assumptions. One of the best-known examples occurred when Fritz Schaefer challenged Gerhard Hertzberg's claim that the methylene radical was linear, and later work proved Schaefer correct. For details, see Henry F. (Fritz) Schaefer III, "Methylene: A Paradigm for Computational Quantum Chemistry," *Science* 231, no. 4742 (1986): 1100–7.

[9]Levinthal's paradox is a staple of undergraduate biochemistry texts. The numbers given are from R. Zwanzig, A. Szabo, and B. Bagchi, "Levinthal's Paradox," *Proceedings of the National Academy of Sciences* 89, no. 1 (1992): 20–2.

[10]Here I am expressing Levinthal's paradox in its usual form although Professor David Vander Laan of Westmont College points out that on average a protein will only need to explore about half these states before finding the proper folded conformation. However, this does not materially affect the overall argument, especially given the approximations Levinthal employs.

[11]For a sampling of folding rate constants see David De Sancho and Victor Muñoz, "Integrated Prediction of Protein Folding and Unfolding Rates from Only Size and Structural Class," *Physical Chemistry Chemical Physics* 13, no. 38 (2011): 17030–43. The slowest protein listed has a time constant of 4.3 seconds; the fastest, 4.8 microseconds.

[12]Cyrus Levinthal, "How to Fold Graciously," in *Mossbauer Spectroscopy in Biological Systems: Proceedings of a Meeting Held at Allerton House, Monticello, Illinois*, ed. J. T. P.

DeBrunner and E. Munck (Champaign, IL: University of Illinois Press, 1969), 22–4.

[13]Although Levinthal's paradox remains incompletely resolved, in many cases folding rates can be reliably predicted from amino acid sequence data as long as their structural class is known. See M. Michael Gromiha, "A Statistical Model for Predicting Protein Folding Rates from Amino Acid Sequence with Structural Class Information," *Journal of Chemical Information and Modeling* 45, no. 2 (2005): 494–501. For a brief review of the state of the protein folding field, see Ken A. Dill and Justin L. MacCallum, "The Protein-Folding Problem, 50 Years On," *Science* 338, no. 6110 (2012): 1042–6. A well-referenced overview of progress on the protein folding rate problem is presented in the introduction to Sergiy O. Garbuzynskiy et al., "Golden Triangle for Folding Rates of Globular Proteins," *Proceedings of the National Academy of Sciences* 110, no. 1 (2013): 147–50.

[14]Most origin of life researchers are currently seeking to discover plausible mechanisms for how life might have arisen; none are, to my knowledge, seeking to find out exactly how life historically arose on the earth.

[15]For instance, the Intergovernmental Panel on Climate Change (IPCC) clearly states the assumptions behind their predictive models and provides estimates of uncertainty. Note also that critics of speculative models have a responsibility to properly interpret the uncertainty involved, and, in no case, should they use the uncertainty to claim that the prediction is untrue. That would be to commit the argument from uncertainty fallacy. They might, however, incorporate the uncertainty into a risk-benefit analysis when deciding what courses of action are warranted by the predictions.

[16]See Michael J. Behe, *The Edge of Evolution: The Search for the Limits of Darwinism* (New York: Free Press, 2007). Nevertheless, it should be noted that Behe admirably takes pains to lay out and think about his assumptions. The issue is the degree to which he was willing to consider the fallibility of his assumptions. Like Levinthal, Behe uses well-attested experimental results to make seemingly generous assumptions about the potential of natural processes. However, he seems less ready than Levinthal to consider whether the assumptions implicit in his model might be incorrect or in need of modification. Indeed, critical reviews of the focus of Behe's book question his assumptions and charge him with misuse of statistics. See Sean B. Carroll, "God as Genetic Engineer," *Science* 316, no. 5830 (2007): 1427–8; Kenneth R. Miller, "Falling over the Edge," *Nature* 447 (28 June 2007): 1055–6.

In fairness, it should also be noted that Behe appropriately attempted to foresee and address potential criticisms of his argument. Furthermore, given Behe's rejection of methodological naturalism, it was not necessarily irrational for Behe to interpret his models as indicating that there are limits to what natural processes can explain. However, he would have been well served by first ruling out naturalistic mechanisms that might have invalidated one or more of his assumptions. This process of ruling out alternatives is common in science. For instance, when establishing a chemical reaction mechanism as likely, it is just as important to rule out alternative mechanisms as it is to establish the reasonableness of the one under consideration.

[17]Behe, *The Edge of Evolution: The Search for the Limits of Darwinism*; M. J. Behe and D. W. Snoke, "Simulating Evolution by Gene Duplication of Protein Features That Require Multiple Amino Acid Residues," *Protein Science* 13, no. 10 (2004): 2651–64; Behe and Snoke, "A Response to Michael Lynch," *Protein Science* 14, no. 9 (2005): 2226–7. The 2004 Behe and Snoke paper was also criticized but much of the criticism was diffused after Behe and Snoke clarified that their model might simply indicate that other evolutionary pathways were involved.

[18]This is not to say that Behe's arguments would have been accepted as definitive proof for his intelligent design proposals; given the state of the public debate over ID in 2007 (and now), it is unlikely that they would have been met with a warm reception by the scientific community anyway. However, by drawing more appropriately nuanced conclusions that encouraged future investigations into the reliability of his assumptions and the potential of alternate mechanisms, Behe could have at least proposed a research plan for establishing the public belief in ID-motivated scientific research, perhaps similar to that currently being conducted at the ID-associated Biologic Institute. Even this is not to say that his intelligent design proposals themselves would have been accepted as scientific; it is only to say that a more appropriately curtailed set of conclusions would have made it more difficult for his opponents to reject his proposals out of hand.

[19]This exchange is somewhat analogous to one that occurred at the conference, although many details have been changed, and it should not be taken as representative of any particular individual's or movement's approach.

[20]Redirection may be used intentionally in order to distract an audience's attention from the main point. However, this tactic will not promote a constructive public discourse on faith and science.

[21]It should be noted that in the incident under discussion, there is no evidence that the original question was sidetracked by the questioner to avoid the original presenter's charge that his movement's ideas were "disingenuous." The questioner, in fact, dismissed that charge based on personal incredulity—a move which was not wholly inappropriate since the issue in part involved the questioner's own personal motivations. However, the questioner still redirected the discussion to a point of his own.

[22]This is not to say that *all* scientists are convinced that evolutionary accounts of natural history are, in general, correct, but only to say that it is almost universally accepted among biologists. Nor is it to say that the existence of consensus alone constitutes an argument that evolution is an adequate explanation for natural history (that would be to commit another logical fallacy). However, the existence or lack of a scientific consensus might reasonably affect the degree of caution one uses when challenging existing ideas in the field.

[23]One might argue that uncertainty over the mechanism of a process is coupled to uncertainty over whether it occurred. However, in that case, it is important to make that argument.

[24]"About the ASA," American Scientific Affiliation, http://network.asa3.org/?page=ASAAbout.

[25]See Caroline Crocker's reflections on the 2011 ASA Annual Meeting (Caroline Crocker to Uncommon Descent, 2011, http://www.uncommondescent.com/evolution/has-the-american-scientific-affiliation-forgotten-their-stated-identity/). Even though I would classify myself as a theistic evolutionist, I also have recollections of being put off by the anti-ID attitudes expressed by some speakers at that meeting.

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