

AAAS Dialogue on Science, Ethics, and Religion (DoSER) Public Lecture April 20, 2006

The Origin of Species: What Do We Really Know?

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Respondent: Emmett Holman, Ph.D., Associate Professor of Philosophy, George Mason University

SUMMARY

“It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us.” Sara Via, professor of biology and entomology from the University of Maryland, began her lecture on speciation with this quote from the first edition of Charles Darwin’s *Origin of Species* (1859). The lecture on the 20th of April 2006 was one in the series sponsored by the AAAS Dialogue on Science, Ethics, and Religion. She noted that Darwin did not explain how speciation worked and that even 147 years later we are still learning a great deal about how the many species on the “tangled bank” evolved.

As a setting for her lecture she commented on why speciation is a problem for religious anti-evolutionists. She went on to discuss speciation research in two time periods: from 1930 to 1990 and from 1990 to the present. She then discussed what has been learned about major evolutionary transitions and concluded her lecture by revisiting anti-evolutionary concerns, particularly what she called the “kinds barrier.”

“Creationists don’t need speciation,” Via pointed out. If all species were created specially and individually there is no need for a speciation process. Because the Bible depicts the creation of individual “kinds,” the discussion of speciation would seem to challenge belief in the scriptures. Further, she stated that religiously motivated anti-evolutionists claim that no one has observed the formation of a new species or a major evolutionary transition e.g. from fish to salamander, and thus they say evolution is a flawed theory. She noted that while anti-evolutionists acknowledge that there is adaptation within species, or “microevolution,” they assert that this process does not lead to speciation and the evolution of diverse organisms. She summarized a

prevalent creationist position that accepts adaptive evolution within “kinds” and even the evolution of new species within “kinds,” such as the evolution of the dog from the wolf, but rejects the evolution of entirely new “kinds.” This position Via called the ‘Kind’ Barrier.

She then asked, “Can we break the ‘Kind’ Barrier?” She noted that no one has seen a major transition first hand. Examples of such transitions not only include fish to salamander but also invertebrate to vertebrate, dinosaur to bird, and primate to human. She acknowledged that imagining such transitions is hard and that this difficulty is increased due to ignorance of the scientific research that seeks to learn how such transitions occur. This led her to discuss speciation research.

In the 1930s classical Darwinian evolutionary theory was integrated with paleontology, biogeography, and the newly re-discovered science of genetics, to form what has come to be called the “New Synthesis.” This led to the development of grand scale models of speciation. According to Via, from the 1940s until 1990, two individuals exerted extraordinary influence on the development of these models; they were Ernst Mayr, focusing on the biogeography of birds, and Theodosius Dobzhansky, who focused on the genetics of *Drosophila* (fruit flies) and population genetics. Their views dominated the study of speciation for 60 years.

Via stated that Ernst Mayr’s legacy included the “Biological Species Concepts.” These held that “reproductive isolation,” the inability to successfully interbreed, was the defining factor of species. He further held that populations must be geographically separated for reproductive isolation to evolve, strongly arguing that all speciation occurs in “allopatric” or geographically isolated populations. Theodosius Dobzhansky proposed a genetic mechanism that would account for speciation in the allopatric context. He proposed that “genetic incompatibilities accumulate during geographical separation” and that “upon secondary contact, these incompatibilities cause hybrid inviability or sterility” as is the case, for example, with the mule. Another researcher, T.H. Muller, made the same proposal and these mechanisms have come to be called “Dobzhansky-Muller incompatibilities.”

Via described this process in the following way: A group from an original population becomes separated from the main body, perhaps due to an environmental event such as a mountain slide or flood. The separation persists for a long period, during which time random genetic mutations in the two groups accumulate causing the populations to diverge genetically. If at some later date circumstances allow the now two populations to encounter one another they may be physically incapable of engaging in reproductive activity or their offspring may be inviable or sterile. In these cases, speciation has occurred.

Most biologists accepted this definition of species and this model of speciation. As a consequence most speciation research focused on “the types of traits that lead to reproductive isolation” and “the biogeography of the species pairs under investigation.” Via characterized this approach to speciation as the “telescope” approach because it takes the long view and attempts to reconstruct past events. “So, Viola! The speciation problem is solved.”

But then, Via asked how exactly do the genetic incompatibilities that result in reproductive isolation accumulate? This question was the focus of much speciation research from 1980 until the mid-1990s. By the 1980s population genetics had matured to the point that some researchers were beginning to question the allopatric model. Perhaps speciation was a consequence of genetic drift or sexual selection. Perhaps there were “genetic revolutions,” genetic mutations that cause large scale changes in an organism’s form. Questions were being asked about the relevance of so-called microevolution and adaptation to speciation and long time scales.

For the past ten years, speciation research has gone “back to Darwin,” Via declared. That is, natural selection is being seen as the motor that drives speciation. “Divergent selection from resource use and species interactions differentiates populations, and leads to evolution of traits that restrict successful mating,” she stated. This model might be called “ecological speciation.” It is driven by selection and “[it] can occur regardless of geographical relationships if selection is strong enough and divergence is rapid. [It] may involve genetic incompatibility or any other barrier to breeding.” In this model “adaptations are key!” Via called this a “magnifying glass” model of speciation because it focuses on particular ecological and genetic details.

Having reviewed the history of speciation research, Via returned to the “Kind” Barrier. What about the major purported evolutionary transitions e.g. fish to salamander, invertebrate to vertebrate, dinosaur to bird, and primate to human? Is “regular” microevolution sufficient to account for major changes, she asked?

First, she pointed out that there is substantial evidence that such “major transitions did not occur suddenly or appear in their full (irreducible?) complexity. Each was foreshadowed by elements that had already evolved before the new form appeared.” Both the lungs and the four limbs of land dwelling creatures are found in lineages of fish that are thought to be their ancestors. When looking at the fossil record of human predecessors, it is noted that bipedalism i.e. walking upright on two feet, comes first, followed by increase in brain size. The appearance of tool use and then language changes the patterns of selection. When looking at the fossils it is not easy to draw lines between them to separate out “kinds.”

Via summarized her discussion of the “Kind” Barrier in the following way. “Creationists see no need to understand evolution or speciation. [They] believe that species or discrete “Kinds” were created. [They] cite incomplete [scientific] knowledge of major transitions as evidence against ‘microevolution’ as agent of diversification. [They] want CERTAINTY!” However, she pointed out that today we know much more about how species are formed and the rate of discovery is increasing. Further, in light of this research there is “no reason to doubt that the same processes [microevolution] that lead to adaptation cause speciation and produce major transitions.” And, finally, science is not about “certainty.” In her view, “Science is a view of life in which new information is admitted and used to reach a better understanding of the world.”

She closed with a final quote also taken from the 1st edition of Darwin’s *Origin of Species*: “There is a grandeur in this view of life, ... that from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.”

The discussant for the evening was Emmett Holman, Ph.D., Associate Professor of Philosophy from George Mason University. He began by indicating that he was not a biologist and could not comment on the details of Via’s presentation, but he assumed that as a philosopher that was

not his role. He noted that a portion of Dr. Via's lecture had been devoted to responding to one of the criticisms that creationists often offer against the theory of evolution; namely, that while the Darwinian Theory might be able to account for microevolution e.g. moths changing color in the context of the industrial revolution in England, it could not explain macroevolution or speciation. He pointed out that this was only one of a number of criticisms offered by creationists.

Holman indicated that while some of the creationist criticisms are naïve and can be answered in a sentence or two, some are more serious and, as the lecture had demonstrated, require a more extended response. Another more serious criticism is what is called the issue of "irreducible complexity" that was popularized by Michael Behe in his book, *Darwin's Black Box*. It is in relation to the more serious criticisms and the responses of the scientific community to them, that Holman stated he observed a pattern. When non-scientists first encounter one of the more serious criticisms, it seems compelling. It is not clear how the evolutionary biologist could answer it. He acknowledged that this was his first response when he read Michael Behe's book. But he went on to observe that "the more biology and evolutionary theory you learn, the less compelling the criticisms seem to be." Even if it is admitted that evolutionary biologists do not have the "final" answer to some evolutionary questions, they do have resources to explore what the answer might be. Creationist criticisms might raise interesting questions for biologists but they are not the "knock down" refutations of evolutionary theory that the creationist critics present. "The present lecture," he said, "nicely illustrates this."

His impression of this pattern (the more biology you know, the less compelling the objections to evolution) was reinforced for him in a conversation with a student at George Mason. She was an officer in the Philosophy Club at George Mason (for which Holman is the faculty adviser) and in the course of their conversation she mentioned that she was taking a 1-credit course on the creation/evolution controversy offered by the George Mason Biology Department. Initially she had said the creationist objections had seemed convincing. But the more biology she had learned the less convincing they were. Holman observed that the student was able to learn enough biology in a 1-credit course to bring about this change of perspective. He declared that he was glad to see the university offering such a course, though he wished it was a 3-credit course

offered during the regular academic year. He went on to say that he would like to see such a course offered in the public schools.

Holman called attention to the fact that creationists and “intelligent design” advocates often make the argument that the schools should “teach the controversy” rather than teaching creationism. But he said that in light of his and the student’s experience, this called to mind the old warning, “Beware of getting what you ask for.” His point was, if the “controversy” is taught and taught rightly (here the qualification is crucial), this might be the quickest way to undermine creationist criticisms of evolutionary theory.

Holman noted that both he and the student were puzzled by the scientific community’s resistance to this approach. In their conversation the student had asked, “Why are these people acting as though they have something to hide?” By “these people” she meant scientists and science educators. She thought that the scientific community was not making itself look good to the public; that its reluctance to “teach the controversy” was bad public relations.

Holman indicated that he had heard one rationale for this reluctance; namely, that to “teach the controversy” would be to convey a kind of credibility on creationism that it does not deserve. His response to this rationale was, “Wake up and smell the coffee burning!” According to national opinion polls creationism already enjoys a high degree of credibility among a wide range of the public, “so things could not get much worse.” Furthermore, he argued, the assumption underlying this rationale did not seem correct in light of his and the student’s experience. In the long run “teaching the controversy” rightly would undermine creationists’ criticisms. He conceded that in the short run there might be some public relations gains for creationists, but not substantively in the long run.

Another objection to the proposal to “teach the controversy” was that of time. In order to give students a really good scientific education, the teacher has to contend with a huge amount of material in a relatively short time. It is not practically possible to go off on a three or four week tangent to talk about creationism and “intelligent design.” As a teacher himself, he indicated his sympathy for this objection. But, his response was that “the controversy” would not be taught in

a mainstream science course. It would be taught as a separate elective course that was offered regularly. Perhaps it could be a philosophy of science course or a history of science course or a course on the politics of science and religion. It would probably still need to be taught by a scientist but would not be called a science course.

In terms of the content and methodology for such a course, Holman had some suggestions. It can be pedagogically effective to use a discredited theory as a foil to teach about the history of science, scientific method, and why some theories succeed and others are rejected. For example the Phlogiston theory of combustion was widely accepted more than 200 years ago. It was held that there was a substance called phlogiston within the various materials that combust and that when these materials burned, the phlogiston was given off. This explained why these materials weighed less after burning and seemed a very common sensible and robust theory. However, Antoine Lavoisier proposed as an alternative that combustion involved a process of chemical combination; namely, the combination of oxygen with the material being burned. It took the accumulation of a lot of carefully measured data, gathered through often very ingenious experiments, before most scientists of the day rejected the Phlogiston Theory in favor of the Oxygen Theory of combustion.

Holman suggested that there were parallels between this history and the contemporary controversy between evolutionary theory and the views of “intelligent design” advocates. If one looks at the complexity and the design found in nature, for many people an explanation involving an “intelligent designer” seems very natural. Holman noted that even Richard Dawkins, an ardent evolutionary biologist and atheist, had indicated that before Darwin he could not have been an atheist (at least an “intellectually satisfied” one). However, Holman declared, in science “seeing is not always believing.” Often science must go beyond naked eye and common sense with more detailed experimental observations. When this is done, evolutionary theory explains the data much better than strict creationism or “intelligent design.”

He suggested another parallel. In the history of the phlogiston controversy, when it was discovered by Lavoisier that in some cases materials became heavier when they burned, phlogiston theorists proposed that some forms of phlogiston had negative mass. This indicates

that it is possible to hang onto almost any theory as long as you are willing to make enough *ad hoc* assumptions. But, there is a point beyond which additional assumptions become silly. Holman suggested that by the 16th century this was the state of Ptolemy's geocentric cosmology with its ever increasing epicycles. In the controversy around evolution, *ad hoc* assumptions of this sort abound within "Young Earth" creationist arguments.

Holman closed his discussion by raising another related issue. "Why is there so much resistance to evolution anyway?" "There is," he answered, "the widely held view that evolution conflicts with religion, that it undermines religious faith." He noted that the scientific community itself is divided on this issue with distinguished scientists on both sides. On one side are those who claim that, if you understand science, religion, and evolutionary theory well enough, there really is no conflict. As an example of such a position he pointed to Brown University biologist and Roman Catholic, Kenneth Miller, and his book *Finding Darwin's God*.

On the other hand, there are scientists who believe that the conflict is very real. Here Holman's examples were the earlier mentioned Richard Dawkins and Daniel Dennett (who, though a philosopher and not a scientist himself has written an influential book on evolutionary theory, *Darwin's Dangerous Idea*).

Holman indicated that he sided with the latter view, that there is a genuine conflict. But if there is a conflict what should the scientific community and its friends do about it? The primary response has seemed to be to "sweep it under the rug and pretend there is no conflict." Given the present political climate this might be an understandable position, but he argued there are two reasons why it will not work. First, much of the American public believes that there is a conflict. Second, in the long run a "no-conflict" position is not going to fool anyone and makes it appear that scientists are "stone-walling" on the issue. The scientific community needs to acknowledge that this is an issue about which scientists themselves disagree and that there are highly respected scientists on both sides.

He noted, however, that there is a statement from the religious community that also claims that there is no conflict when the relationships are rightly understood; namely, the 1996 statement by

Pope John Paul II on evolution. Before commenting on this statement Holman acknowledged that he had only read excerpts. He also stated that he was not an expert on Roman Catholic theology. Nevertheless, he wanted to call attention and focus to the caveat contained within the Pope's statement. He said that he thought this caveat was more important than most people recognized.

Stated simply, the caveat proposes that evolutionary theory can explain the physical aspects of human development but spiritual matters, such as whether and how the human soul emerged, are off-limits. Such matters are not the domain of evolutionary theory particularly or science generally. In Holman's view, the Pope's position is an example of a popular strategy for avoiding conflict between science and religion.

The basic proposition seems to be that science and religion deal with mutually exclusive domains, which means that they cannot come into conflict with one another. Holman suggested that this may be a popular strategy because it is particularly comforting to people who are religious. "It allows the believer to insulate his or her beliefs from any possible scientific disconfirmation." But, the position, he suggested is a "two-edged sword." It also insulates religion from any sort of scientific confirmation as well.

More seriously, Holman argued, such a position actually undermines the tenet that evolutionary theory or science can, in principle, explain all the physical aspects of human development. Having a soul presumably makes a difference to the kind of creature humans are here on Earth, including the kinds of behaviors in which humans can engage. Maybe it gives humans a kind of free will that they would not otherwise have. This would mean that humans can engage in kinds of behavior that would not be possible for them if they did not have souls. But this is now a discussion of overt physical behavior not something mystical or hidden. So, Holman suggests that the Pope's caveat, which implies that there *are* physical aspects of human development and behavior that cannot be explained strictly in terms of evolutionary processes, is in conflict with the theory of evolution.

“Furthermore,” he proposed, “it is a conflict that can be tested empirically, at least in principle.” Dr. Holman conceded that, in practice, such testing might be very difficult and even impossible. But in principle all that is being talked about is overt physical behavior. “It is as public as scientists can hope for. “So,” he concluded, “it is a conflict that can be decided scientifically which means that there are at least some religious claims, some religious doctrines that cannot be insulated from scientific tests, QED.”