

How to Navigate Species Boundaries

A Reply to The American Journal of Bioethics

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Three years ago, *The American Journal of Bioethics (AJOB)* published a series of essays on the ethics of research involving the creation of human-animal chimeras. The lead essay was a target article written by Jason Scott Robert and Françoise Baylis, titled “Crossing Species Boundaries,” which critically examined the notion of species identity and the morality of crossing species boundaries.¹ It was followed by twenty-four peer commentaries on the target essay that represented a diversity of views primarily for the creation of human-animal chimeras. These essays represent some of the best thinking on the subject of human-animal chimeras within the tradition of secular bioethics.

In this paper, I will respond to the essays published in *AJOB*. I will begin by summarizing the two main arguments raised in the lead target article. First, Robert and Baylis suggest that the debate over crossing species boundaries, especially the boundary between any other animal species and the human species is unintelligible because the notion of species boundaries is itself problematic. They argue that, biologically speaking, no species boundaries really exist, because no fixed species identities *really* exist. This is a philosophical argument. Next, Robert and Baylis go on to propose that research involving human-animal chimeras is objectionable to many

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¹ Jason Scott Robert and Françoise Baylis, “Crossing Species Boundaries,” *AJOB* 3.3 (Summer 2003): 1–13.

ordinary people because it would introduce “inexorable moral confusion” that would threaten the moral order: These chimeras would force us to “confront the possibility that humanness is neither necessary nor sufficient for personhood.”² This is an ethical argument. Next, I will highlight the responses of the peer commentators to the two arguments made in the lead article. While a significant majority of the peer commentators embraced the nominalism inherent in the philosophical argument made in the target article, nearly all of them rejected the ethical argument put forward by Robert and Baylis.³ Finally, in response to the authors writing in *AJOB*, I will defend the reality of biological species, and suggest that an approach that combines a “homeostatic property cluster” view of biological species with Aristotle’s hylomorphic theory and a commitment to defend the dignity of the human person can properly help us navigate species boundaries.

Target Article: “Crossing Species Boundaries”

In their lead article, titled “Crossing Species Boundaries,” Jason Scott Robert and Françoise Baylis make two principal arguments. The first is a philosophical argument dealing with the species question, while the second is an ethical proposal concerning moral objections to the creation of human-animal chimeras.

First, they propose that the debate over crossing species boundaries is unintelligible, because the notion of species boundaries is itself problematic. Despite the persistence of the commonplace belief in the existence of species—for instance, Robert and Baylis acknowledge that cross-cultural comparative research has demonstrated that people around the globe tend to carve up the natural world in significantly similar ways⁴—they suggest that, biologically speaking, no species boundaries really exist because no fixed species identities really exist. Biological species names are simply convenient labels for organisms that share a superficial resemblance. To defend their nominalism, Robert and Baylis argue that evolutionary thinking and recent discoveries in genetics have conclusively demonstrated that there is no genetic lowest common denominator, no genetic essence, which can account for the essential sameness that is presupposed by a species concept. Instead, science has shown that everything about evolution points toward variability rather than identity. Not surprisingly, Robert and Baylis note that no authoritative definition for a biological species exists in the scientific literature. No definition exists because no species exist.

Significantly, Robert and Baylis contend that their rejection of essentialism in biology applies even to our own human species. They claim that there is no basis for

² Robert and Baylis, “Crossing Species Boundaries,” 9, 10.

³ “Nominalism” is the designation usually applied to any philosophical system, ancient or modern, that denies that objects that share the same name do so because they share a common underlying reality.

⁴ For details, see S. Atran, “The Universal Primacy of Generic Species in Folk-biological Taxonomy: Implications for Human Biological, Cultural, and Scientific Evolution,” in *Species: New Interdisciplinary Essays*, ed. R. A. Wilson (Cambridge, MA: MIT Press, 1999), 231–261.

holding that our species as a unique class of individuals possessing the same human nature even exists as such. For example, the human genome project has shown that there is no single, standard, normal DNA sequence that is shared by all human beings. Except for identical twins, each human being has a unique DNA sequence that is unlike that of any other human being.⁵ Thus, there is no biological substrate that can ground a common human nature. Moreover, according to Robert and Baylis, even the ability to use language—a trait that they say is believed by some to be found only among human beings—cannot be used to defend the existence of our species, since it is clear that no one would deny human species membership to individuals born without the capacity to use language whatsoever. Thus, without adequate criteria that can be used to affirm that our species can be uniquely identified as such, Robert and Baylis conclude that it is incoherent to speak about a human-animal species boundary that would be transgressed by research that creates human-animal chimeras:

As we have seen, neither essentialism (essential sameness, genetic or otherwise) nor universality can function as appropriate guides in establishing the unique identity of *Homo sapiens*. Consequently, no extant species concept justifies the erection of the fixed boundaries between human beings and nonhumans that are required to make breaching those boundaries morally problematic.⁶

Next, Robert and Baylis propose that among ordinary people, the primary ethical objection to research involving the creation of human-animal chimeras is that it would generate moral confusion—moral confusion that would “constitute an unacceptable threat to valuable and valued conceptual, social, and moral boundaries that set human beings apart from all other creatures.”⁷ They suggest that many individuals find human-animal chimeras intuitively repulsive because there would be uncertainty in our dealings with them, insofar as there is no clear way of understanding our moral obligations to beings that are somewhat, but not completely, human. Therefore, since countless social institutions and practices depend on the moral distinction drawn between human and nonhuman animals, Robert and Baylis argue that it is not surprising that many people reject human-animal chimeras: “To protect the privileged place of human animals in the hierarchy of being, ... the notion that species identity can be a fluid construct is rejected, and instead a belief in fixed species boundaries that ought not to be transgressed is advocated.”⁸

Finally, despite their extensive analysis, we should acknowledge that Robert and Baylis do not take a personal ethical stance either for or against the creation of interspecies hybrids or chimeras. They simply conclude that, in their view, “the most plausible objection to the creation of novel interspecies creatures rests on the notion of moral confusion—about which considerably more remains to be said.”⁹

⁵ For a recent discussion of the uniqueness of each individual human being’s genome, written for the nonscientist, see Erika Check, “Patchwork People,” *Nature* 437.7062 (October 20, 2005): 1084–1086.

⁶ Robert and Baylis, “Crossing Species Boundaries,” 6.

⁷ *Ibid.*, 7–8.

⁸ *Ibid.*, 10.

⁹ *Ibid.*, 11.

Peer Commentaries

Overall, the peer commentaries responding to Robert and Baylis were supportive of the philosophical argument rejecting biological essentialism. Most agreed that any talk about species boundaries or species identities is pragmatic at best and unintelligible at worst. For example, A. M. Chakrabarty asserts, "There are enough variations for a strict definition of species to be meaningless. If species cannot be defined, then the fear of crossing the evolutionary boundary is irrational."¹⁰ In a similar vein, Bernard E. Rollin from Colorado State University proposes, "The arguments about species barriers (particularly mixing human and animal genes) rest on a mistaken, biblical or Aristotelian view of species as fixed and immutable rather than being slices of a dynamic, ever-changing process."¹¹ Rachel A. Ankeny of the University of Sydney opines, "Our working notion of fixed species boundaries is just that: a working model that allows biologists to get on with their work."¹² Phillip Karpowicz agrees, suggesting that "genetic similarity or reproductive criteria used to describe species do not reveal real categories but are instead theoretical tools used to generate predictions and further empirical scientific advances."¹³ Finally, Urie, Stanley, and Friedman even go on to propose that "the notion of human uniqueness is a myth or a convenient and comforting fabrication by human beings." They believe that "one can successfully argue that the species identity of human beings is not 'genuinely fixed' but made sacred by convention."¹⁴ In sum, like Robert and Baylis, most of their peer commentators are nominalists.

To be fair, however, we should also acknowledge that a few of the open peer commentaries were more cautious about embracing the nominalism expressed in the target article. Lee L. Zwanziger is concerned that it is methodologically and logically flawed to shift between the abstract idea of the mutability of species, to the idea that species have no reality or the idea that duties of human nature are concrete and historically local social constructs.¹⁵ She also suggests that terms like "humankind" and "species: *Homo sapiens*" might be meaningful in the sense of referring to something that exists with stability, even though it may be mutable.¹⁶ Louis Charland agrees. He argues that Robert and Baylis may have overstated their case. Simply admitting that there is no consensus regarding an authoritative definition of species does not

¹⁰ A. M. Chakrabarty, "Crossing Species Boundaries and Making Human-Nonhuman Hybrids: Moral and Legal Ramifications," *AJOB* 3.3 (Summer 2003): 20.

¹¹ Bernard E. Rollin, "Ethics and Species Integrity," *AJOB* 3.3 (Summer 2003): 15.

¹² Rachel A. Ankeny, "No Real Categories, Only Chimeras and Illusions: The Interplay between Morality and Science in Debates over Embryonic Chimeras," *AJOB* 3.3 (Summer 2003): 32.

¹³ Phillip Karpowicz, "In Defense of Stem Cell Chimeras: A Response to 'Crossing Species Boundaries,'" *AJOB* 3.3 (Summer 2003): W17.

¹⁴ Kimberly A. Urie, Alison Stanley, and Jerold D. Friedman, "The Human Imperative: A Moral Opportunity," *AJOB* 3.3 (Summer 2003): W20.

¹⁵ Lee L. Zwanziger, "Crossing Perspectival Chasms about Species," *AJOB* 3.3 (Summer 2003): W9.

¹⁶ *Ibid.*, W10.

necessarily mean that no authoritative definition exists. As Charland rightly points out, “How does [the no-consensus argument] preclude the philosophical judgment that there might be one position that is the right one and that the others are simply wrong?”¹⁷

Finally, we should point out that in addition to being nominalists, it is clear that a majority of the peer commentators writing in *AJOB* hold to a materialism that equates the identity of an organism with either the identity of its DNA or, more commonly, the identity of its—especially neural—cells. Cynthia B. Cohen’s essay is representative of this view. She proposes that the proportion of human to nonhuman-animal materials in a human-made chimera should guide our ethical judgments. She writes, “We need to develop a way of assessing when the proportion of human cells transferred to mice has crossed the boundary between human beings and mice and then to consider whether it is ethically acceptable to cross that boundary.”¹⁸

Although most of the peer commentators embraced the nominalism expressed in the target article, most of them also rejected the ethical argument, i.e., the introduction of “inexorable moral confusion,” made against human-animal chimeras. The peer commentators gave different reasons for their objections.

Several commentators reject the ethical proposal put forward by Robert and Baylis because there is no empirical evidence that supports it. Citing the importance of actual empirical evidence, Bernard E. Rollin points out that in the past, it was almost universally claimed (without empirical evidence) that European rejection of biotechnology was based on an aversion to risk. However, a survey of about seventeen thousand Europeans from sixteen countries later showed that these people rejected not what they saw as most dangerous, but what they saw as morally wrong.¹⁹ Robert Streiffer brings up the same concern. He argues that there are data that undermine the proposal that the creation of human-animal chimeras would undermine the usefulness of species boundaries. The report by the U.S. Office of Technology Assessment on public perceptions of biotechnology, for instance, shows that concerns about playing God and tampering with nature were more prevalent than consequentialist concerns among respondents who believed that creating cross-species plants or animals is morally wrong.²⁰

Other peer commentators reject the proposal put forward by Robert and Baylis because they believe that moral confusion is not necessarily bad, especially if it is a vehicle for social change. Hilary Bok suggests that moral confusion is good, espe-

¹⁷ Louis C. Charland, “Are There Answers?” *AJOB* 3.3 (Summer 2003): W1.

¹⁸ Cynthia B. Cohen, “Creating Human-Nonhuman Chimeras: Of Mice and Men,” *AJOB* 3.3 (Summer 2003): W4.

¹⁹ Biotechnology and the European Public Concerted Action Group, “Europe Ambivalent on Biotechnology,” *Nature* 387.6636 (June 26, 1997): 845–847, cited in Bernard E. Rollins, “Ethics and Species Integrity,” *AJOB* 3.3 (Summer 2003): 16.

²⁰ Office of Technology Assessment, *New Developments in Biotechnology—Background Paper: Public Perceptions of Biotechnology*, OTA-BP-BA-45 (Washington, DC: U. S. Government Printing Office, 1987), cited in Robert Streiffer, “In Defense of the Moral Relevance of Species Boundaries,” *AJOB* 3.3 (Summer 2003): 37.

cially if it “might also lead us to wonder whether our views about the moral status of human and nonhuman animals, and the forms of treatment appropriate to them, are in fact defensible.” She goes on to claim that chimeras may “reveal ways in which those views are inadequate and make us think about how we might improve them.”²¹ Daniel B. McGee proposes that the creation of human-animal chimeras might generate moral ambiguity, but not moral confusion. This moral ambiguity is the nature of serious and honest moral deliberation. He writes:

Responsible moral struggle does not lapse into confusion caused by the assumed presence of an ultimate and complete moral value that cannot be challenged. Rather it acknowledges that perfect understanding is never possible but that with broad-based participation we can find the courage and insight to accept even the toughest challenges of life.²²

Still other commentators raise questions relating to human dignity. They suggest that the moral revulsion experienced by ordinary individuals opposed to human-animal chimeras may reflect concerns that these hybrid organisms could offend human dignity, rather than that they would generate moral confusion. For example, Josephine Johnston and Christopher Eliot propose that creating human-animal chimeras could offend human dignity for any of three reasons: (1) it is cruel to the creature created; (2) it reflects badly both on those who created the chimera and on those societies that allowed its creation; and (3) it appears to use another human being or even a part-human as a means to an end rather than as an end in itself, a use that has been confirmed as morally unacceptable since at least the Declaration of Helsinki. They write that the phrase “‘offence to human dignity’ might ... be one way [that we] express the worried ‘look what we have intentionally done to someone who is, almost, one of our number!’”²³ David B. Resnick of East Carolina University would concur. He suggests that even if human-animal chimeras are not human, they might threaten human dignity if attempts were made to patent them.²⁴

Finally, others reject the moral proposal put forward by Robert and Baylis because they believe it is grounded in false premises. For example, David Castle argues that Robert and Baylis’s presupposition that human-animal chimeras are mixtures is a fallacy of composition.²⁵ Instead, he suggests that the proper approach is to see these chimeras as organisms in their own right. Then they would get whatever moral consideration they deserve on the same grounds that apply to other organisms, including hybrid fruits, such as pluots (which are 75 percent plum and 25 percent

²¹ Hilary Bok, “What’s Wrong with Confusion?” *AJOB* 3.3 (Summer 2003): 26.

²² Daniel B. McGee, “Moral Ambiguity? Yes. Moral Confusion? No,” *AJOB* 3.3 (Summer 2003): W11.

²³ Josephine Johnston and Christopher Eliot, “Chimeras and ‘Human Dignity,’” *AJOB* 3.3 (Summer 2003): W7.

²⁴ David B. Resnick, “Patents on Human-Animal Chimeras and Threats to Human Dignity,” *AJOB* 3.3 (Summer 2003): 35.

²⁵ David Castle, “Hopes against Hopeful Monsters,” *AJOB* 3.3 (Summer 2003): 28–30.

apricot), and hybrid animals, such as mules (which are 50 percent donkey and 50 percent horse). Next, Andrew W. Siegel argues that Robert and Baylis's moral proposal is flawed, since there is good reason to think that no one really believes that humanness is logically necessary for personhood. He points to the creations of Walt Disney: We regard mice, pigs, insects, aliens, and so on as having the moral status of persons in those possible worlds in which they exhibit the psychological and cognitive traits that we normally associate with human beings. He concludes, "Our reactions in such cases do not result from a category mistake about species membership. Rather, the judgments reflect the belief that species doesn't matter where one possesses other traits that confer moral standing."²⁶

How to Navigate Species Boundaries: A Reply

Is essentialism dead? The consensus among the authors in *AJOB* is that it is. For these thinkers, science has definitively demonstrated that biological species do not exist because science has demonstrated that essences do not exist. However, their argument is flawed because they make a category mistake. They do not see that essentialism is properly a philosophical and not a scientific hypothesis, which has to be attacked or defended using arguments that come not from biology but from metaphysics. And as several metaphysicians belonging to a new movement in contemporary philosophy called the New Essentialism have recently proposed, there are cogent reasons to think that essentialism is true.²⁷

In brief, advocates of the New Essentialism argue that essentialism as a hypothesis has greater explanatory power than nominalism. For example, it can explain why similar things like protons, chloride atoms, and other entities postulated by the natural sciences have the causal powers that they have and behave in a consistent and reproducible manner—they do so because they share a common essence. In fact, the New Essentialists argue that essentialism is a necessary metaphysical presupposition for the scientific realism that is presupposed by the natural sciences, because nominalism cannot account for the regularity and reproducibility of the causal powers found in the world. Essentialism makes the scientific task intelligible.

The philosophical argument for the existence of essences in general can also be made for the existence of biological essences in particular. To posit that biological essences exist explains why similar organisms have the causal powers that they have

²⁶ Andrew W. Siegel, "The Moral Insignificance of Crossing Species Boundaries," *AJOB* 3.3 (Summer 2003): 33.

²⁷ For a representative view of the New Essentialism, see Brian Ellis, *Scientific Essentialism* (Cambridge, U.K.: Cambridge University Press, 2001). For two insightful essays that defend essentialism against its critics, see the following: David S. Oderberg, "How to Win Essence Back from Essentialists," *Philosophical Writings* 18 (Autumn 2001): 27–45, and G. Klima, "Contemporary 'Essentialism' vs. Aristotelian Essentialism," in *Mind, Metaphysics, and Value in the Thomistic and Analytical Traditions*, ed. J. Haldane (Notre Dame, IN: University of Notre Dame Press, 2002), 175–194.

and why they behave in a consistent and reproducible manner—they do so because they share a common biological essence. In other words, they belong to the same biological species. To put it another way, many of the commentators writing in *AJOB* admit that the biological species concept “works.” It allows one biologist in Russia to do an experiment with his mouse of the species *Mus musculus*, while expecting to reproduce the results of another scientist in Singapore who had done her experiments with another mouse of the same species. But *why* does the species concept work? Why do the two scientists get the same results? Biological essentialism provides an answer where nominalism cannot—the biological species concept works because members of the same species actually do share a common essence that behaves in a reproducible manner when it is manipulated in the same way. Biological essentialism makes the biological task intelligible.

Several objections can be and have been raised against essentialism in biology. I will focus here on two of the more significant ones. First, some have argued that biological kinds do not exist because the biological sciences have demonstrated that there is a great diversity of traits among individuals that are supposed to belong to the same species. In fact, as Robert and Baylis rightly acknowledge, genetics has revealed that there is no identical common biological substrate—for instance, no identical genome that is shared by all the members of a species—that can ground the essential sameness that is presupposed by biological essentialism. How can biological essentialism be reconciled with this diversity and apparent absence of identity among members of the same species?

In response, we should note that to affirm that there is an essential sameness among members of a species is not to deny there are also differences among them. Thus, an adequate philosophical account that affirms the existence of biological essences and biological species would have to explain both of these realities. I propose that hylomorphic theory—the philosophical theory of Aristotle, who hypothesized that individual substances are composed of two principles, matter and form—remains a potent explanation for biological species because it can do this.²⁸ It posits the existence not only of a form to explain the essential sameness shared by natural kinds, but also of individuated matter that explains the unique properties of the individual organism. Hylomorphism can even explain the absence of an identical biological substrate shared by all the members of a biological species. It accounts for this because genetics, as an empirical science, is only able to study the individual substance and cannot empirically study the form—the cause of the sameness shared

²⁸ In several published essays, I have proposed that hylomorphic theory can be reconciled with contemporary biology using systems theory. For details, see the following articles: “On Static Eggs and Dynamic Embryos: A Systems Perspective,” *National Catholic Bioethics Quarterly* 2.4 (Winter 2002): 659–683, and “Immediate Hominization from the Systems Perspective,” *National Catholic Bioethics Quarterly* 4.4 (Winter 2004): 719–738. For a contemporary philosophical defense of hylomorphism, see the essay by David S. Oderberg, “Hylemorphic Dualism,” in *Personal Identity*, ed. E. F. Paul, F. D. Miller, and J. Paul (Cambridge, UK: Cambridge University Press, 2005): 70–99, <http://www.rdg.ac.uk/AcaDepts/Id/Philos/dso/dso.htm>.

by the members of a species. The object of study for all the biological sciences, genetics included, remains the individual living system. Therefore, given the hylomorphic composition of organisms, hylomorphic theory predicts that no empirical science will ever be able to identify a material substrate that can account for the essential sameness of the members in a biological species.

Next, some have argued that biological kinds do not exist because it is impossible to establish the absolute boundaries that distinguish one biological species from another. For example, Brian Ellis, himself a New Essentialist, is skeptical about the existence of biological kinds as such, because it is difficult to precisely distinguish one biological species from another.²⁹

In response, we should acknowledge the real difficulty of specifying species boundaries. This, however, is not a modern problem created by Darwin and his theory of evolution by natural selection. As Mortimer Adler in his masterly treatise on the problem of biological species shows, many philosophers in the Aristotelian tradition were themselves not sure if we possess real definitions for any of the natural substances.³⁰ Indeed, a few notable philosophers, including Jacques Maritain and Fr. Reginald Garrigou-Lagrange, O.P., argued that we possess quidditive knowledge, i.e., an essential and real definition, of only one species, namely, our own, and that with respect to the specific essences of all other composite substances, we have only nominal and descriptive definitions. The problem with species boundaries is a real and difficult one. However, acknowledging that it is difficult to determine the bound-

²⁹ “Biological kinds would appear to be natural kinds without essences. For, although they are like natural kinds in many ways, they do not have essences in quite the way that chemical substances do. Their similarities are due to the importance of their genetic constitutions in explaining their morphological characteristics. Their dissimilarities are due to the variance and evolution over time of their genetic constitutions. The existing species of animals and plants are therefore just clusters of morphologically similar organisms whose similarities are due to their genetically similar constitutions. Hence, our species concepts are generic cluster concepts. They are not, however, generic kinds that are categorically distinct from one another, as the generic chemical kinds are. The species ‘elephant’ has a number of subspecies, which are sub-clusters within the elephant cluster, that are distinct enough to be reliably distinguished morphologically, and sufficiently different genetically to be said to be different kinds of animals. However, if we broadened our vision to include all of the ancestors of the current elephants in the world, we should find, I think, that the morphological clusters, and the genetic clusters that explain them, would shift about as we go back in time, and eventually overlap. Therefore, neither the generic species, nor any subspecies, of elephant is a natural kind in the same sense as the generic and specific chemical kinds are. Chlorine, for example is a generic chemical kind, the species of which include the various isotopes of chlorine. But there is no species of chlorine existing now, or at any other time, that could possibly be a species of any element other than chlorine. Chlorine, the generic kind, has a fixed nature, and each species of chlorine has its own fixed nature.” Brian Ellis, “Universals, The Essential Problem, and Categorical Properties,” *Ratio: An International Journal of Analytic Philosophy* 18.4 (December 2005): 462–472.

³⁰ Mortimer J. Adler, *Problems for Thomists: The Problem of Species* (New York: Sheed and Ward, 1940), 32–47.

aries between species is not the same as denying the reality of those same species. Note, for instance, that acknowledging that it is difficult to determine the precise boundary between day and night is not the same as denying the reality of these periods of time. Thus, one cannot point to the difficulty of specifying species boundaries in order to argue that biological species do not exist. The reality of biological kinds has to be evaluated on its own merits, and as we saw above, there are good reasons to think that they exist.

In sum, there are persuasive philosophical reasons to affirm the reality of biological essences and biological species against the skeptical nominalism of the authors writing in *AJOB*. One question remains: How then are we to deal with the species boundary question, especially with regard to the creation of human-animal chimeras? In the absence of absolutely certain metaphysical criteria for determining boundaries, for example, between things such as day and night or, in this case, between biological species, I propose that boundaries can be and are often set by convention and by more pragmatic concerns. For example, in order to determine the beginning and the end of the Sabbath, Orthodox Jews traditionally define nightfall as that point in time when three stars can be seen in the sky. Clearly, this is a convention. Here, I suggest that an approach that combines a “homeostatic property cluster” view of species with Aristotle’s hylomorphic theory, and a commitment to defend the dignity of the human person, can properly help us navigate species boundaries, especially the boundary between any other animal species and our own species, the human species.

First, the homeostatic property cluster view of species would help us distinguish one species from another. According to this view, a biological species is defined by a cluster of properties. No one of these properties, and no specific set of these properties, must be exhibited by any individual member of that species. However, at least one set of these properties must be possessed by all individual members of that species.³¹ The list of distinguishing traits is homeostatic in that they constitute a property cluster that manifests the causal structure of the biological world. This definition would help us to define a biological species—for instance, the common house mouse, *Mus musculus*—by establishing a normative yet flexible list of traits

³¹ For representative accounts of the homeostatic property cluster view of biological species, see the following essays: R. Boyd, “Homeostasis, Species, and Higher Taxa,” in *Species: New Interdisciplinary Essays*, ed. Wilson, 141–185; P. Griffiths, “Squaring the Circle: Natural Kinds with Historical Essences,” in *Species: New Interdisciplinary Essays*, ed. Wilson, 208–228; and R. A. Wilson, “Realism, Essence, and Kind: Resuscitating Species Essentialism?” in *Species: New Interdisciplinary Essays*, ed. Wilson, 187–207. These essays were cited by Jason Scott Robert and Françoise Baylis in their target *AJOB* essay. After noting that this view of biological species carries a hint of essentialism, they dismiss such homeostatic property cluster viewpoints “because essentialism—or at least stock conceptions of essentialism according to which a species is identified by essential intrinsic properties—is at odds with evolutionary biology.” As we noted in the text, however, there are reasons to think that essentialism is true. See Roberts and Baylis, “Crossing Species Boundaries,” 5.

taken from the distinctive physiological, morphological, reproductive, genetic, and behavioral characteristics of the group.

Next, Aristotle's hylomorphism would help us to describe chimeras. It would challenge the materialism inherent in much of the writing published in *AJOB* and would help us to develop an account of human-animal chimeras that anchors their identity not in their proportion of human to animal cells, but in their overall behavior and organization. It could help us to see that a mouse with human neural cells remains just that—a mouse with human cells. The creation of such a human-animal chimera could be morally justifiable if it could lead to scientific advances that benefit patients. In contrast, hylomorphism could also help us see that a primate with human neural cells could be something other than a primate, because cellular manipulations involving closely related species could so change the predisposition of the matter in the chimera that a human being with primate cells could be created. Here, a commitment to defending the dignity of the human being would help us to draw an ethical line prohibiting the creation of such chimeras, simply because we should not take the risk of creating a human being and treating him as an experimental subject.

I have argued that there are persuasive reasons to affirm the reality of biological essences and biological species. Both make the biological task intelligible. However, affirming that biological species exist does not solve the species boundary problem. And so, in this essay, I have outlined an approach that brings together classical and contemporary philosophical insights to help us navigate species boundaries. However, much work remains. I am convinced that one of the primary tasks of classically minded moral theologians working in the twenty-first century—a century already called the century of biology—will be to articulate a coherent moral vision that is able to reconcile an Aristotelian-Thomistic virtue and natural law ethics with the basic framework of Darwinian evolutionary theory. The approach to navigate species boundaries that I have outlined here is simply one dimension of this narrative. Now it has to be placed within a historical and evolving perspective to answer an important question: How would an Aristotelian or a Thomist explain speciation within the context of a process involving natural selection and random variation? Let the work continue.