

Chimeras, Cybrids, and Hybrids: A Christian's Observations and Critique of Some Aspects of the Controversy Involving the Mixing of Human and Animal Materials for Scientific Research

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Abstract

The paper discusses and critiques some aspects of the controversy in bioethics concerning the mixing of human and animal materials for scientific research, including the science and technology of chimeras, cybrids, and human-animal hybrids, and the conceptual logic of evolutionists. It is argued that the logic of evolutionists explains why objections to the research are unconvincing, and concludes that the controversy cannot be settled in secular terms.

Keywords: bioethics, chimeras, creation, cybrids, embryo, evolution, human-animal mixtures, hybrids

Introduction

On July 22, 2011, some readers of the *Daily Mail* UK were stunned by news that “Scientists have created more than 150 human-animal embryos in British laboratories” (Martin and Caldwell 2011). The introduction of the 2008 Human Fertilisation and Embryology Act¹ in the United Kingdom, the article continues to say,

legalised the creation of a variety of hybrids, including an animal egg fertilised by a human sperm; “cybrids,” in which a human nucleus is implanted into an animal cell; and “chimeras,” in which human cells are mixed with animal embryos. (Martin and Caldwell 2011)

Unfortunately, the article neglected to mention that there is a controversy about the mixing of human and animal materials for scientific research purposes that has been going on for quite some time now, and that none of the objections to restrict the research have thus far been successful.

The purpose of this paper is to discuss and critique some of the central issues of the controversy from the writer's Christian perspective, including the science and technology of chimeras, cybrids, and human-animal hybrids, and the conceptual logic of evolutionists, which explains why the arguments to restrict research have been unconvincing. The paper concludes that the controversy cannot be settled in secular terms.

The Context of the Controversy

The controversy over the mixing of human and animal materials for scientific research revolves around a single question: Is there a boundary between human and animal, and if so, is the crossing of the boundary morally wrong? Those who argue for the restriction of the research seem to think of the concept of a boundary as a natural barrier between human and animal and/or as referring to distinctions between the moral status of a human and animal and the moral obligations it implies (Robert and Baylis 2003). However, none of the objections that have been raised over the last 10 years or so—the arguments from unnaturalness, moral confusion, personhood, human dignity, and moral status—succeeded to provide sufficient rationales for restricting the mixing of human and animal materials (Huther 2009; Robert 2006; Streiffer 2010). Some of the debaters cannot fathom how the objector to creating human-animal chimeras can take offense with mixing human and animal materials, at all. Others find it hard to see how being a member of a certain species could give an individual its moral status. And still others think that the arguments manifest ethical confusion and a failure to understand exactly what chimeras, cybrids, and hybrids are.

Although new terminology has been introduced into the debate, very little about the core issues has

¹ Section 4(2) of the Act states that only persons in possession of a licence are allowed to “(a) mix human gametes with animal gametes, (b) bring about the creation of a human admixed embryo, or (c) keep or use a human admixed embryo.” Section 4(3) stipulates that admixed embryos must be destroyed at the time of the appearance of the primitive streak—the part of the embryo that develops into the brain—or at the end of 14 days after the “human admixed embryo began, but not counting any time during which the human admixed embryo is stored.” Section 4(6) (a) to (e) provide three definitions of “human admixed embryo”; (a), (b), and (c) to (e) corresponds, respectively, to what is popularly known as cybrids, hybrids, and chimeras, and (b) defines a human admixed embryo as an embryo “created by using (i) human gametes and animal gametes, or (ii) one human pronucleus and one animal pronucleus.”

changed. In fact, the current debate is part and parcel of a larger controversy. It began with the legislation of abortion and questions about the life and moral status of the human embryo in the 1980s and embryonic stem cell research in the 1990s. We shall see that the theological and philosophical questions that are raised by developments in biotechnology—including questions about the uniqueness of human beings and what it means to be human—remain the same. But it would be useful to gain some understanding of the science and technology involving the mixing of human and animal materials first.

The Science and Technology of Chimeras, Cybrids, and Hybrids

Chimeras

The word “chimera” (pronounced “ki-mi-ra”) has its origin in Greek (pagan) mythology. It denotes a monster with the head of a lion, a tail that has the form of a serpent’s body and head, and a body of a goat and a goat’s head on top of it. In contemporary biology, biotechnology, and bioethics chimera acquired new meanings. Baylis and Robert define chimeras as entities which “comprise a mixture of cells from two or more genetically distinct organisms of the same or different species” (Baylis and Robert 2006, p. 2). I will clarify a bit.

The cells or organisms referred to by Baylis and Robert are not limited to, for example, two zygotes or embryos. They include whole or parts of organs, gametes (sperm and egg cells), and fetal tissue. Cells must also be of a certain quality, otherwise they are of little use in the biotechnology. In the words of Huther,

Human fetal tissue used in interspecific [interspecies] research is usually obtained from intentionally aborted fetuses because the source has numerous advantages to using spontaneously aborted or still-born fetuses (i.e. cells are fresher and in better condition, usually not tainted with pathogens or carriers of genetic disorders. (Huther 2009, p. 88)

The mixing of cells is looked upon as either a naturally or artificially occurring phenomenon. When a chimera is the result of a natural process, scientists regard it as something that is happening between beings of the same kind (the term used in the literature is “species”). In contrast, an artificially produced chimera results from the manipulation and

mixing of mostly human stem cells² and embryos, and it is these entities that are the centre of the bioethical controversy.

The entity produced is, accordingly, classified in the literature as either a chimera or hybrid. The geep (produced in 1984), for example, has the head of a goat, the shape of a sheep, and has both wool and hair on its body. It is classified as a chimera when it is artificially produced by transferring (or fusing) a sheep cell nucleus with a goat’s enucleated egg or by fusing the embryo of a sheep and goat, and it is regarded as a hybrid when the geep is the result of a natural mating process between a sheep and goat (Huther 2009, pp.9–10; cf. Lightner 2007; Lamb 2007).

Examples of naturally occurring chimeric organisms include twin embryos which often exchange cells in the womb (uterus) and leading to an “intraspecies” chimera (a new being within the same kind of animal or human), and the fusion (or amalgamation) of two twins (zygotes or embryos) in the womb. The latter, also referred to as cases of the so-called “disappearing twins,” can result in an adult that carries a “parasitic” twin in his or her body and deformations like hermaphroditism or supernumerous limbs. Here it is useful to note that, although conjoined (Siamese) twins exhibit a composition resulting from a fusion of two separate twins, they are not chimeras; they are the product of the fusion of two identical twins. Thus, unlike normal (fraternal) twins who do not have the same genes (DNA), identical twins stem from a single, common zygote.

Other examples of chimeras include humans with an animal’s heart valve or kidney, the transplantation³ of human fetal brain tissue into the brains of patients with Parkinson’s disease (so far, unsuccessful), human neural (brain) cells into the fetal brain of developing monkeys, and the insertion of human embryonic stem cells into chick embryos, fetal sheep, and mouse brains (Baylis and Robert 2006, p.3; Huther 2009, p.8; Knowles 2003, p. 2). Two incidents caused quite a stir among bioethicists. The first was the production of a quail-chick chimera in 1988. Parts of the neural tube (i.e., of the brain) of a quail embryo were implanted in the brain of a chick embryo. The resultant chick exhibited certain behaviors of a quail, such as crowing like a quail and responding to a quail’s maternal calls. What it means for the scientists, in principle,

² It is embryonic stem cells that are in view in this paper, and not “adult” stem cells. The former are both pluripotent and totipotent. “Pluripotency” refers to the ability of the stem cells to produce all of the differentiated cell types of the mature organism; during the single-cell stage (of the so-called “zygote” or fertilized egg), the cells are capable of becoming a whole new embryo, and is therefore “totipotent” (up to 5–6 days after fertilization). Adult stem cells are typically “multipotent”; they are capable of producing only cell types belonging to particular tissue. Whereas embryo stem cells can only be harvested from a pre-implanted human embryo, adult stem cells are extracted from a variety of tissues in the fetus, newborns and adult human beings, such as bone marrow, body fat, the placenta and umbilical cord (George and Landry 2012, pp.62–63). Harvesting adult stem cells does not necessarily result in the destruction of a living organism.

³ Human-to-human transplantation of tissue (for example, of a heart, liver, or kidney) is called “allografting.” Animal-to-human transplantation of tissue is called “xenografting” or “xenotransplantation” (Huther 2009, pp. 8–9).

is that transfer of behavioral characteristics from one species of animal to another is possible (Huther 2009, p. 10). The second was caused by Stuart Newman, a developmental biologist, who, in 1997, sought rights to patent the technology by which a “humanzee”—a part-human, part-chimpanzee chimera—is produced. His aim was not to use the technology but to restrict the use of the technology until public consensus has been reached on the desirability of such products. He was unsuccessful (Baylis and Robert 2006, p. 3).⁴

Cybrids

Cybrids are typically produced in one of two ways: taking an egg from an animal, removing its nucleus—which leaves only the cytoplasm or ooplasm of the egg—and fusing it with the nucleus taken from a human cell, or fusing the resultant embryo with an enucleated egg cell from another organism (or species). The resulting entity is called a “nucleo-cytoplasmic hybrid” or “cybrid,” for short (Huther 2009, p. 32). In other words, the result is an embryo with human nuclear DNA and animal mitochondrial DNA. These cybrid embryos are said to be 99.9% human (Knowles 2003, p. 1), even when, in 2003, a Chinese scientist extracted stem cells from cybrids produced by the mixing of rabbit eggs and human sperm (Huther 2009, p. 33; Knowles 2003, p. 2).⁵

It is worth noting that the technology (known as SNCT—somatic nuclear transfer) that is used to produce a cybrid is the same technology that was used to produce Dolly, the first cloned sheep. In the case of cloning, both the nucleus of a bodily (somatic) cell and an enucleated egg are extracted from the same entity.

Hybrids

A hybrid is generally the product of either natural or artificial breeding. As such, hybrids result from the combining of gametes (sperm and egg cells) of two related or unrelated animals. This means that a hybrid contains combined genetic material throughout its genome and throughout all the tissues in its body. A mule, for example, is the product of a horse and donkey; a liger is the product of a male lion and female tiger; and a tigron is a male tiger crossed with a female lion.

However, the literature reflects the understanding that human-animal hybridization is a commonplace phenomenon today. For example, for more than 30 years now, fertility specialists have been fertilizing hamster ova (eggs) with human sperm to test human male fertility: “The resulting human-hamster hybrid embryo does not proceed beyond the two cell stage” (Huther 2009, p. 31).⁶ In the 1920s, Russian biologist Ilya Ivanov, tried with great effort and support of his government, to fertilize female chimps with human sperm in Africa. Back in Russia, Ivanov inseminated a woman with orangutan sperm. Both projects were a failure. Huther offers two possible explanations for Ivanov’s failures: inseminations were conducted under adverse circumstances, and no more than three artificial attempts were undertaken (Huther 2009, p. 29). The implication is, of course, that with today’s technology the result might be different. The question is, however, should such attempts even occur? Those who support the scientific research involving human-animal mixtures answer in the affirmative, and often point toward the reasons (that is, the potential benefits) of the research. And it is precisely here where the problems are identified by those who object to certain forms of the research.

Reasons for and the Core Problems with Human-Animal Mixtures

There are mainly three reasons why chimeras, cybrids and human-animal hybrids are produced by scientists (Huther 2009, pp. 4–6; Knowles 2003, pp. 2–3). First, mixes (DNA, cells, organs, and organisms) provide tools for studying cell development; the genetic basis and development of certain diseases (for example, cancer, Alzheimer’s, and Parkinson’s), and what drugs or therapies might effectively combat those diseases. Second, the fact that chimeras or cybrids have human DNA means that research data should be more predictive and closer related than data in pure animal models. And third, the mixing of materials provide a way of conducting experiments that either cannot be performed ethically or legally on human research subjects or in which it is not practical to use humans. What, then, could possibly be the problem with the research?

To produce their research subjects (cf. fn. 1),

⁴ The reader is referred to Newman (2006) for a brief explanation of his actions and some very interesting insights shared by Newman on the subject of human-animal mixes.

⁵ According to a publication of Human Genetics Alert (n.d), a secular organization that updates British citizens on developments in the field of biotechnology, “it is completely scientifically untrue.” Until the so-called blastocyst stage (5–6 days after conception), the stage at which stem cells are harvested from the cybrid, no one is able to claim that the human DNA determines the embryo composition and “species” identity. Until the blastocyst stage, the vast majority of the material of the embryo will be of animal origin (i.e., the cytoplasm in the egg which is a large store of protein and other molecules that enable early development). The human genes are only gradually turned on and some human proteins made.

⁶ Knowles (2003, p. 2) refers to the resulting entity as a chimera. It is not entirely clear why the result should not be construed as the onset of a human-animal hybrid, since a failure of the human sperm to fertilize the hamster egg serves as an indication that the sperm donor might be infertile.

researchers use precursor or stem cells. A “precursor cell” is a generic term for both stem cells and progenitor cells, and are used in cases where it is not clear whether either of the cells have stem cell or progenitor cell properties. In technical terms, whereas progenitor cells are “multipotent” (they develop into only some kinds of cells), stem cells are “pluripotent” (they develop into all kinds of cells—Huther 2009, p.12, fn.39). Now if stem cell harvesting results in the death of the human embryo, and a human being comes into existence at fertilization, then it entails the killing of an innocent human person.⁷

The research therefore raises questions about the life and moral status of the embryo as well as the uniqueness of human beings. We shall see that they are topics about which evolutionists have much to say. What seems to be overlooked is that the conceptual logic of evolutionists sets a limit to the range and type of arguments that can be fitted into their worldview.

The Conceptual Logic of Evolutionists

The standpoints of evolutionists in the controversy are pretty clear. Baylis and Robert spoke for them when they wrote that the

idea of fixed or rigid breaks between species plays no role whatsoever in contemporary biology. Indeed, the fluidity of species boundaries has been revealed through the techniques of comparative genomics, warning against the interpretation of species as unique types.... When we refer to species and the crossing of species boundaries, we do so based on the following simple idea: Every individual human contains a human genome. In all likelihood, this genome will not be representative of other human genomes and will contain a lot of DNA that is contained in many other kinds of organisms, thanks to our evolution from a common ancestor. (Baylis and Robert 2006, pp. 1, 2)

It is therefore not strange that followers of Darwin see in the artificial production of chimeras, cybrids, and human-animal hybrids the eroding of whatever distinctions people might still think to draw between humans and animals (Ballantyne 2004; Sherringham 2008). But what is strange is that they would have others believe that science has validated their belief that there are no fixed differences or rigid breaks between humans and animals.⁸ The truth of the matter is just the opposite; their worldview validates their scientific goals and the interpretation of scientific experiments. It therefore explains why

this issue is not even discussed in the debate about human-animal mixtures; it is simply assumed to be the case that science has spoken and nothing further is to be said about it. An exception is evolutionary biologist at Saint Louis University, Richard Mayden. He writes that

Theories and concepts are fundamental links...and are employed by everyone, not just scientists, to aid in our understanding and interpretation of the world around us. They derive from our metaphysical world view, provide a framework influencing our observations and the kinds of observations made, and serve as fundamental bridges between observations to interpretations and conclusions. Today, most scientists work within the metaphysical paradigm of descent with modification. (Mayden 2002, pp. 175–176)

Mayden says it is impossible to interpret scientific data apart from one’s worldview, and anyone who thinks that scientific research can be conducted from a neutral point is simply mistaken. It follows that science itself is not the problem in conflicting views about the life and moral status of the human embryo and the uniqueness of human beings. It is a problem of metaphysics, or, in different words, a clash of worldviews.

It is accordingly important to see that the worldview of evolutionists necessarily constrains the range and type of arguments they could accept and defend in the debate in question. To begin with, it is consistent for an evolutionist to argue that the crossing of the boundary between human and animal “cannot be immoral” because crossing the species lines happens in nature all the time (for example, the mule; see Huther 2009, p. 70; Streiffer 2010, p. 5). Furthermore, it is consistent with the assumption of molecule-to-animal-to-human evolution; it disallows evolutionists to argue that fixed differences or breaks between animal and human exist. The problem is that what is consistent is not necessarily true. Why should people think that a horse and donkey are representatives of two different species and not members of the same kind of animal?

The fact of the matter is that these questions cannot be answered from the perspective of evolutionary biology. The first difficulty is that there is no single concept of what a species is among evolutionists; there are at least 22 (Baylis and Robert 2006, p. 1).⁹ Gerhard Ernst registers the difficulty of evolutionists when he says, “whoever is in need of a species concept that fits his field of study can simply define one”

⁷ For a discussion of this topic and related issues, see Condic (2008), Feinberg and Feinberg (1993, pp. 47–72, 207–298); Grisanti (2000); Harrub and Thompson (2004).

⁸ I am indebted to one of the anonymous reviewers for having drawn my attention to this important point.

⁹ Jody Hey traces the confusion and the failure of “modern species concepts” to Ernst Mayr, and acknowledges that “the 19th and early 20th century use of ‘concept’ had little of the modern profusion” (Hey 2006, p. 447). In other words, it is an indirect reference to a problem that started with Darwin’s *Origin of Species* and which evolutionists have, to date, not been able to solve.

(Ernst 2007, p.16). Unfortunately, we are not told whether all the conceptions of what a species is can be equally true; does the multiplicity of species concepts violate the laws of logic—the law of identity (P is identical to P), non-contradiction (P cannot both be true and false at the same time in the same sense) and excluded middle (P must be either true or false)? So the first constraint of evolutionists is that it would be inconsistent for them to accept that humans have not evolved from some hypothetical hominid or ape-like creature over billions or thousands of years. For this reason humans cannot be unique.

The second constraint makes it difficult, if not impossible, for the evolutionist to provide a coherent account of what it is that makes something what it is. Whatever it is, it cannot be a nature or essence, for such a thing remains the same through change over time, and consistent evolutionists know that all too well: it “is at odds with evolutionary biology” (Robert and Baylis 2003, p.5; cf. Ernst 2007, p.20; Huther 2009, p.134). Put simply, it is because the

outstanding characteristic of an essence [nature] is its unchanging permanence....If species had such an essence, gradual evolution would be impossible. (Mayr 1987, p.156)

Hence, there is no such thing as human nature (Hull 1978, p.358; cf. Hull 1989, pp.74–75).

The difficulty of evolutionists can be stated differently: an unchanging nature of a living being is at odds with evolutionary biology simply because the worldview of the evolutionary biologist is inadequate to explain both its origin and ontology. The evolutionist must therefore deny the reality of unchanging natures because it would falsify his worldview and science (evolutionary biology).

Consequently, the evolutionist is unable to tell where animal nature ends and human nature begins in the evolutionary process. If he does, then that would be wholly arbitrary. Evolutionists are therefore quick to point out that chimpanzees share more than 98% of their genes with humans.¹⁰ Robert and Baylis state the point as follows:

Although human beings might share 99.9% commonality at the genetic level, there is nothing as yet identifiable as absolutely common to all human beings....we differ genomically from chimps by no more than 1.2–1.6% (Robert and Baylis 2003, p.4).

In other words, the data serve the evolutionists well: it serves a serious blow to the idea of human

uniqueness and a natural boundary between human and animal.

As has already been noted, at the root of the conceptual logic of evolutionists is the notion of molecule-to-animal-to-human evolution: “from nothing to something, from inorganic to organic, from animals to humans” (Berry 2007, p.3). This notion presents at least three problems for evolutionists. The first is metaphysical: we need an explanation for how something can come from nothing. If it is a reasonable principle that a first member in a series of members can only pass on to others what it has to pass on, then evolutionists owe us an explanation of how life can come from non-life, how something can change into something totally different from itself, and how a moral sense can be produced by something that lacks this sense—without being illogical.

The second problem is scientific:

Put simply, no one has ever observed the interconnecting continuum of foundational forms linking all known and present species of life. The concept of the continuity of nature has existed in the mind of man, never in the facts of nature. (Denton 1985, p.353)

The third problem is theological: the idea of the “continuity of nature,” to borrow Denton’s words, has also never existed in the mind of the Creator, which means that the idea is without any biblical basis, as we shall shortly see.

To summarize: if all living things stemmed from a common ancestor, then all living things are interconnected in some way; where animal ends and human begins in the evolutionary process is arbitrary. All living things have changed, but evolutionists cannot explain what accounts for sameness of identity through change across time; they cannot accept an intrinsic universal (character) shared by entities of the same kind for it would falsify their worldview and science. Neither can they explain how something can come from nothing (for example, life and the moral sense of human beings) or how something can change into something totally different from itself.

The question is therefore whether the morality of crossing the human-animal boundary can be settled in secular terms. The arguments of those who object to crossing the boundary and the problems they create for those who reject them make it reasonable to conclude that it cannot. To show this, I shall mainly focus on an article of Streiffer’s (2010).¹¹

¹⁰ This is a reductionist strategy. It reduces the question of what something is to biology (that is, genes). However, the research of creationist Jeffrey Tomkins (2011) has shown a different picture to what is generally assumed about chimp and human genes.

¹¹ It is the opinion of this writer that the article provides the best summary of the moral and ethical arguments scattered in the literature on the subject. For a detailed treatment of the subject, the reader is referred to the Ph.D. thesis of Huther (2009). For a list of some of the most important papers produced over the period 2002 to 2007, see Baylis and Robert (2007, p.43). For a treatment of the concept of natural kinds, see Bird and Tobin (2008), Crane (2004), Dupré (2004) and Ernst (2007). For discussions about the legal implication of crossing the human-animal boundary, see Bennett (2006) and Sherringham (2008). Of all the papers surveyed, only Mayden (2002, pp.171–196) discussed the influence of a scientist’s worldview on the interpretation of scientific data. All the authors are evolutionists.

Arguments to Restrict Research Involving Human-Animal Mixtures

The unnaturalness argument

The form of the argument goes something like this: there is a natural boundary between species (human and animal); crossing the boundary is unnatural, therefore, violating the boundary is wrong. Streiffer informs his readers that this argument is the one that is most often rejected (Streiffer 2010, p. 4). Responses to the argument reflect four main problems that make it unconvincing to evolutionists.

The first of the problems, I will refer to as the “species problem.” Crane stated the problem as follows: the

species problem is central to the ontological status of species. A species concept answers the species problem by providing criteria for conspecificity [that is, parts of the same whole, or members of the same class]. (Crane 2003, p. 166)

The problem is straightforward: the many species concepts of evolutionists cannot adequately answer the question of what a species is and the argument must therefore be rejected.

The second and related problem, I will refer to as the “boundary problem.” Again, the problem is straightforward: it is a problem to think there is a boundary between human and animal (Streiffer 2010, p. 5), therefore, the idea of fixed boundaries becomes morally irrelevant.

The third problem refers to what I will call the “wrongfulness problem.” The question is: why should people think there is a link between unnaturalness and wrongfulness? If crossing the boundary is sufficient for unnaturalness and if unnaturalness is sufficient for wrongfulness then the production of mules and other animal hybrids would be wrong too (Streiffer 2010, p. 5). Streiffer says that supporters of the unnaturalness argument can advance their argument in one of two ways, or both. One can say that the act of producing mixtures is intrinsically wrong or, alternatively, say it is wrong because of its consequences. However, the fact of the matter is that not everything that is unnatural is unethical; unnaturalness is also not necessarily connected with bad consequences, and even where it is, it can be justified on other grounds (Streiffer 2010, p. 6).

Alternatively, the person who wishes to advance the unnaturalness argument could say that crossing the human-animal boundary is an offence against God, the Creator (Streiffer 2010, p. 7). This argument, however, faces at least three obstacles. On the one hand, many people (and most biologists)¹² do not believe in God. Therefore, such people will not be committed to thinking all unnatural acts are wrong. On the other hand, it is unclear why the production of human-animal mixtures could not be construed as a manifestation of our God-like nature. The third obstacle is that what is defined as wrong varies from context to context.

The fourth problem with the unnaturalness argument relates to what is generally referred to in the literature as the “yuck factor,” which I will refer to as the “moral emotion problem.”¹³ Those who advance this argument believe that human beings have an intuitive grasp of phenomena such as cannibalism, incest, and bestiality, and accordingly express their knowing of the wrongfulness thereof with an emotion of repugnance, revulsion, or disgust. Why is it a problem to the evolutionist? Such experiences are not sufficient for knowing an act is wrong (Streiffer 2010, p. 8); it needs rational justification. After all, there was a time when people thought that interracial marriages were wrong. So how could the crossing of the human-animal boundary in acts such as human-animal mixes be wrong? “It is hard to even begin to make the case, at least in secular terms,” says Streiffer (2010, p. 9).

The moral confusion argument

Simply stated, the argument from moral confusion holds that a crossing of the human-animal boundary could lead to moral confusion in the public sphere (Streiffer 2010, p. 10). There are at least four problems with the argument from a secular perspective. The first, as already has been noted above, is the “species problem.” In a word, the many species concepts make it difficult to draw a well-defined boundary between human and animal, and there is therefore nothing unique about being human. The second is because hybrids such as a mule and geep do not cause moral confusion. Thus, people have no reason to think it would be the case with human-animal mixtures. The

¹² About this Streiffer is correct. Jerry Bergman’s (2010) review of the views of most of the leading scientists reveals that evolution demands atheism.

¹³ The reader should note that emotions such as shame, guilt, remorse, regret, indignation, revulsion, and disgust are referred to in the literature on emotions as moral emotions (cf. Furrow 2005; Hauskeller 2006; Tangney, Stuewig, and Mashek 2007; Tangney, Stuewig, and Hafez 2011). It deserves mention that God also expresses His moral character, holiness, and aversion to wickedness in emotional terms, which indicates how He feels about it—in no uncertain terms. It appears most vividly in Leviticus 18. Right after God’s stated prohibition against two persons of the same sex having sexual relations (v. 22) and people engaging in sexual deeds with animals (v. 23), God refers to and personalized the land Canaan and stated that it “vomits out” (v. 25) its inhabitants because of their wickedness. The crucial point is that God’s disgust as expressed through the rhetorical personification of nature served as a warning to Israel that the same thing would happen to them should they decide to follow the evil practices that defile “the nations” (v. 24). One New Testament equivalent to God’s prohibitions is found in the injunction to “Abhor [hate] what is evil” (Romans 12:9; cf. vv. 1–2). Another is: “Be holy, for I am holy” (1 Peter 1:16; cf. Leviticus 19:2).

difficulty with clarifying such mixtures is therefore only a hypothetical problem (Streiffer 2010, p. 11) and surely unfounded.

The third problem is that those who believe that a human conceptus (zygote, embryo) has no moral status prior to the onset of consciousness will not be committed to the idea that the embryo has full moral status (Streiffer 2010, p. 12). And finally, it is unclear why being a human being is sufficient for full moral status; many people do not believe that a human embryo is a human person from the moment of conception.

The borderline personhood argument

The borderline argument is advanced by those who believe that the great apes (chimpanzees, bonobos, gorillas, and orangutans) are “borderline persons,” and should therefore not be used as research subjects (Streiffer 2010, p. 13; cf. DeGrazia 2007). The argument is that human newborns who are considered human beings are not yet persons. The argument follows from two premises: a human being becomes a human being and personhood is defined in terms of a list of manifest characteristics. Thus, since a human being becomes a person and characteristics are exemplified in degrees, it follows that moral status is also a matter of degree.

It is further argued that certain human beings exhibit fewer features of personality than the great apes, for example, a newborn, toddlers, the severely retarded patient, and anencephalic newborns (they are children born with no brain and usually die within seven to ten days). Therefore, the great apes are analogous to a child, and are not to be used in research (Streiffer 2010, p. 15), and it would be inconsistent for an evolutionist to reason otherwise. Human beings are members of the order “Primates, the group that contains all the monkey and ape species” (Dunbar, Barrett, and Lycett 2007, pp. 1, 30–31).

The human dignity argument

In order for the argument to work, Streiffer contends that it needs to provide an account of what dignity is, what kinds of individuals have human dignity, what implications human dignity has, and what constraints those moral implications place on human-animal research. The argument from human dignity states that a human being is a being with incomparable value and worth and is therefore uniquely valuable and worthy of our respect (Streiffer 2010, p. 17). The immediate question is: in what exactly is this dignity grounded? The most natural answer would be one constructed with elements present in the other arguments, especially the third argument, namely, the possession of characteristics and capacities (cf. also Ravelingien, Braeckman, and

Legge 2006). Or one could argue that interference with a human being’s growth and development is morally objectionable. Unfortunately, these approaches are unable to persuade those who favor human-animal mixtures.

To argue, for example, as Karpowicz, Cohen, and van der Kooy do, namely that human dignity is degraded or demeaned when “deliberately and wrongfully diminished or eliminated” (Karpowicz, Cohen, and van der Kooy 2005, pp. 120–121), raise at least two problems. On the one hand, there is the empirical problem, which could be referred to as the “knowledge or epistemological problem.” From observation people know that there are certain people who have certain capacities and others who don’t. Thus, if dignity is a matter of manifest capacities, then “non-human animals” with the same or greater degree of dignity-grounding capacities than human newborns should have human dignity. It would be inconsistent to say that newborns and the mentally retarded person have the same degree of dignity as a human adult. On the other hand, it is simply false to think that a medical procedure diminishes or eliminates dignity-conferring capacities. Whenever people provide for the biological needs of a great ape while failing to train them to speak, they deprive them from the opportunity to enhance themselves. If this is what Karpowicz, Cohen, and van der Kooy’s argument implies, says Streiffer, then dignity seems to be irrelevant to the argument (Streiffer 2010, p. 20). The purpose of research that involves human-animal mixtures is to confer physical capacities on subjects sufficient for the possession of certain capacities.

The moral status argument

Although the argument from moral status applies more to the moral permissibility of using animals for research, it nonetheless has implications for the moral status of human beings. Firstly, to argue that human beings have a greater moral status than animals purely because they are members of *Homo sapiens* cannot hold. The argument suffers from an explanatory gap: “it is hard to see how being a member of a certain species could give an individual its moral status” (Streiffer 2010, p. 26). Secondly, if a human-centered view of moral status is correct then the moral status of human beings “would clearly condemn such research” (Streiffer 2010, p. 26). Unfortunately, it cannot, argues the evolutionist: personhood—that is the possession and manifestation of personal characteristics—is a degreed phenomenon. Therefore, moral status is a matter of degree.

It should be evident that the arguments surveyed are in conflict with a secular perspective. It presents at least one lesson for those involved in the debate: evolutionists who advance one or more of these

arguments cannot justify them on the basis of evolutionism. The answer is straightforward: it is self-refuting. A Christian critique of some of the issues will therefore be in order.

Response

The objections to the arguments to restrict research involving human-animal mixtures reflect some things true and some false. Some are simply comparing apples with oranges. For example, it is true that interracial marriages were once thought to be wrong, but this is an inadequate analogue to the mixing of human-animal materials. Interracial marriages occur between two entities of the same kind: mankind. A perhaps more appropriate analogue of mixing human and animal gametes is bestiality. In this case the unity and the nature of the relationship is unnatural. However, a relationship can also be unnatural even if it occurs between entities of the same kind, for example, incest. Thus, the fact that it was once believed that interracial marriages were wrong shows precisely what is the issue here: a false belief, which can be and has been corrected.

It is also true that many people do not believe in God. But this is an unreasonable objection to the unnaturalness argument. It is merely a statement of fact. Many unbelievers believe that theft, rape, incest, and breaking one's word are wrong and bad. However, if the implicit message is that unbelief in God should settle questions about what ought to be morally permissible then people are in trouble. In a democracy people vote and the majority rule, but even if it is legislated that people may exercise the right to torture babies for fun or fondle little children for self-gratification, it would still be wrong. It is wrong not only because it is harmful, it is also a perversion of what is right and good. It has at least one implication for people who are convinced that it is wrong: the duty to make rigorous arguments to convince minds that it is wrong, and expressing those arguments in a way that moves hearts.

It is also true that what is wrong varies from context to context, but it is not at all clear that this is a valid objection to the unnaturalness argument. If cultural relativism is in mind, then we can make at least two observations. First, although cultural relativism holds that right or wrong varies from culture to culture, it is questionable whether this is a moral thesis. It rather seems to be a factual statement about morality. When due consideration is given to factual clarification many apparent moral differences turn out to be merely factual, not moral; for instance, no culture has valued killing at random and cowardice in battle. Second, if the objection implies that moral propositions are not simply true or false, that truth values of moral principles themselves are

relative to the beliefs of a given society (context), then it becomes difficult to define what a society is or to specify in a given case what the relevant society is. It is because people are often simultaneously a member of several different societies that may hold different moral values. Which context is the relevant one? In any event, it would be inconsistent for a Christian to be a Christian in context A and not in context B.

It is true that most animal mixtures to date resulted in individuals that people can easily classify as animals. But this argument distracts attention from the crucial point: human beings are now used and destroyed in the process of producing human-animal mixtures. Furthermore, to draw up a list of characteristics to indicate the presence of personhood is ill-conceived, for several reasons. First, the person drawing up the list can make anyone to fit or not to fit the list (for example, newborns, the mentally retarded person, or comatose patient). Second, what something is does not come in degreed form. It is not like someone walking into a room with a first step, followed by another step until the person finally enters the room. It is an all or nothing affair. When, for example, James (a human person) comes to exist, there must be at least one property that belongs to him, and that is he must be human.

Some of James's properties may indeed be exemplified by him to various degrees, such as his non-essential properties, precisely because they are characteristics, features, qualities, or attributes of him as an individual. Wisdom, rationality, insight, and the ability to reason are examples; they characterize their objects—the particular thing that has them as their owner—in one way or another. And because they are non-essential, their owners are what they are independent of whatever non-essential characteristics they possess. A white painted pipe does not need to be white in order to be a pipe. So if the pipe loses its colour it would lose a non-essential property but still remain the same pipe and continue to exist as one. In contrast, essential properties constitute the essential nature of a thing. If we then describe an object's essential properties, we will be able to say what kind of thing it is.

Thus, although not all persons are human beings (for example, divine and angelic persons), there is no such thing as a human non-person. By analogy, there can be colors that are not red, but no red things that are not colored things. Moreover, to think that a human being becomes a person is to confuse change with alteration. Anything that changes must exist first, and must exist at the beginning, during the process of change, and at the end of the change. Gaining or losing properties is a matter of the coming and going of properties, thus of alteration (a leaf or chameleon changing from green to brown are examples), and

not a matter of change in kind (nature) or existence. This entails that living existing things can only grow and develop according to what they already are. A zygote does not become more of its kind or change into something different from the kind the zygote already belongs to. The zygote matures as a member of its kind because of its human nature, which guides that maturity. Likewise, kittens are immature cats, not potential cats, and the same truth applies to human fetuses. They are immature persons and not potential persons.

Everything that has been said so far is consistent with how creationists think about species.¹⁴ Briefly, biblical (young-earth) creationists believe that the whole world has been affected by the Curse following the rebellion of Adam (cf. Romans 5:12, 14; 8:19–22). They therefore do not believe that God made the plants and animals just as people see them today. For instance, when God created a dog, he did not create a scottish-terrier. Creationists also believe that natural selection is a process that can change the DNA of populations (Patterson 2011, p. 11; Purdom 2008). In other words, it is a mistake to think that the Bible teaches the notion of the “fixity of species.” However, in contrast with evolutionists, creationists believe that natural selection and mutations can never lead to new kinds of creatures (plants, animals, or humans), but only varieties within the same kind (Spetner 1998). Put another way, to creationists, “all species alive in the past and today would have had to be produced in fewer than 6,000 years from the original created kinds” (Purdom 2008, p.9). The “created kinds” refer to individuals which could breed with one another. Thus, the boundary for a kind is implied by reproduction. But the mere fact that two species will not hybridize would not necessarily indicate that they are not originally from the same kind. Don Batten explains:

In the case of three species, A, B, and C, if A and B can each hybridize with C, then it suggests that all three are of the same created kind—whether or not A and B can hybridize with each other. Breeding barriers can arise through such things as mutations. For example, two forms of ferment flies (*Drosophila*) produced offspring that could not breed with the parent species. That is, they were a new biological “species.” This was due to a slight chromosomal rearrangement, not any new genetic information. (Batten 2000, p.2)

Those who reject the idea that human beings have an intuitive grasp of phenomena such as cannibalism, incest, and bestiality, and accordingly express their knowing of the wrongfulness thereof with repugnance, revulsion, or disgust, and that such emotions need

rational justification seem to think that emotions are irrational. The light which Scripture brings to bear on the emotions, however, shows precisely the opposite. First, Scripture reveals that God has created human beings in His image, and part of that image is the moral law of God engraved in every human heart. The Apostle Paul explained it as follows:

for when Gentiles, who do not have the [written] law [of God], by nature do the things in the law, these, although not having the law, are a law to themselves, who show the work of the law written in their hearts, their conscience also bearing witness, and between themselves *their* thoughts accusing or else excusing *them*. (Romans 2:14–15)

It is inescapable, humans have an innate moral sense; “by nature” they are doing things which they are aware of as right or wrong. Further, we have reason to think that people who do not show moral emotions are people who do not understand the nature of evil, and therefore, are unable to experience, for example, remorse or shame. The Creator, through the mouth of the prophet Jeremiah, expressed these truths as follows:

I listened and heard, *but* they do not speak aright. No man repented of his wickedness, saying “What have I done?” . . . Were they ashamed when they had committed abominations? No! They were not at all ashamed; nor did they know how to blush. Therefore they shall fall among those who fall . . . says the Lord. (Jeremiah 8:6, 12)

It is important to know to whom Scripture is referring here, as well as what was the cause of their malady. The immediate context in which the quoted texts appear indicates that they were people to whom the word of the Lord has become an object of reproach or scorn (cf. Jeremiah 6:10 and 8:10). It is also not difficult to see that God expected an emotional (moral) response from them, which suggests that remorse and shame are crucial for understanding what morality requires. Shame, in the text quoted, is a function of attentiveness to oneself and wrongful actions. It thus implies that emotions are basic forms of perception with a rational nature; they are not fleeting subjective entities that pass through consciousness with no necessary connections with anything outside a person. In other words, they provide people with knowledge, which can be referred to as acquaintance (that is, through emotions people become aware of things).

Although emotions, just as sense perception, can be accurate or inaccurate, they can and do serve as rational grounds for certain beliefs (for example, my indignation at injustice serves as a rational ground for the belief that justice is an intrinsically good thing; a

¹⁴ For a brief account of the origin of the term “species,” and how the definitions of the concept have changed since the 1800s, see Hodge (2009). Hodge (2010) also provides an uncomplicated biblically based taxonomy (classification of the biblical created kinds). For an impressive attempt to bring greater clarity to our understanding of the created kinds, see Jean Lightner (2012).

women's post-abortion remorse serves as a rational ground for her belief that she has killed an innocent person, therefore, that human life is valuable). Just as a heightened state of fear helps a person to pick out dangers in the environment, a heightened state of revulsion engages people's capacity to notice morally relevant properties that are otherwise inaccessible.

Thus, to recognize a moral wrong is one thing and quite another to be outraged or do something about it. To simply notice moral wrongness without experiencing moral indignation (an emotion) is a failure of understanding the moral importance of an act. Likewise, to note that an action is one of extraordinary charity but fails to admire it is to miss something about it. In short, there is no reason to think that the moral emotion of disgust associated with the mixing of human-animal materials cannot be rational justification for believing that it is wrong and needs to be attended to and corrected.

The aforesaid raises the question about the place of moral obligation and conscience in a person's life. It suffices to make three points. Firstly, obligations (or duties) make moral demands on people (cf. the Good Samaritan in Luke 10:29–37, and that of the Apostle Paul in Romans 1:14); they are very difficult to escape. Once a person accepts an obligation, it is his whether he wants it or not. For example, parents have to take care of their child, even if they do not want the child (cf. the obligations of a teacher in 1 Timothy 4:6–16 and 2 Timothy 2:15). In other words, and secondly, an obligation binds the will; it restricts what a person morally can and cannot do regardless of his desires. This could be referred to as the inescapability of conscience, which implies that obligations are among the strongest reasons people have for doing or not doing something. And thirdly, obligations have a relation to authority, for if something is to bind someone's will, there must be some authority behind it (cf. 2 Corinthians 10:5). For Christians, their ultimate authority is the will of the Creator as recorded in Scripture (cf. Acts 5:29; 2 Timothy 3:16–17). Put otherwise, Christians do not choose that God be authoritative; He is authoritative.

By way of summary, the emotions in moral judgment provide powerful reasons to choose a certain course of action. It is also reasonable to think that it

is only after people know what something is that they can adequately conclude how it ought to be treated. It follows that human activity can only fall into one of two categories: right or wrong, and good or bad. I shall now turn to a survey of crucially important ontological (real) distinctions in the opening chapters of Genesis.

Ontological Distinction in Genesis 1–3

There are a number of real distinctions¹⁵ in Genesis 1–3, but the survey will be limited to the four main ones: God/creation, animal/human, male/female gender, and good/evil. Each of the distinctions is not only morally and spiritually significant but also entails definite restrictions on human activity.

Creator/creation

The first real distinction is between the Creator and “His handiwork” (Psalm 19:1; cf. Ephesians 2:10): “In the beginning God created the heavens and the earth” (Genesis 1:1). Creator and creation are really different and therefore not to be confused with one another. Although creation manifests the attributes of God, it is only the Creator that is worthy of people's worship (Romans 1:18–32).

Animal/human

God created the plants, the creatures living in water, birds, cattle, creeping things, the beasts of the earth, and the first humans to yield seed and fruit (Genesis 1:11–12), and multiply “according to its kind” (Genesis 1:20–30; 5:1–3). The created kinds can be referred to as natural kinds, for they were endowed with the natural ability to reproduce. Scripture declares, “Then God saw everything that He had made, and indeed *it was* very good” (Genesis 1:31).

There are two similarities and at least four differences between animals and humans. The animals and Adam were created from the ground (Genesis 2:19 and 2:7), and the animals and Adam are described as “living creatures” (Genesis 1:20 and Genesis 2:7), because they had their “breath of life” in them (“breath” from *nephesh*, meaning “life” or “living soul”; cf. Genesis 1:30; 7:22–23). So neither the material out of which they were formed nor the fact that they were called living beings constitutes

¹⁵ An ontological distinction is a real distinction that involves two or more entities: if A and B exist, then A is not identical to B. Some non-identical entities can exist separately from one another (for example, a table and a chair, a man and a woman), others cannot. (God can exist separately from the world, but not the world from God). In a word, a real distinction is rooted in how the world is. A real distinction is often confused with a distinction of reason which comes in two forms. The first form is merely a distinction in thought, and has no foundation in reality. It happens when we say, for example, that “Peter is Peter.” The second form of the distinction in reason occurs when a person draws a distinction between A and B that is either right or wrong. To confuse God with the world or a human being with an animal is a conceptual error or misunderstanding. The crucial point about such confusions or errors of the mind is this: if A and B differs by a distinction of reason, and the distinction is not a real distinction, then A is identical to B. A real distinction is also different from a third distinction which is rooted in nature, prior to the activity of the mind. We call this a “modal distinction.” When a modal distinction exists between A and B, and where B is a mode of A, then A and B are not identical to each other. Put simply, B depends on A, is separable from A, and genuinely distinct from that of which it is a mode. If A is a natural kind of thing with an intrinsic nature, and B is a property like a thought, wisdom or a colour, then A can exist without B but not vice versa (adapted from Moreland 2001, pp. 22, 57–58).

the essential factors which distinguish man from animals. Here are some of the main differences.

1. God created the animals by way of His word: “And God said, . . .” (Genesis 1:20, 24; Genesis 1:26–27 in reference to humans), and, in contrast, “the LORD God formed man” directly, immediately, separately from the animals, and “breathed into his nostrils the breath of life” (Genesis 2:7). In Genesis 2:7 a potter’s term, *yatzar*, meaning “to form” or “fashion,” is used for the creation of man (Brown, Driver, and Briggs 1972, pp.427–428) and in Genesis 2:22 an artistic and architectural term, *banah*, meaning “to build,” is used for the creation of woman (Brown, Driver, and Briggs 1972, pp.124–125). The use of *yatzar* and *banah* thus emphasize the creative and multifaceted work of the Creator. It is evident that the molecule-to-animal-to-man assumption underlying evolution is squarely at odds with Scripture.
2. The flesh of the living creatures are different; there is one kind for humans, another for beasts, another for birds, and another for fish (1 Corinthians 15:39).
3. The spirit of animals and humans has a different destiny when death occurs; the spirit of man goes to the One who gave it to man, and those of animals goes “down to the earth” (Ecclesiastes 3:21, 12:7). An animal can never pray: “Lord Jesus, receive my spirit” (Acts 7:59).
4. Man alone was created “in the image of God” (Genesis 1:26–27). This fact widens the boundary between human and animal even further: (a) the image of God ascribes to man an exceptional position (Genesis 1:26; Psalm 8:5, 6); (b) it is to man alone that God communicated His purposes and commands, and it is from man alone that God expects obedience (Genesis 2:15–17); (c) the nature (or character) of man is only known in relation to God, which implies that the nature of man as an “image” is only truly discerned by knowing the Original (that is, the Creator; cf. Romans 8:29; Ephesians 4:24; Colossians 3:10). It does not apply to animals; (d) the image of God encompasses both sexes, male and female (Genesis 1:27); and (e) it is characteristic of all human beings—believer and unbeliever—which confers on man intrinsic value or worth (cf. James 3:9). Degrading it, for example, by cursing one’s fellow man, is an offense to God. Likewise, to kill an innocent human being is to strike at a being created in the image of God (Genesis 9:6).

It is reasonable to conclude that human dignity derives its importance from the creation order and the image of God in man. Now, if the nature or

character of man is understood as a condition, which presupposes the existence of certain faculties or capacities, then many things fall into place that are otherwise obscured. In simple terms, the image means both the imitation and mirroring of God—spiritually, intellectually, and morally. Christians therefore accept their Creator as a paradigm case of what a person is, and accept God as ontologically, epistemologically, and morally analogous with themselves.

Male/female

The third real difference is the distinction between male and female, which the Creator declared “very good” (Genesis 1:31; cf. Genesis 1:27).¹⁶ There are at least four pieces of evidence in support of this truth. The first followed directly after the Creator said that it is “not good that man should be alone” (Genesis 2:18). The fact that God requested Adam to name the animals (Genesis 2:19) suggests that God wanted Adam to understand that no suitable companion for him is to be looked for among the animals (Genesis 2:20). The second and third indications are found in Genesis 2:23 and Genesis 3:20; Adam recognized and acknowledged his companion’s origin (from himself), thus their metaphysical sameness (kind), and called her “Woman” because “she was taken out of Man” and “she was the mother of all living”—which he took as the basis for her name. The fourth indication of the male/female distinction is expressed in unity. Genesis 2:24 states that a man shall “be joined to his wife, and they shall become one flesh,” which was confirmed by both Jesus and the Apostles (cf. Matthew 19:4–5; Mark 10:6–7; 1 Corinthians 6:16; Ephesians 5:31–33).

Good/evil

The distinction between good and evil is a boundary set by God. Genesis 3:1–19 describes the devastating and catastrophic results when man decides to ignore the commands of God. From Genesis 2:16–17 and Genesis 3:11, 17 it appears that Adam was given the power of choice and the right to eat from all the trees in the garden, except one: the tree of knowledge of good and evil. Thus, Adam was free to choose, but he was not free to decide for himself what is good and evil. For that knowledge he had to rely on his Creator.

To summarize: Genesis 1–3 explains why and in what way human beings are unique. Beings are either animals or human beings; there is no such thing as a human-animal, therefore, human nature stops with humans. If God’s created order was declared very good, and if that order entails keeping distinct the categories of creation, correct definition, and discrimination, then the following warning should be taken seriously:

¹⁶ Humans are the only life forms that are not said to be created according to their kinds. This indicates that they are unique, with both male and female created in the image of God. I am indebted to an anonymous reader for pointing this out to me.

Woe to those who call evil good, and good evil; who put darkness for light, and light for darkness; who put bitter for sweet, and sweet for bitter! (Isaiah 5:20)

Boundaries are set for a purpose; they limit what people can and cannot do or allow.

Concluding Remarks

So far, arguments to restrict research involving the boundary between human and animal, the life and moral status of a human embryo, and the uniqueness of being human have been unconvincing, because they are at odds with the worldview of evolutionists and evolutionary biology. To draw analogues with Nazi Germany and the desire of Nazis to improve the human race is unnecessary. But one thing seems pretty clear, and that is that we are confronted with is nothing less than a project to redefine “human being”—a slippery slope which may end in a situation where anything in biotechnology goes. In 1990, the United Kingdom prohibited the production of hybrids and cloning by law; in 2001, cloning embryos were allowed; and seven years later, in 2008, the Human Embryology and Fertilization Act legalized the mixing of human and animal gametes and requires that the “admixture” be destroyed within 14 days after fertilization. What would be the next logical step? Could it be legislation that allows scientists and biotechnologists to bring human-animal “admixture” to maturity?

If it is argued that people have a duty to improve the human condition through biotechnology, then they also have the duty to assess the technology as good or bad, and to look for alternatives. A good beginning, at the very least, is to prohibit the deliberate production of human embryos for experimental purposes. An embryo is always an embryo of something, and it only matures according to what it already is: a member of its own kind. Scripture shows that living beings are either human or animal, and human nature stops with human beings. The controversy, in other words, involves issues that cannot be settled in secular terms. Where man is coming from, what he is, and how he ought to be treated, can only be adequately answered by his Maker.

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References

Ballantyne, A. 2004. Humans and hybrids: A critique of the western moral framework. *Essays in Philosophy* 5 no.2, Article 3.
 Batten, D. 2000. Ligers and wholphins? What next? *Creation* 22, no.3:28–33. Retrieved from <http://www.creation.com/ligers-and-wholphins-what-next> on January 13, 2013 .

Baylis, F. and J.S. Robert. 2007. Part-human chimeras: Worrying the facts, probing the ethics. *The American Journal of Bioethics* 7, no.5:41–58.
 Bennett, D.S. 2006. Chimera and the continuum of humanity: Erasing the line of constitutional personhood. *Emory Law Journal* 55:347–387.
 Bergman, J. 2010. Why orthodox Darwinism demands atheism. *Answers Research Journal* 3:147–152. Retrieved from <http://www.answersingenesis.org/articles/arj/v3/n1/orthodox-darwinism-atheism>.
 Berry, R.J. 2007. Creation and evolution. Not creation or evolution. *Faraday Paper* No. 12. Retrieved from http://www.faraday.st-edmunds.cam.ac.uk/resources/FaradayPapers/FaradayPaper12Berry_EN.pdf on March 11, 2011.
 Bird, A. and E. Tobin. 2008. Natural kinds. *Stanford encyclopedia of philosophy*. Retrieved from <http://plato.stanford.edu/entries/natural-kinds/> on October 27, 2012.
 Brown, F., S.R. Driver, and C.A. Briggs. 1972. *A Hebrew and English lexicon of the Old Testament*. Oxford, United Kingdom: Clarendon Press.
 Condic, M.L. 2008. When does human life begin? A scientific perspective. *Westchester Institute White Paper* 1:1–18.
 Crane, J.K. 2004. On the metaphysics of species. *Philosophy of Science Association* 71, no.2:156–173.
 Denton, M. 1986. *Evolution: A theory in crisis. New developments in science are challenging orthodox Darwinism*. Chevy Chase, Maryland: Adler & Adler Publishers.
 DeGrazia, D. 2007. Human-animal chimeras: Human dignity, moral status, and species prejudice. *Metaphilosophy* 38, no.2–3:309–329.
 Dunbar, R., L. Barrett, and J. Lycett. 2007. *Evolutionary psychology. A beginner's guide. Human behaviour, evolution and the mind*. Oxford, United Kingdom: One World.
 Dupré, J. 2004. Human kinds and biological kinds: Some similarities and differences. *Philosophy of Science* 71: 892–900.
 Ernst, G. 2007. “Human” as a natural kind—a solution to the problem of marginal cases? *Hauptseminar: Naturgesetz und Natürliche Arten*.
 Feinberg, J.S. and P.D. Feinberg. 1993. *Ethics for a brave new world*. Wheaton, Illinois: Crossway Books.
 Furrow, D. 2005. *Ethics: Key concepts in philosophy*. New York, New York: Continuum.
 George, R.P. and D.W. Landry. 2012. The stem cell debates: Lessons for science and politics. *The New Atlantis* 34: 9–60. Retrieved from <http://www.thenewatlantis.com/publications/the-stem-cell-debates-lessons-for-science-and-politics> on October 4, 2012 .
 Grisanti, M.A. 2000. The abortion dilemma. *The Master's Seminary Journal* 11, no.2:169–190.
 Harrub, B. and B. Thompson 2004. *Matters of life and death*. Montgomery, Alabama: Apologetics Press.
 Hauskeller, M. 2006. Moral disgust. *Ethical Perspectives: Journal of the European Ethics Network* 13, no.4:571–602.
 Hey, J. 2006. On the failure of modern species concepts. *Trends in Ecology and Evolution* 21, no.8:447–450.
 Hodge, B. 2009. Fixity of species. A lesson in changing definitions. Retrieved on March 5, 2011 from <http://www.answersingenesis.org/>.
 Hodge, B. 2010. Feedback: A biblically based taxonomy.

- Retrieved from <http://www.answersingenesis.org/> on January 24, 2013.
- Hull, D.L. 1978. A matter of individuality. *Philosophy of Science* 45, no. 3:335–360.
- Hull, D.L. 1989. *The metaphysics of evolution*. Albany, New York: State University of New York Press.
- Human Genetics Alert (n.d.). Human Fertilization and Embryology Act 2008. Parliamentary briefing 2: Human-animal hybrid embryos. Retrieved from www.hgalert.org on December 16, 2012.
- Huther, C. 2009. *Chimeras: The ethics of creating human-animal interspecifics*. PhD diss., Ludwig-Maximilians-University of Munich. Retrieved from http://edoc.ub.uni-muenchen.de/10022/1/Huther_Constanze.pdf on November 10, 2012.
- Karpowicz, P., C.B. Cohen, and D. van der Kooy. 2005. Developing human-nonhuman chimeras in human stem cell research: Ethical issues and boundaries. *Kennedy Institute of Ethics Journal* 15, no. 2:107–134.
- Knowles, L.P. 2003. Ethics of research using hybrids, chimeras and cytoplasmic hybrids. Retrieved from <http://www.stemcellschool.org/pdf/Ethics-of%20Research-Using-Hybrids.pdf> on November 10, 2012.
- Lamb, A. 2007. Sheep and goats? Since when? Retrieved from <http://www.creation.com/sheep-and-goats-since-when> on January 13, 2013.
- Lightner, J.K. 2007. Separating the sheep from the goats. *Creation* 29, no. 3:43–45. Retrieved from <http://www.creation.com/separating-the-sheep-from-the-goats> on January 13, 2013.
- Lightner, J.K. 2012. Mammalian ark kinds. *Answers Research Journal* 5:151–204. Retrieved from <http://www.answersingenesis.org/articles/arj/v5/n1/mammalian-ark-kinds>.
- Martin, D. and S. Caldwell. 2011. 150 human animal hybrids grown in UK labs: Embryos have been produced secretly for the past three years. *UK Daily Mail*, July 22, 2011. Retrieved from <http://www.dailymail.co.uk/sciencetech/article-2017818/Embryos-involving-genes-animal...> on December 12, 2012.
- Mayden, R.L. 2002. On biological species, species concepts and individuation in the natural world. *Fish and Fisheries* 3, no. 3:171–196.
- Mayr, E. 1987. The ontological status of species: Scientific progress and philosophical terminology. *Biology and Philosophy* 2, no. 2:145–166. Retrieved from <http://mechanism.ucsd.edu/teaching/philbio/readings/mayr.ontologicalstatusofspcies.1987.pdf> on March 8, 2011.
- Moreland, J.P. 2001. *Universals*. London, United Kingdom: McGill-Queen's University Press.
- Newman, S.A. 2006. My attempt to patent a human-animal chimera. *L'Observatoire de la génétique* 27. http://www.nymc.edu/sanewman/PDFs/L'Observatoire%20Genetique_chimera.pdf.
- Patterson, R. 2011. *Evolution exposed*, chapter 8. Retrieved from <http://www.answersingenesis.org/articles/ee/origin-of-invertebrates> on April 28, 2011.
- Purdum, G. 2008. Is natural selection the same thing as evolution? In *The New Answers Book*, chapter 22, ed. K. Ham. Green Forest, Arkansas: Master Books. Retrieved from <http://www.answersingenesis.org/articles/nab/is-natural-selection-evolution> on January 24, 2013.
- Ravelingien, A., J. Braeckman, and M. Legge. 2006. On the moral status of humanized chimeras and the concept of human dignity. *Between the Species* VI:1–22. Retrieved from <http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1037&context=bts> on December 16, 2012.
- Robert, J.S. and F. Baylis. 2003. Crossing species boundaries. *The American Journal of Bioethics* 3, no. 3:1–13.
- Robert, J.S. 2006. The science and ethics of making part-human animals in stem cell biology. *The FASEB Journal* 20:838–845.
- Sherringham, T. 2008. Mice, men, and monsters: Opposition to chimera research and the scope of federal regulation. *California Law Review* 96, no. 3:765–800.
- Spetner, L. 1998. *Not by chance! Shattering the modern theory of evolution*. New York, New York: The Judaica Press.
- Streiffer, R. 2010. Human/non-human chimeras. *Stanford encyclopedia of philosophy*. Retrieved from <http://plato.stanford.edu/entries/chimeras/> on October 27, 2012.
- Tangney, J.P., J. Stuewig, and D.J. Mashek. 2007. Moral emotions and moral behaviour. *Annual Review of Psychology* 58:345–372.
- Tangney, J.P., J. Stuewig, and L. Hafez. 2011. Shame, guilt and remorse: Implications for offender populations. *Journal of Forensic Psychiatry and Psychology* 22, no. 5:706–723.
- Tomkins, J.P. 2011. Genome-wide DNA alignment similarity (identity) for 40,000 chimpanzee DNA sequences queried against the human genome is 86–89%. *Answers Research Journal* 4:233–241. Retrieved from <http://www.answersingenesis.org/articles/arj/v4/n1/blastin>.

