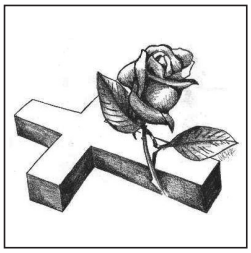
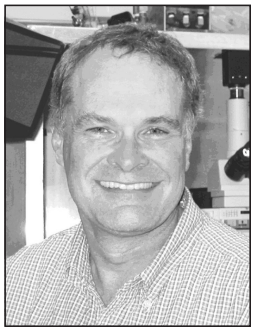


Evolving Concepts of Nature and Human Genetic Engineering

J. Bruce McCallum

The US Supreme Court once asked Christian denominations when human life begins so they could accord the rights and protections due persons under the constitution. In retrospect, the Christian tradition could not answer the question because traditional views of human origins took shape long before the details of procreation were known. The discovery of the human genome requires a new concept of nature that gives intrinsic value to human life without reducing personal dignity to chromosomes. The present ecological crisis offers science and theology a new appreciation of nature. Instead of a value-free sphere, nature is now valued as that which sustains life. Holmes Rolston typifies a theological response to the ecological crisis with his notion of "cruciform nature," as the experience of life persisting in the midst of perpetual perishing. The purpose of this paper is to apply his concept of cruciform nature to bioethical issues.



Bruce McCallum

If twentieth-century scientists worked under the threat of a nuclear holocaust, twenty-first-century scientists must cope with ecological disaster. One hundred thirty-seven species disappear daily, while the boreal forest canopy and permafrost tundra in Canada are threatened by global warming.[1] These threats have disclosed the moral dimensions of science as a human activity. Nowhere is the ecological threat more imminent and less appreciated than in the area of human genetic engineering.

Research on the genetic makeup of human beings coupled with biomedical techniques such as cloning and regenerative medicine using human embryonic stem cells have blurred the boundaries between human and nonhuman nature and promise to radically alter human existence. Meanwhile, ethical reflection lags behind scientific progress in biomedical engineering due to lingering cultural disagreements over the meaning of human dignity and the status of human embryonic life. However, James Watson clearly grasped the moral significance of his discovery of the genetic code. He warned:

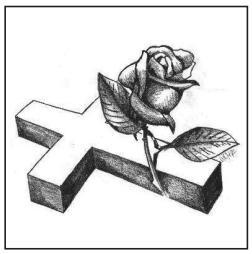
> [Cloning] is a matter far too important to be left solely in the hands of the scientific and medical communities …
>
> [I]f we do not think about it now, the possibility of our having a free choice will one day suddenly be gone.[2]

With the sequencing of the human genome, the time for assessing the moral value of our genetic environment draws nearer.

As is often the case with environmental ethics where utilitarian benefit must be balanced against ecological cost, so also in genetic engineering, potential gain to personal well-being must be balanced against potential loss of human genetic diversity. Ethical reflection, including religious ethics, will mislead if nature is relegated to the realm of a value-free resource as it was in the past.[3] On the other hand, cultural and moral values transcend natural values insofar as human beings have loosened the bonds to their genetic niche.[4] Ethics, especially biomedical ethics, must therefore embrace both human and nonhuman nature without collapsing them.

Ethics, especially biomedical ethics, must … embrace both human and nonhuman nature without collapsing them.

Bruce McCallum *is research scientist in the Department of Anesthesiology at the Medical College of Wisconsin in Milwaukee, WI. He received his Ph.D. in systematic theology from Marquette University. He participates in NIH-funded pain research at the biophysical level with publications in peer reviewed, professional journals. He also proctors in the Biomedical Ethics course for second-year medical students. An ASA member, Bruce lives with his wife Joan in New Berlin, Wisconsin, where he enjoys gardening and bicycling. He can be reached at mccallum@mcw.edu.*



Article

Evolving Concepts of Nature and Human Genetic Engineering

Augustine transferred natural theology into the realms of civic and mythic theology, as his philosophical contemporaries would have understood it, or he relocated nature into Christian theology.

This paper elucidates a concept of nature within the Christian tradition which extends the idea of redemptive suffering beyond the realm of human life to include nonhuman nature. Regeneration in the midst of perpetual perishing accords better with the redemptive suffering of Christ than a notion of nature as static blueprint or impersonal mechanism. An extension of redemptive suffering into the realm of nature suggests that nature is worthy of ethical reflection irrespective of the way it is used. Although this view of nature arises from Christian revelation, it is compatible with scientific findings of purpose in the emergence of increasing biological complexity, diversity, and convergence through evolution.[5] This paper will explore an ethic of natural value through the thought of Holmes Rolston, accredited as the father of environmental ethics, and will apply his view to the troubled issue of genetically-modified human nature.[6]

Theological Background

One of the ironies of the twentieth century is that a new concept of nature came through the rejection of natural theology by Karl Barth (1886–1968). As I have argued elsewhere,[7] polemics against natural theology or natural religion, which appeared regularly in the history of modern theology before the notable debate on this subject with Emil Brunner (1889–1966) in 1934, actually represents a re-absorption of the natural into theology. Indeed, regular revisions and retractions in the area of natural theology make it look like a rear guard effort to keep up with the latest understanding of what it means to live in the natural world.

The dilemma of natural theology, however, has much deeper roots. It arises from the juxtaposition of the truth of a particular event in the life of Jesus Christ with a universal claim to truth. All other claims to universal truth are to be judged against the central claim that "God was in Christ reconciling the world to himself" (2 Cor. 5:19). Central to this claim is an unrepeatable, absolute fact with universal benefit. This is why Brunner made the somewhat unexpected claim that the topic of their debate was the Reformational doctrine of *sola gratia*—justification by faith alone through grace alone.[8] The dilemma is far more serious than Gotthold Lessing (1729–1781) imagined when he made the derogatory remark about the contingency of Christian revelation: "Accidental truths of history can never become the proof of necessary truths of reason."[9]

The Christian assertion of an unrepeatable, absolute fact produces a dilemma, which is the origin of natural theology. On the one hand, natural theology must show the distinction between the truth of Christianity and all other truths, as well as demonstrate the impossibility of unbelief. On the other hand, natural theology has the positive task of providing the necessary conditions for the possibility that truth comes to be at a point of time in the life of one person. To solve this dilemma, natural theology sets forth the distinction between nature and grace as well as the relationship between faith and reason. The success of natural theology is measured by the extent to which it is incorporated into the substance of Christian faith.

The word "nature" in natural theology is an ambiguous term. Hints of this ambiguity are apparent even in the writings of Paul. He borrowed the term from the realm of apologetics to show that Gentiles obey laws "by nature" (Rom. 2:14) and, while equally critical of this tradition, applied the same term to Jewish Christians who had been sinners "by nature" (Eph. 2:3).[10] The ambiguity surrounding the use of "nature" in natural theology arises from the dilemma of divine revelation in Christ and leads to a complex history.

Augustine, who introduced the term "natural theology,"[11] represents the metaphysical tradition of natural theology whereby philosophical arguments for the existence of God were used to show that Christian truth could be reconciled with a universal understanding of truth. Augustine had to revise pagan Greek arguments for Christian use. The "natural theology" of ancient philosophy was theistic in a loose, abstract sense inasmuch as it turned away from religious myth and civil religion to find transcendent ideas governing the relationship between thought and being exemplified in the reliability of geometric axioms.[12] Augustine, with his commitment to a historic religion and sacred texts, introduced Christ as the mediator of knowledge about the final end of human existence,[13] thereby making natu-

ral theology explicitly theistic. For example, after appealing to the metaphysical arguments for the existence God, Augustine asked "whether sacred rites are to be performed to one God, or to many, for the sake of the happiness which is to be after death."[14] Augustine transferred natural theology into the realms of civic and mythic theology, as his philosophical contemporaries would have understood it, or he relocated nature into Christian theology.

Augustine's synthesis produced an inner tension insofar as it was unclear what, other than sin, distinguished nature from grace. The inner tension between nature and grace was gradually hardened into a distinction between nature and supernature, exemplified by the Dogmatic Constitution of Vatican I as "a twofold order of knowledge, distinct not only in origin but also in object."[15] However, the distinction between nature and supernature was fatal. Insofar as Christian truth presupposes and perfects the knowledge of God acquired through nature, revelation through Christ became less certain, and nature was deprived of grace. John Locke typifies the difficulty of distinguishing between faith and unbelief when supernature somehow completes the deliverance of reason through nature. He states:

> *Reason* … I take to be the discovery of the certainty or probability of such propositions or truths, which the mind arrives at by deduction made from such ideas, which it has got by the use of its natural faculties; viz. by sensation or reflection. *Faith* … is the assent to any proposition, not thus made out by the deductions of reason, but upon the credit of the proposer, as coming from God, in some extraordinary way of communication.[16]

Certainty, according to Locke, comes through reason and nature, while faith is relegated to the realm of opinion backed by the power of tradition. It is not difficult to imagine that reason, once freed from the constraints of authority through the natural sciences, politics, and economics, found faith to be at best a subjective commodity.

Barth's challenge to natural theology must be understood against this background. An often-overlooked passage in his response to Brunner indicates that Barth's reason for rejecting natural theology was the inherent assumption that divine grace applied to moral justification alone. Barth explained:

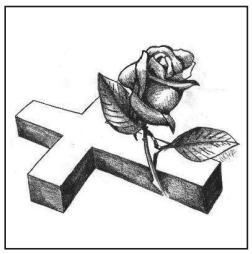
> "[T]he practical non-existence of St. Thomas in the sixteenth century has had even graver consequences in that the reformers could not clearly perceive the range of the decisive connection which exists in the Roman Catholic system between the problem of justification and the problem of the knowledge of God [in nature], between reconciliation and revelation." The extrinsic connection between natural proofs for the existence of God and supernatural revelation of divine grace gave rise to "the possibility of an intellectual work-righteousness in the basis of theological thought," which the Reformers did not perceive as clearly as "the possibility of a moral work- righteousness in the basis of Christian life."[17]

As this paragraph indicates, Barth's denial of natural theology was not a restriction of grace to Christian revelation as much as it was an expansion of grace from the realm of human moral salvation to include humankind's understanding of God through nature.

Barth re-absorbed nature by equating grace and revelation in such a way that all revelation must be explained in terms of divine grace, including nature and nature's laws.

Barth re-absorbed nature by equating grace and revelation in such a way that all revelation must be explained in terms of divine grace, including nature and nature's laws. Bruce McCormick has shown how Barth came to reject natural theology long before his debate with Brunner by working through the pattern, enshrined in scholastic Reformed federal theology, of a covenant of works followed by a covenant of grace after the Fall. Barth criticized this pattern because it made grace an external relationship between God and the creature and introduced the doctrine of works back into the Reformed tradition.[18] For Barth, grace is an intra-Trinitarian event whereby God the Father graciously turns toward the Son, Jesus Christ, in self-revelation. Barth therefore abandoned the scheme of supra-, infra- or postlapsarian grace in favor of an analogical view of nature and grace, which he subsequently called the analogy of faith. The correctness of Barth's interpretation of the Reformers is not the point of this paper.[19] So far as the order of nature and grace is concerned, for Barth, grace no longer presupposes and completes nature; instead, nature presupposes grace. Furthermore, the pattern of the history of salvation from Creation, through the Fall, to Redemption is changed to Creation, Redemption, Reconciliation.

In *John Calvin Versus the Westminster Confession*, Holmes Rolston takes aim at the same separation in Calvinism between a covenant of works and a covenant of grace. Rolston is concerned not only with the history of salvation, but even more with the law that "is written immutably and non-negotiably into creation."[20] Rolston knows that the language of covenants in the *Westminster Confession*



Rolston's concept of nature is firmly rooted in Darwinian biology guided by divine transcendence. He proposes a loose correlation between nature and grace in which nature is "struggling through to something higher."

is archaic, but in this case, the product outlasted the label. In the notion that autonomous humans are responsible to the law of nature, and grace is called in to assist them in its fulfillment, the substance of federal theology lives on. This residue is resistant to historical criticism of the literal interpretation of Genesis and therefore more dangerous because it leads to a legalistic interpretation of nature. Rolston's reforming temperament comes through in his early theological work, but it remains central to his subsequent philosophical work on the concept of nature.

Cruciform Creation

Although nature has different meanings in science and religion, for the Christian tradition, it remains an ambiguous but useful term. The root of this ambiguity lies not in nature but in Christian revelation given through a unique event in the life and death of Jesus Christ. If Christians start from the assumption that the Cross discloses the purpose and meaning of nature, they must show how Christianity is consistent with the truth in nature and yet unique and different. While Augustine and Barth examine nature in their own ways, Rolston engages nature more specifically as a cruciform prelude to the passion of Christ. He finds more in nature than the fact that all humans are sinners; he also claims that all humans and nature itself are objects of grace without compromising the freedom of divine grace. Unlike Barth who took an agnostic position with respect to Darwinian natural selection, considering it irrelevant to his theological program,[21] Rolston's concept of nature is firmly rooted in Darwinian biology guided by divine transcendence. He proposes a loose correlation between nature and grace in which nature is "struggling through to something higher."[22]

Rolston explores controversial aspects of biological evolution in order to propose a concept of bioscience compatible with Christian faith. In Rolston's view, the most controversial elements of evolution are the emergence of complexity and diversity over time. These two aspects of natural history exhibit an unavoidable tendency toward biological progress. The modestly incomplete account of natural history given by biologists provides no explanation for progress in evolution.[23] Even if life on earth evolved, nothing in inorganic chemistry makes biological life either necessary or predictable. Growth in complexity and diversity, therefore, raises a new metaphysical question. Whereas physics prompts the question, "How does something come from nothing?" biology elicits the question, "How does more come from less?" Rolston answers this question by emphasizing the most important characteristic of biological life: the ability of living organisms to learn, reproduce, and defend a way of life through genetic duplication.[24]

The genetic code bears a remarkable resemblance to communication in that information contained in the code defines a normative set of conditions for survival in a specific environmental niche. Rolston equates genetic information with natural value. He avoids the naturalistic fallacy of reading value into a natural state of affairs by arguing that natural value can be good *for* a plant even if no conscious subject is there *to* whom natural value is important.[25] Natural value is also creative. Genes search out new solutions in a prescribed way, resembling the cybernetic power of computers, and new solutions build "axiological" resources for future generations.[26] However, natural value is acquired at a fearful cost. The same Darwinian science that discovered intrinsic value in the genome also bequeathed an almost tragic sense of tinkering and waste in nature. Indeed, evolution guided by chance survival was the hardest element to accept in the mechanistic and optimistic system of natural theology before Darwin.[27] Yet suffering is not the end of the story. Out of trial and error comes growth in complexity and diversity. Growth against a background of suffering is the image nature holds forth for contemplation, and Rolston identifies the value in nature as "struggling through to something higher."[28] Whether this view of nature obscures or enhances grace is another question.

Rolston's argument for natural value is best judged by how well it integrates into the substance of Christian faith without collapsing nature and grace. God in Rolston's natural theology is neither an intelligent designer nor a part of the process. While Rolston holds biology distinct from matter-energy and culture distinct from biology,[29] he does not invoke a Creator God as the intelligence active in the gaps. Instead, he

calls upon biology in support of an inherent creativity, which evokes a sense of caring concern for survival. The biological root of concern for survival is transformed into religious truth with the insight that human consciousness transcends natural environment. Rolston draws from the vocabulary of Process Theology to argue for divinely enhanced "possibility spaces" as an explanation for the appearance of human consciousness out of biological information.[30] But he retains a distinction between human consciousness and genetic information embedded in DNA.

Rolston affirms "transcientific theism" where the freedom and love of God are hidden within the interplay of chance and necessity in nature.[31] The inner logic of this interplay is suffering. Only with the appearance of natural value in biology is suffering possible. Rocks do not suffer, but organisms do. With suffering, causality is transformed into meaning because suffering is both the cause of evolution and its outcome. "Bio-logic" has a narrative structure where nature becomes the history of individuals surviving by incorporation into larger wholes, where life is regenerated out of death. However, "bio-logic" is incapable of interpreting the meaning of suffering. The moral redemption of human beings through Christ's sacrifice on the Cross brings to light the hidden meaning of regeneration in nature. The suffering required to achieve adaptive fit is "a botanical analogy to the passion of Jesus."[32] The passion of Christ, says Rolston, "[is] … survival of the fittest at an emergent level."[33] The connection between nature and grace is a loose integration necessary to explain the intrinsic value of the genome but insufficient to explain the sanctity of human life.

Ethical Implications

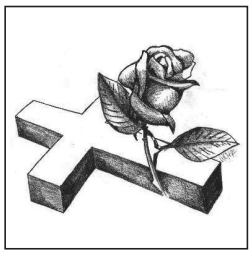
Rolston's concept of natural value has important ethical implications for assisted reproductive technologies, genetic engineering, and restorative medicine, but he has not specified them. Any responsibility for the conclusions drawn in this paper will therefore be indirect. What is clear from the above is that the integrity of the human genome must be preserved as the bearer of natural value, but the increase in value for human persons takes precedence as the bearer of moral value. However, human well-being is not limited to the survival of autonomous human persons so much as it is rooted in the natural inducement to struggle through to something higher. It can be surmised that destructive human embryonic stem cell research should be regulated so as to preserve the integrity of the human genome and the survival value of human sexual reproduction, while all cloning or genetic engineering should be prohibited unless it can be demonstrated that increased value is equally distributed.

Some clarity about terms is helpful. Assisted reproductive technologies consist primarily of *in vitro* fertilization (IVF) and genetic counseling. IVF typically requires the injection of fertility drugs followed by the *inter utero* harvesting of 12–20 female oocytes. The eggs are then fertilized to become embryos with a protective trophoblast layer that sustains freezing. Up to four embryos are implanted in the donor at one time to increase chances of pregnancy. Genetic counseling often accompanies the selection of embryos for implantation. Human embryonic stem cells (hESC) are derived from human embryos at the fourth day after fertilization. Derivation destroys a human embryo and gives rise to an amorphous colony of cells that reproduce continuously through asymmetric cell division.[34] Cloning tech-nology must accompany hESC therapies to overcome compatibility conflicts between the histology of cultured and host cells.[35]

An ethic of natural value would encourage us to preserve the integrity of the human genome and the survival value of sexual reproduction from the environmentally destructive practices of genetic engineering because the human genome is a good-of-its-kind with intrinsic value.

Somatic Cell Nuclear Transfer (SCNT) or therapeutic cloning involves enucleation of a female ovum and injection of DNA from a mature cell, followed by electrofusion to promote cell division. Therapeutic cloning enables the generation of new embryos from which stem cells that are compatible to the individual can be derived. Reproductive cloning uses the same techniques to produce an embryo for implantation and eventual offspring with identical genetic makeup as the donor. For the purposes of this paper, a human embryo is an organism that possesses all the genetic and epigenetic information for self-directed growth and maturation through the stages of human development.[36] Human embryos are not analogous to any other somatic cells inasmuch as these cells do not have the genetic information required to mature through all the stages of human development without being transfected into a female gamete.[37]

An ethic of natural value would encourage us to preserve the integrity of the human genome and the survival value of sexual reproduction from the environmentally destructive practices of genetic engineering because the



An ethic of natural value is not absolute. Human values trump natural values under circumstances where natural value is unsustainable. Surplus embryos destined for destruction from IVF clinics can be used for hESC research. Destructive use of surplus embryos is the cost of suffering through to something higher.

human genome is a good-of-its-kind with intrinsic value. Examples of environmentally destructive practices include human/animal chimeras and human cloning. Chimeras refer to the experimental technique of injecting human stem cells into animals to determine how they differentiate into specialized tissues.[38] The practice takes its name from Greek mythical creatures with bodies from different species. Although genetic differences between species are minimal and have evolved over time, an ethic of natural value would provide grounds for species integrity.[39] Since genomes are selected to produce an organism that is an adapted fit in a niche in an ecosystem, intrinsic value is located in a species. Chimeras destroy intrinsic value to the extent that these new species are destined for destruction.

Another practice that violates natural value is human cloning. Destructive human and animal cloning confers identical genetic information from one individual to another. While this practice benefits individuals, it destroys species. Species survive and adapt to ever changing environmental circumstances by diversifying the gene pool. Analogues to destructive cloning exist naturally in the form of identical twins or inbred strains, but they are either rare or prone to extinction. Destructive cloning defaces natural value insofar as it places benefits to individuals above the species, and insofar as the benefits of cloning cannot be equally distributed among the genome. Destructive cloning is different from restorative medicine in that it produces duplicate organs or organisms for the benefit of individuals, whereas restorative medicine identifies genes or gene products that benefit entire species. Widespread use of destructive cloning would reduce biodiversity among species and potentially lead to their extinction.

An ethic of natural value is not absolute. Human values trump natural values under circumstances where natural value is unsustainable. Surplus embryos destined for destruction from IVF clinics can be used for hESC research. Destructive use of surplus embryos is the cost of suffering through to something higher. However, human values can be preserved in so far as they are exercised with respect for natural values. The human genome is a good-of-its-kind and should not be used as a means to other ends. Destruction of excess human embryos does not mean complacence about embryonic or intrauterine life. Creation of embryos for destructive research turns human life into a commodity. Indeed, IVF practices should be regulated to limit the number of female eggs and embryos to those necessary for implantation. Research on cryoprotection for female zygotes should be encouraged.

The ethic of natural value gained by struggling through to something higher suggests a further distinction between restoring function and improving the genome. Exploiting mechanisms of repair restores function to an individual organism, while modifying genetic traits incorporates changes that survive in the entire species. Engineered genetic improvements preclude gain through suffering unless it can be shown that particular point mutations will benefit the entire population without risk, and genotypic variants remain the property of all. An example of restoring function is the use of adult stem cells in bone marrow transplants.

Examples of improving the genome are speculative at this point, but they would include therapeutic cloning to prevent genetically inherited diseases such as cystic fibrosis. Functional genomics is barely recognized as a scientific discipline, yet even genetic screening practices have not prevented this maladaptive genetic disease. Cystic fibrosis patients carry one of twenty-five mutations of an amiloride sensitive channel that mediates sodium flux. Although genetic screening for phenotypic carriers is greater than 90% effective, the likelihood that a carrier will give birth to a child with cystic fibrosis is only a 40% risk factor due to pleiotropism and unequal penetration.[40] Given this risk factor, is it not likely that some birth parents will elect to implant?

Does genetic information constitute a preexisting condition? How does gene replacement therapy influence environmental triggers in, for example, genetic predispositions to alcohol sensitivity? Is a genetic counselor liable for undetected genetic abnormalities? These questions emphasize the priority of our genetic ecology and the integrity of human suffering over the utilitarian benefits of genetically engineered "improvements" to human nature.

In sum, human nature is at stake in the debate over genetic engineering. Ethical reflection guided by respect for the regenerative powers of nature may guide us past the cultural impasse left over from the abortion controversy of the last century. Rereading the famous case of Roe v. Wade forty-two years afterward, one is struck by the way the term "person" is used to determine at what point the fetus is accorded full protection under the constitution. Is the term "person" itself not a social construct growing out of the human rights tradition of the West? Indeed, the use of that term in Roe v. Wade is self-referential inasmuch as the word is derived from the constitution without further explanation. The case is then settled by asking when personal life begins and answered with the concept of viability. If personhood is identical to viability, then an aborted fetus is equivalent to disposable human tissue. This result of Roe v. Wade codifies a person/body dualism strangely reminiscent of the mind/body dualism of ancient Greek philosophy and incapable of guiding ethical reflection in the age of the human genome where so many facets of human personality are genetic.

Human nature is at stake in the debate over genetic engineering. Ethical reflection guided by respect for the regenerative powers of nature may guide us past the cultural impasse left over from the abortion controversy of the last century.

One is also struck by the inability of religious communities to answer the court's question of when personal life begins. In retrospect, Christian denominations could not reach agreement on the answer because traditional views of human origins took shape long before the details of procreation were known.

As I hope I have argued, questionable views of nature rather than a consensus on the sanctity of human life have led some Christian denominations to a sterile ethic equating human personality with the human genome.[41]

Acknowledgment

My deep gratitude to Dr. Bradford Hinze, my advisor at Marquette, for reading a revised version of this paper.

Notes

[1]*Scientific American Frontiers Program #1404 (Transcript)*, "Hot Times in Alaska," airdate: June 15, 2004.

[2]James D. Watson, "Moving Toward the Clonal Man," *The Atlantic Monthly* 227 (1971): 53.

[3]G. E. Moore, who dominated ethical thinking in the twentieth century after the publication of his *Principia Ethica* in 1903, criticized natural law ethics as a naturalistic fallacy. "The naturalistic fallacy," wrote Moore, "consists in the contention that good *means* nothing but some simple or complex notion, that can be defined in terms of natural qualities" (Section 44, p. 73). The argument that many find convincing appears in section 11 of *Principia*: "When they say 'Pleasure is good,' we cannot believe that they merely mean 'Pleasure is pleasure' and nothing more than that." Moore came to define the good as a nonnatural, indefinable property of judgments about relationships that pertain to the world.

[4]Debates about the extent to which culture is free from genetic restraints are beyond the scope of this paper. For Christian ethics, the natural bonds of food laws and Promised Land have been shattered as frameworks for natural law ethics. Cf. Mark 7:20; Matt. 8:20; Luke 9:58. The Christian is bound to the body of Christ.

[5]Cf. Simon Conway Morris, *Life's Solution: Inevitable Humans in a Lonely Universe,* rev. ed. (Cambridge: Cambridge University Press, 2004).

[6]A similar shift of emphasis toward a Christological concept of nature is exemplified in "*Lumen Gentium,*" *Documents of Vatican II,* ed. A. P. Flannery (Grand Rapids, MI: Eerdmans, 1975), 350–1. The Papal Letter, *Truth Cannot Contradict Truth,* accepts evolution "as something more than just a hypothesis" (*L'Osservatore Romano*, Oct 30, 1996).

[7]J. Bruce McCallum, "Modernity and the Dilemma of Natural Theology: The Barth-Brunner Debate, 1934" (Ph.D. diss., Marquette University, 1994).

[8]Brunner established the topic of their debate when he wrote:

> We are not concerned with Luther nor with Lutheranism, but with that hard truth and message of Luther's concerning *sola gratia*, which is so greatly opposed to the thought of our time—with Christ crucified as the only salvation of the world and with justification by faith alone.

Emil Brunner, "Nature and Grace: A Contribution to the Discussion with Karl Barth," in *Natural Theology,* trans. Peter Frankel (London: Centenary Press, 1947), 18.

[9]"On the Proof of the Spirit and of Power," *Lessing's Theological Writings: A Library of Modern Religious Thought,* trans. Henry Chadwick (London: Adams & Charles Black, 1956), 53.

[10]*Theological Dictionary of the New Testament*, vol. IX, s.v. "φυσις."

[11]Augustine, *City of God* VI, 5–8, citing Varro, writes:

> They call the *mystical* which the poets chiefly use; *natural*, that which the philosophers use; *civil*, that which the people use.

[12]Plato, *Republic,* 509d–511c adopted the famous analogy of the line from Pythagorean geometry and applied it to the idea of the good.

[13]Augustine, *Confessions* VII, 9. Cf. *City of God* VII, 31, indicates the transition to historical revelation through Christ as mediator of divine knowledge with the famous "nevertheless."

[14]Augustine, *City of God* VIII, 12.

[15]"Faith and Reason," in *Documents of Vatican Council I, 1869–1870,* trans. J. F. Broderick, SJ (Collegeville: Liturgical Press, 1971), 46.

[16]John Locke, *Essay Concerning Human Understanding*, ed. A. C. Fraser (New York: Dover Publications, 1959), 2:416.

[17]Karl Barth, "No! Answer to Emil Bruner," in *Natural Theology: Comprising "Nature and Grace"* by Professor Dr. Emil Brunner and the Reply "No!" by Dr. Karl Barth (London: Centenary Press, 1947), 101–2, passim.

[18]Bruce L. McCormack has documented topic by topic how Barth changed Federal Theology from his earliest work at Göttingen in "A Scholastic of a Higher Order: The Development of Karl Barth's Theology, 1921–1931" (Ph.D. diss., Princeton Theological Seminary, 1989).

[19]Cornelis P. Venema, "Recent Criticisms of the Covenant of Works in the Westminster Confession of Faith," *Mid-America Journal of Theology* 9 (1993): 165–98.
[20]Holmes Rolston III, *John Calvin Versus the Westminster Confession* (Richmond, VA: John Knox Press, 1972), 114–5.
[21]Karl Barth, *Church Dogmatics* III, 2: 79–90.
[22]Holmes Rolston III, "Does Nature Need to be Redeemed?" *Zygon: Journal of Religion and Science* 29 (1994): 217.
[23]Rolston relies on the thought of the late biologist John Maynard Smith for the inadequacy of evolutionary theory. Smith famously said: "There is nothing in neo-Darwinism which enables us to predict a long-term increase in complexity" (as cited in Rolston, *Genes, Genesis and God: Values and Their Origins in Natural and Human History* [Cambridge: Cambridge University Press, 1999], 15).
[24]Rolston, *Genes, Genesis and God,* 1–53.
[25]Holmes Rolston III, "Value in Nature and the Nature of Value," in *Philosophy and the Natural Environment*, Roman Institute of Philosophy Supplement 36 (Cambridge: Cambridge University Press, 1994), 17–8.
[26]Rolston, *Genes, Genesis and God,* 24–37. Indeed, Rolston finds the roots of the ecological crisis in the "anthropocentric fallacy" of finding value only in conscious human beings or sentient animals. Cf. Holmes Rolston III, "Respect for Life: Counting What Singer Finds of No Account," in *Singer and His Critics,* ed. D. Jamieson (Oxford: Blackwell Publishers, 1999), 265–7.
[27]Holmes Rolston III, "Disvalues in Nature," *The Monist* 75 (1992): 250–78.
[28]Rolston, "Does Nature Need to be Redeemed?" 215–8.
[29]Rolston has a running debate with sociobiologists about the relationship of genes and culture. See Holmes Rolston III, "Natural and Unnatural: Wild and Cultural," *Western North American Naturalist* 61 (2001): 267–76 and *Genes, Genesis and God*, 108–59.
[30]Holmes Rolston III, "Evolutionary History and Divine Presence," *Theology Today (Princeton)* 55 (1998): 415–34. Rolston refers here to God as the "Ground of Information" (p. 429).
[31]Holmes Rolston III, *Science and Religion: A Critical Survey* (New York: Random House, 1987), 327.
[32]Holmes Rolston III, "Kenosis and Nature," in *The Work of Love: Creation as Kenosis* (London: SPCK, 2001), 58.
[33]Rolston, *Science and Religion,* 327.
[34]Each stem cell produces both an exact copy of itself and a new type of cell that will differentiate into specific tissue. Cf. H. Lin, "Stem Cells: To Be and Not to Be," *Nature* 425 (2003): 353–5. James Thomson of UW Madison first isolated and cultured stem cells from discarded human embryos in 1998. Cf. J. A. Thomson, J. Itskovitz-Eldor, et al., "Embryonic Stem Cell Lines Derived from Human Blastocysts," *Science* 282 (1998): 1145–7. John Gearhardt of John's Hopkins isolated and cultured stem cells from the gonadal ridge and mesenteries of aborted fetuses. Cf. M. J. Shamblott, J. Axelman, et al., "Derivation of Pluripotent Stem Cells from Cultured Human Primordial Germ Cells," *Proceedings of the National Academy of Science* 95 (1998): 13726–31. Geron Corporation of Menlo Park, CA, supported both labs in exchange for patent rights to any techniques developed by these investigators.
[35]V. Brower, "Human ES Cells: Can You Build a Business around Them?" *Nature Biotechnology* 17 (1999): 139–42.
[36]R. P. George, "The Ethics of Embryonic Stem Cell Research and Human Cloning," At the Podium, Family Research Council (2003) (www.frc.org/get.cfm?i=PD02D5$v=PRINT:) accessed Dec. 7, 2003.
[37]R. Bailey, "Are Stem Cells Babies? Only if Every Other Human Cell Is, Too," *Reasononline* (2001). http://reason.com/rb/rb071101.shtml: accessed Dec. 7, 2003. But some labs are coaxing human cells back to an embryonic state. Cf. Carina Dennis, "Developmental Reprogramming: Take a Cell, Any Cell …" *Nature* 426 (2003): 490–1.
[38]Maryann Mott, "Animal-Human Hybrids Spark Controversy," *National Geographic News* (January 25, 2005), accessed online at news.nationalgeographic.com. Jamie Shreeve, "The Other Stem-Cell Debate," *The New York Times,* April 10, 2005. Accessed at www.nytimes.com/2005/04/10/magazine/10CHIMERA.html.
[39]Holmes Rolston III, "Duties to Endangered Species," *Bioscience* 35, no. 11 (1985): 718–26.
[40]A. M. Hedgecoe, "Expansion and Uncertainty: Cystic Fibrosis, Classification and Genetics," *Sociology of Health & Illness* 25 (2003): 50–70; and E. Lyon and C. Miller, "Current Challenges in Cystic Fibrosis Screening," *Archives of Pathology and Laboratory Medicine* 127 (2003): 1133–9.
[41]Of all the theological arguments in favor of equating personal life with the human genome, perhaps the best is the case of the Incarnation. If the chronology in Luke is to be believed, Mary was no less than one and no more than fourteen days pregnant when Elizabeth recognized her as "the mother of my Lord" (Luke 1:43). Yet, here the argument is most vulnerable because the human contribution of the Virgin Mary was only twenty-three chromosomes and not the full compliment of forty-six. The confusion is exemplified in an otherwise penetrating argument against cloning by Robert W. Evans, Ph.D posted at www.veritasministries.com/positions/human_cloning.html:

> Furthermore, it may well be that the reason that Christ was able to take up residency in one of Mary's fertilized ovum is her fertilized ovum was already image-bearing in and of its own nature.

It is confusing because Joseph obviously did not fertilize "Mary's fertilized ovum" if we believe in the Virgin birth. Of course, Mary's fertilized ovum would not only bear the image of God, it would also be God Incarnate. On the other hand, a fertile ovum is no longer an ovum but rather an embryo. It suggests that the female gamete bears the image of God. The confusion is inevitable if the *humanum* as bearer of the image of God is equated with the human genome.