



*Essays*



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# ***Genetic Engineering, Post-Genomic Ethics, and the Catholic Tradition***

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Three billion DNA bases, thirty thousand genes, three years of labor — though the human genome published earlier this year remains a landmark achievement in the history of science,<sup>1</sup> it is only one of many genomes that have been or are being deciphered. As of this writing, there are sixty-six published complete genomes (including chromosomes) and 364 ongoing sequencing projects encompassing the genomes of a wide range of organisms from simple bacteria to the honey bee, the zebrafish, the potato, the mouse, the dog, and the cow.<sup>2</sup> Even the genome of the kangaroo is a candidate for sequencing! This deluge of data will mean that scientists will soon possess genetic blueprints for numerous species, information that will revo-

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<sup>1</sup>International Human Genome Sequencing Consortium, “Initial sequencing and analysis of the human genome,” *Nature* 409 (2001): 860–921; and J.C. Venter, et al., “The Sequence of the Human Genome,” *Science* 291 (2001): 1304–1351.

<sup>2</sup>For details, see GOLD: Genomes OnLine Database HomePage, last update: June 24, 2001; available at: <http://wit.integratedgenomics.com/GOLD>; accessed on July 28, 2001. For a discussion of comparative genomics, the science of sequencing and comparing different genomes, see Karl A. Thiel, “The ABCs of Comparative Genomics,” *DailyTwist Online Magazine*, May 16, 2001; available at: [www.doubletwist.com/news/columns/article.jhtml?section=weekly01&name=weekly0158](http://www.doubletwist.com/news/columns/article.jhtml?section=weekly01&name=weekly0158); accessed on August 1, 2001.

lutionize biology and focus our understanding on how genomes produce organisms. Medicine too will change with the advent of gene therapy.<sup>3</sup>

As the Congregation for the Doctrine of the Faith (CDF) has made clear, scientific research is not morally neutral,<sup>4</sup> and the publication of these genomes raises numerous ethical questions. In particular, the post-genome age will have to struggle with the ethics of genetic manipulation. When, if ever, is it morally permissible to modify genes in plants, animals, or human beings? This will be the fundamental question for post-genomic ethics because it grapples with the possibility of altering the very nature of nature itself. How can the Catholic tradition contribute to this conversation?

In our postmodern age, there is a growing appreciation for the importance of traditions in rational inquiry. Alasdair MacIntyre has persuasively argued that ethical discourse can only occur within a community and its tradition, which he has defined as a historically extended, socially embedded argument. Furthermore, MacIntyre has proposed a holistic, post-foundational epistemology where intellectual inquiry within a tradition involves both maintaining the integrity of one's own position in the face of external challenges and demonstrating the superior explanatory power of one's own tradition over its rivals.<sup>5</sup> It is a postmodern account of knowing which resonates with the classical premodern conception of Catholic theological inquiry best exemplified in the *sacra doctrina* of St. Thomas Aquinas.<sup>6</sup>

With these epistemological insights in mind, this essay will focus on three tasks. First, it will sketch a portrait of the tradition by exploring the implications on the ethics of genetic engineering through what I shall call the Fundamental Principle of Catholic bioethics especially as recent popes have articulated it. Backed by two thousand years of reflection on creation, the Catholic tradition is especially suited to the task of dealing with questions regarding the manipulation of nature. This being said, however, the sequencing projects also pose challenges to the tradition and this essay will point out potential incoherencies raised by scientific discoveries coming out of the genome age and will outline possible responses. Finally it will argue for the superiority and truth of the Catholic tradition by showing how its understanding of

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<sup>3</sup>For details on the scientific implications of the human genome project, see the preceding essay by William F. Dietrich in this issue of the *National Catholic Bioethics Quarterly*.

<sup>4</sup>Congregation for the Doctrine of the Faith, Introduction, *Donum vitae: Instruction on Respect for Human Life in Its Origin and on the Dignity of Procreation*, in *Origins* 16 (1987): 697–711 (699).

<sup>5</sup>For a discussion on communal knowing and the rationality of traditions see Alasdair MacIntyre, *Whose Justice? Which Rationality?* (Notre Dame, IN: University of Notre Dame Press, 1988), 349–369. For a discussion, and an example, of MacIntyre's method of tradition constituted inquiry, see his *Three Rival Versions of Moral Enquiry* (Notre Dame, IN: University of Notre Dame Press, 1990).

<sup>6</sup>For a comparison of MacIntyre's tradition, constituted inquiry, and Aquinas's *sacra doctrina* see my "Sacra doctrina as Tradition Constituted Inquiry: Premodern Postmodernity in Catholic Theology," forthcoming.

nature as created allows it to solve the problem of contingent future persons, an intractable contradiction which has arisen within the secular, consequentialist tradition which dominates the public square today.

### **The Fundamental Principle**

In the classical tradition which undergirds Catholic moral inquiry, ethical reflection begins with an analysis of ends. In this case, we have to begin by discussing the purpose of scientific research. What is science for? The secular tradition finds a representative answer in the writings of René Descartes, who proclaimed that we obtain scientific knowledge because of its utility. To be precise, Descartes believed that science would allow man to master and control nature and allow him to conserve health which was the principal good and the basis of all other goods in this life.<sup>7</sup> In contrast, the Catholic tradition does not look to utility or the mastery of nature or even the conservation of health as the highest good. Indeed, Pope John Paul II in his encyclical *Evangelium vitae*, specifically condemned the technical and scientific worldview which reduces nature to mere matter and completely dominates it through human manipulation.<sup>8</sup> According to the Pope, this attitude is one of the root causes of the culture of death. The Catholic tradition holds instead that science must first seek to serve the dignity of the human person. Citing *Gaudium et spes*, the Pastoral Constitution of the Church in the Modern World of the Second Vatican Council, the CDF puts it this way:

Science and technology require, for their own intrinsic meaning, an unconditional respect for the fundamental criteria of the moral law: That is to say, they must be at the service of the human person, of his inalienable rights and his true and integral good according to the design and will of God.<sup>9</sup>

This is the Fundamental Principle of Catholic Bioethics. Even the pursuit of knowledge, which is consonant with our natures as rational creatures, must be subservient to the dignity of the human person and a created hierarchy of values.<sup>10</sup> Thus, scientific research, and this includes genetics and genetic engineering, in order to be morally licit, must always be done in the service of the human person.

An important consideration which emerges from the Fundamental Principle's emphasis on the dignity of the human person is that a proper anthropology must

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<sup>7</sup>"This [knowledge of nature] is desirable not only for the invention of innumerable devices which would facilitate our enjoyment of the fruits of the earth and all the goods we find there, but also, and most importantly, for the maintenance of health which is undoubtedly the chief good and the foundation of all the other goods in this life." René Descartes, *Discourse on Method*, in *The Philosophical Writings of Descartes*, vol. 1, trans. by J. Cottingham, R. Stoothoff, and D. Murdoch (Cambridge: Cambridge University Press, 1985), 143.

<sup>8</sup>John Paul II, *Evangelium vitae*, no. 22.

<sup>9</sup>I-6, *Donum vitae*, 699.

<sup>10</sup>This was recognized at the Nuremberg trials and codified in the Nuremberg code. See "The Nuremberg Code (1947)," *British Medical Journal* 313 (1996): 1448.

ground any moral inquiry of genetic engineering. John Paul II has often remarked that many of the ills of contemporary society, especially those involving the abuse of persons, have arisen from a mistaken conception of human nature.<sup>11</sup> In particular, two aspects of the Christian vision of the human person have consequences for our discussion. They are the unique nature of the human being in the order of creation and his ontological status as an embodied soul. Both are essential distinctions.

The Catholic tradition is quite clear that the human being is unique because he is the only creature on earth willed by God for itself.<sup>12</sup> The *imago Dei*, he is “mysteriously different” from other earthly creatures.<sup>13</sup> The most important consequence of this perspective is that there is a categorical difference between human and non-human creatures—the human being is not simply a highly evolved animal! As Pope Pius XII said in 1953 in an address to a symposium of geneticists:

Would that your science, in weighing the means devised to achieve [its] ends could remain always conscious of the fundamental difference that exists between the animal and vegetable world on the one hand, and man on the other! In the first case, the means of bettering the species and race are entirely at the disposal of science. On the other hand, where man is concerned, genetics is always dealing with personal beings, with inviolable rights, with individuals who for their part are bound by unshakable moral laws in using their power to raise up new life.<sup>14</sup>

Animals are not persons; they are at the service of the human person and hence can be the object of experimentation.<sup>15</sup> Consequently, the development of animal models that mimic human disease, a technological innovation which will become even more important in light of the discoveries of the human genome project, is permissible. Already this approach has given scientists much insight into several neurological disorders including Alzheimer’s and Lou Gehrig’s diseases.<sup>16</sup> The sequencing of the genomes of agriculturally important plants and animals also opens up the possibility of genetically modifying these organisms. For example, maize has been genetically modified so that it is resistant to the European corn-borer, a serious

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<sup>11</sup>For instance, in *Centesimus annus*, his social encyclical commemorating the centenary of *Rerum novarum*, the Holy Father wrote that “the fundamental error of socialism is anthropological in nature” (no. 13).

<sup>12</sup>Second Vatican Council, *Gaudium et spes*, no. 24.

<sup>13</sup>John Paul II, *Evangelium vitae*, no. 22.

<sup>14</sup>Pius XII, “Moral Aspects of Genetics: Allocation to the those attending the “Primum Symposium Geneticae Medicae,” September 7, 1953, in *The Human Body: Papal Teachings* (Boston: St. Paul Editions, 1960), 246–260 (260).

<sup>15</sup>John Paul II, “Biological Research and Human Dignity,” *Origins* 12 (1982): 342–343 (342).

<sup>16</sup>For details, see David R. Borchelt, Philip C. Wong, Sangram S. Sisodia, and Donald L. Price, “Transgenic Mouse Models of Alzheimer’s Disease and Amyotrophic Lateral Sclerosis,” *Brain Pathology* 8 (1998): 735–757.

agricultural pest.<sup>17</sup> John Paul II has acknowledged that technological applications of this type have already benefited our society by improving food production.<sup>18</sup> At the same time, however, he has encouraged prudent caution so genetic modification is not used for arbitrary or trivial purposes since plants and animals have to be treated as creatures of God “which are destined to serve man’s good, but not to be abused by him.”<sup>19</sup> Given the number of simpler alternatives available for pet owners, for instance, it is debatable if a plan to produce hypoallergenic pets through genetic engineering is warranted.<sup>20</sup>

The Catholic tradition is also quite clear that the human being is best described as an ensouled body, a substantial composite of matter and form.<sup>21</sup> Thus, as the Holy Father has reminded us, “the human body is not independent of the spirit, just as the spirit is not independent of the body, because of the deep unity and mutual connection that exist between one and the other.”<sup>22</sup> As such, any manipulation of the human body, including those involving genetic alterations, necessarily affect the person. The Pope has put it this way: “Thus in the body and through the body, one touches the person itself, in its concrete reality.”<sup>23</sup> This is important to keep in mind because the most important contribution of the human genome project to medicine is that it makes real the possibility of curing diseases of genetic origin.<sup>24</sup> Therapeutic methods are already being developed that seek to correct genetic defects that are responsible for such diseases as hemophilia, cystic fibrosis, and Duchenne muscular dystrophy.<sup>25</sup> Though these therapies have only been used in the treatment of chil-

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<sup>17</sup>For details, see J.J. Estruch, N.B. Carozzi, N. Desai, N.B. Duck, G.W. Warren, and M.G. Koziel, “Transgenic Plants: An Emerging Approach to Pest Control,” *Nat. Biotechnol.* 15 (1997): 137–141.

<sup>18</sup>John Paul II, “Ethics of Genetic Manipulation,” *Origins* 13 (1983): 385–389, at 388.

<sup>19</sup>John Paul II, “Biological Research,” 342–343.

<sup>20</sup>For details, see the June 27, 2001, news release, “Company to Produce Allergen-Free Cats” available at: <http://www.transgenicpets.com/news.htm>; accessed on July 22, 2001.

<sup>21</sup>In 1312, the Council of Vienne defined, *de fide*, that the soul is the form of the body. See the *Catechism of the Catholic Church*, no. 365. St. Thomas Aquinas using Aristotle’s hylomorphic theory has articulated a philosophically coherent explanation of this anthropological position. For a recent defense of this Thomistic account of human nature in the face of revisionist proposals, see J. P. Moreland and Scott B. Rae, *Body & Soul: Human Nature and the Crisis in Ethics* (Downers Grove, IL: Intervarsity Press, 2000).

<sup>22</sup>John Paul II, “Biological Research,” 342.

<sup>23</sup>John Paul II, “Ethics of Genetic Manipulation,” 388.

<sup>24</sup>For a discussion of the promise of genetic medicine, see Leena Peltonen and Victor A. McKusick, “Dissecting Human Disease in the Postgenomic Era,” *Science* 291 (2001): 1224–1229.

<sup>25</sup>For example, see D. A. Persons and A. W. Nienhuis, “Gene therapy for the hemoglobin disorders: Past, present and future,” *Proc. Natl. Acad. Sci.* 97 (2000): 5022–5024,

dren and adults, techniques that will allow physicians to correct genetic defects very early in human development while the fetus is still in his mother's womb are also being invented. What is the moral import of these techniques? First, one has to keep in mind that, as John Paul II has said on several occasions, genetic manipulation for therapeutic reasons is morally permissible:

A strictly therapeutic intervention having the objective of healing various maladies—such as those stemming from chromosomal deficiencies—will be considered in principle as desirable, provided that it tends to real promotion of the personal well being of man, without harming his integrity or worsening his life conditions. Such intervention actually falls within the logic of the Christian moral tradition.<sup>26</sup>

These interventions must not involve disproportionate risks to the patient and must be performed only when free and informed consent has been given. Second, when these treatments involve embryos at the earliest stages of development, there is the additional requirement that all procedures respect the dignity of both marriage and the conjugal act. For instance, any genetic intervention involving in vitro fertilization would be contrary to the unity of marriage, to the dignity of the spouses, to the vocation proper to the parents, and to the child's right to be conceived and brought into the world in marriage and from marriage, and therefore would be illicit.<sup>27</sup> It is clear then that Christian anthropology shapes the ethics of genetic engineering within the Catholic tradition.

### **Boundaries to Scientific Research**

The Fundamental Principle, in addition to emphasizing the inviolable dignity of the human person as one limit against improper laboratory experimentation, also places other boundaries to scientific research. In particular, as noted above, science must respect the design and will of God. The Second Vatican Council asserted that "all things are endowed with their own stability, truth, goodness, proper laws, and order. Man must respect these as he isolates them by the appropriate methods of the individual science or arts."<sup>28</sup> In other words, scientists must work in active conformity to the order of nature through which they participate in the plan of the Creator. Accordingly, recent popes have emphasized that nature should not be modified. For instance, John Paul II has suggested that rather than talking about genetic engineering we should talk about genetic surgery, "so as to show better that the physician intervenes not in order to modify nature, but to help develop along its line, that of creation, that willed by God."<sup>29</sup>

What is problematic is that in light of recent biological advances, the line between modifying nature and favoring its development is not clear. For instance,

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and R. Parkman, K. Weinberg, G. Crooks, J. Nolta, N. Kapoor, and D. Kohn, "Gene therapy for adenosine deaminase deficiency," *Annu. Rev. Med.* 51 (2000): 33–47.

<sup>26</sup>John Paul II, "Ethics of Genetic Manipulation," 388.

<sup>27</sup>I-6, *Donum vitae*, 703.

<sup>28</sup>*Gaudium et spes*, no. 36. Quotation taken from *The Documents of Vatican II*, edited by Walter Abbott, S.J. (New York: Corpus Books, 1966).

<sup>29</sup>John Paul II, "Ethics of Genetic Manipulation," 388.



some may suggest that respecting the order of nature necessarily includes a prohibition against the creation of new species of life. But what does this mean? Does the transfer of genes from one species to another constitute an essential modification of nature? Recently, a gene encoding a green fluorescent protein originally isolated from jellyfish was introduced into a rhesus monkey in an experiment designed to improve techniques at creating better animal models for disease.<sup>30</sup> Is a glowing green monkey still a monkey? Most would say yes. Given the current philosophical resources of the tradition, it is difficult to distinguish genetic modifications which give rise to either accidental or substantial changes. Furthermore, the sequencing projects have revealed that horizontal gene transfer, that is, gene transfer between species, is common in nature and may, in fact, be an essential driving force in the evolution of new species of life.<sup>31</sup> It appears that the divine will and design of the Creator includes the exchange of genes from diverse organisms to generate novelty in creation.

How then are we to clarify the tradition so that it may properly account for these observations? The solution may have to include a reformulation of the body-soul unity theory which grounds Catholic bioethics so that it may incorporate the notion of genetic change. The challenge would be to reconcile the classical essentialist perspective with an evolutionary worldview, an impossible task according to some.<sup>32</sup>

One possibility is to utilize concepts borrowed from the science of complexity to update the physics of Aristotle and Thomas. Here an organism would be modeled as a complex system where its state cycle, the principle of unity and integrity of the system—using the classical Aristotelian terminology, its substantial form—would govern the robust natural process which directs the development of the organism. The constraints of this state cycle—for Aristotle, the predisposition of the matter that receives a form—would depend upon the initial genetic constitution of the organism.<sup>33</sup> Such an account would recognize that some genetic novelty may be introduced into an organism without changing its essence while still being able to

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<sup>30</sup>For details, see D. Stephens, “ANDi - the first transgenic monkey,” *Trends in Cell Biology* 11(2001): 151.

<sup>31</sup>John M. Logsdon, Jr., and David M. Faguy, “*Thermotoga* heats up lateral gene transfer,” *Current Biology* 9 (1999): R747-R751. Also see the discussion in J. Ross Fitzgerald, D. E. Sturdevant, S.M. Mackie, S.R. Gill, and J.M. Musser, “Evolutionary genomics of *Staphylococcus aureus*: Insights into the origin of methicillin-resistant strains and the toxic shock syndrome epidemic,” *Proc. Natl. Acad. Sci.* 98 (2001): 8821–8826.

<sup>32</sup>Distinguished evolutionary biologist Ernst Mayr has commented: “[T]he concepts of unchanging essences and of complete discontinuities between every *eidōs* (type) and all others make genuine evolutionary thinking impossible. I agree with those who claim that the essentialist philosophies of Aristotle and Plato are incompatible with evolutionary thinking.” See his *Populations, Species and Evolution* (Cambridge: Harvard University Press, 1970), 4.

<sup>33</sup>For some initial formulations of this proposal, see my “Causality Within Complexity,” *J. Interdisciplinary Studies* 11 (1999): 141–156. Also see the discussion in Brian Goodwin, “Development as a Robust Natural Process,” in *Thinking About Biology*,

place limits on genetic modification by highlighting distortions in the state cycle that radically alter the developmental program of the plant or animal. Further, the solution may also have to include the recognition that an order of nature which has a place for change and novelty is not an invitation to unfettered experimentation which could lead to the production of genetic curiosities that do not produce any genuine advance in knowledge. In particular, whimsical experiments attempted just to accomplish a feat—these are usually random, “what if” experiments that are not part of a legitimate research tradition—should be resisted. As already mentioned above, though nature is placed at the service of human society, it is not to be abused. All genetic engineering of plants or animals must still have as its goal the service of the human person.

One final point remains. Some have suggested that man by nature is creative—he is a created co-Creator—and as such should not be hindered by an order of nature because this would prevent him from realizing his divine calling to be creative and innovative.<sup>34</sup> A brief response would be that legitimate boundaries discerned with prudent judgment and respect for nature as a divine gift are never a hindrance to legitimate and responsible creativity.<sup>35</sup> But the claim that man is a co-Creator leads to the question of limits to the modification of human nature itself. In addition to curing genetic diseases, the human genome project has also opened up the possibility that individuals may choose to go beyond therapeutics in an attempt to “improve” upon human nature. How are we to evaluate the morality of these actions?

In 1983, John Paul II suggested that eugenic interventions may be permissible if they respected the fundamental dignity of man and our common biological nature which is at the base of liberty. Specifically, the Holy Father said that scientists were to avoid “manipulations tending to modify the genetic stock and to create groups of different people, at the risk of provoking fresh marginalization in society.”<sup>36</sup> In a more recent document, however, the magisterium seems to have indicated that *any* non-therapeutic interventions of the genome made to an unborn individual would be a violation of the dignity of the human person:

*Certain attempts to influence chromosome or genetic inheritance are not therapeutic but are aimed at producing human beings selected according to sex or other predetermined qualities. These manipulations are contrary to the personal dignity of the human being and his or her integrity and identity. Therefore in no way can they be justified on the grounds of possible beneficial consequences for future humanity [original emphasis].*<sup>37</sup>

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eds. W. D. Stein and F. J. Varela (Reading, MA: Addison-Wesley Publishing Comp., 1993), 123–148.

<sup>34</sup>Ted Peters, *Playing God? Genetic Determinism and Human Freedom* (New York: Routledge, 1997), 14–16.

<sup>35</sup>For an insightful discussion of how seeing creation as a gift can change our perspective, see Kenneth L. Schmitz, *The Aquinas Lecture. The Gift: Creation* (Milwaukee: Marquette University Press, 1982).

<sup>36</sup>John Paul II, “Ethics of Genetic Manipulation,” 388.

<sup>37</sup>I-6, *Donum vitae*, 703.

Eugenics appears to be completely ruled out because it inherently treats the unborn person as an object to be manipulated and designed according to the dictates of his parents. Furthermore, genetic enhancement presumes that “enhancement” can be objectively determined without consulting the individual who is to be enhanced. For instance, a recent study has suggested that perfect pitch may have genetic components.<sup>38</sup> Would genetically altering the genome of the embryo so that the individual will have perfect pitch be an enhancement? Though some may say yes, cantors with perfect pitch who often have to deal with the frustration of singing alongside those who do not may suggest otherwise. The same may prove to be true for an all-around “superior being” created by more extensive genetic modification.

### Contingent Future Persons

Thus the Catholic tradition recognizes the legitimacy of genetic engineering which respects the dignity of the human person. Governed by its Fundamental Principle, Catholic bioethics is open to technological innovation and creativity as long as science does not abuse the individual. Ultimately, it is a person-centered approach to moral inquiry.

But which tradition should govern the debate over the ethics of genetic manipulation? How is one to choose between rival traditions? Today, the predominant bioethical tradition in the public square is secular, utilitarian, and naturalistic. I believe that this consequentialist approach is flawed. It is unable to resolve the problem of contingent future persons, which arose from the secular tradition’s own attempts to develop a utilitarian ethic for genetic engineering by answering the question: When does genetic modification, *in utero*, benefit the individual? In contrast, the Catholic tradition is able to transcend this difficulty by appealing to its conviction that nature is created.

The problem of contingent future persons involves two commonsense ethical notions. The first is that persons have inherent value, and the second is that it is wrong to genetically engineer a child so that it is born handicapped in any way. Any adequate ethical theory should be able to explain these two notions. The utilitarian approach to ethics, however, cannot simultaneously account for both these basic intuitions. In fact, some secular bioethicists have asserted that if someone holds that value is inherent to persons, then he must also say that one does not harm a baby if one chooses to make it be born deaf.<sup>39</sup> According to this argument, a person can only be harmed if he is caused to be worse off than he otherwise would have been. Therefore, these philosophers would say, to assert that one harms a child by making him to be born deaf is to say that this child is worse off than he would have been had

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<sup>38</sup>S. Baharloo, P.A. Johnston, S. K. Service, J. Gitschier, and N.B. Freimer, “Absolute Pitch: An Approach for Identification of Genetic and Nongenetic Components,” *Am. J. Hum. Genet.* 62 (1998): 224–231.

<sup>39</sup>For details, see the discussion in J. C. Heller, *Human Genome Research and the Challenge of Contingent Future Persons*, (Omaha, NE: Creighton University Press, 1996), 9–17, and in Bonnie Steinbock and Ron McClamrock, “When Is Birth Unfair to the Child?” *Hastings Center Report* 24 (1994): 15–21.

he not been born in the first place, a conclusion which does not seem to makes sense. It appears here that one is comparing existence to nonexistence. In response to this challenge, utilitarian philosophers have had to advocate an impersonal conception of value where value is not attached to persons as such but to states of affairs more generally. It is a troubling dilemma.<sup>40</sup>

How would the Catholic tradition respond to this challenge? Catholic bioethics is grounded in a revelation that recognizes that the world is created and as such, teleological: Things have essences which, by definition, specify both what a thing is and what it should be. One does not compare existence to nonexistence when assessing value, but to an objective standard determined by nature. For example, it is commonplace for a customer to criticize a craftsman for botching a custom-made job because the craftsman was responsible for creating the defective object. This is possible only because expectations were in place ahead of time which specified the nature of the final product. Likewise human nature can be used as a standard to evaluate the morality of acts which bring persons into existence. A person by virtue of the humanity which he shares with others, whether actually or potentially, has certain obligations owed to him by the nature of things, including, for one, the right to be born hearing if that is what his genetic constitution initially specified. Thus even contingent future persons have an inherent dignity which must be protected by all.

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<sup>40</sup>Philosopher Jan C. Heller remarked in an April 1999 interview: “The argument about contingent future persons, that we cannot harm them or benefit them by bringing them into existence, either through germline engineering or cloning or some other kinds of interventions, or that we cannot make them a subject of a right or an obligation, that we cannot attribute human dignity to these individuals until they come into existence, is a problem that I think I write about objectively, as carefully as I can, but it’s a problem that worries me emotionally.” Available at: <http://research.mednet.ucla.edu/pmts/Germline/Therapy%20versus%20Enhancement/tejchvideo1.htm>; accessed on August 1, 2001.