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## **Biotechnology and the Creation of Ethics**

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# Biotechnology and the Creation of Ethics

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## **Abstract**

Biotechnology promises to change the course of evolution. Rather than patiently waiting as natural selection channels the forces of biology into contouring the nature and character of the organisms that populate our world, biotechnology allows humans to directly manipulate the basis of life itself. By allowing the deliberate reorganization of the genetic programs of organisms, biotechnology affords the greatest revolution in scientific and cultural understanding in history. It also is beginning to severely strain our established concepts of right and wrong and to require us to rethink most of our basic moral assumptions.

## Biotechnology and the Creation of Ethics

Raymond R. Coletta\*

Biotechnology promises to change the course of evolution. Rather than patiently waiting as natural selection channels the forces of biology into contouring the nature and character of the organisms that populate our world, biotechnology allows humans to directly manipulate the basis of life itself. By allowing the deliberate reorganization of the genetic programs of organisms, biotechnology affords the greatest revolution in scientific and cultural understanding in history. It also is beginning to severely strain our established concepts of right and wrong and to require us to rethink most of our basic moral assumptions.

Ethical issues surround almost every technological breakthrough. When science makes new associations and combinations possible, the propriety of the new order is called into question, as is the resilience and viability of the well-worn status quo. The Copernican revolution heralded more than a new awareness of the orbital motions of our solar system; it ushered in new social, political, and moral orders, rearranging the “place” of humans and reconfiguring our notion of self. Biotechnology promises no less of a social upheaval. Daily news clippings proclaim the re-engineering of parenthood, sexuality, and reproduction. By recombining base biological material, scientists are realizing the dreams of past alchemists. We are not only creating new organisms, but learning to create the behavior inherent in the organisms themselves. Such biological manipulation of an organism’s “personality” forces us to reconsider the very concept of the meaning of life and our relationship to each other. We are becoming the engineers of temperaments, of emotions, and ultimately of moral sentiment. It is likely that in the near future biotechnology will allow us to reconfigure the genetic codes of living organisms to produce moods and behaviors that are currently absent or tailor existing moods and behaviors to the particular environmental stimuli the organism faces. Our commonplace notion of free-will will be redefined, as will our common understanding of ourselves and our world. The notion of man as “the moral animal” will need to be reexamined.<sup>1</sup>

The changes precipitated by biotechnology within the past decade have severely strained our established notions of right and wrong. The outcry over the cloning of

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1. Robert Wright used the then emerging field of evolutionary psychology to explain human behavior, including human moral sentiments, in his 1994 book *THE MORAL ANIMAL*. Noting that Darwin believed that the human species was the only moral animal, Wright observed that humans have the technical capacity for morality, although they tend not to embrace true morality. As Wright concluded, “Chronically subjecting ourselves to a true and bracing moral scrutiny, and adjusting our behavior accordingly, is not something we are designed for.” See ROBERT WRIGHT, *THE MORAL ANIMAL* 344 (1994).

Dolly<sup>2</sup> evidences the distance that exists between current technology and established social ethics. Our legal responses to these changes lag even further behind. As scientific innovations in gene recombination replaces established “natural” biological systems and ordering, ensconced ethics no longer seem a good “fit.” Today, our mores wrestle with possibilities of eugenically engineering the physical attributes of our children and even more so with designing their moods and emotional systems. In a world where we anticipate the ability to soon “manufacture” a more intelligent child, it is somewhat comical that we still wrestle with the issue of whether we should “choose” a child’s sex. Our old technology remains a contemporary ethical issue.

We are still straining to “catch-up” with the legal and ethical implications of our somewhat antiquated technological advances of the past thirty years. Moral issues surrounding modern methods of contraception remain a hot topic. *In vitro* fertilization and methods of parental surrogacy continue to evoke considerable ethical debate and legal analysis despite the fact that these practices have been common for over twenty years.<sup>3</sup> The legal implications are only slowly being resolved as we strain to apply old standards such as the rule against perpetuities and notions of privacy to these recent technological possibilities. The speed of the current scientific revolution exaggerates the gap between the emerging bio-industrial world and our moral conscience. We simply have not come to terms with the older advances and yet are being thrust into the new biotech century<sup>4</sup> where the ability to control the most fundamental life processes seems certain. In a world of emerging eugenic possibilities, current concepts of morality will be severely strained. Indeed, our sentiments of morality may become so overloaded that breakdowns in our

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2. See Elizabeth Neus, *Scientists Weigh in on the Dolly Debate*, GANNETT NEWS SERVICE, Feb. 19, 1998, at ARC.

3. John and Lesley Brown gave birth to the first “test tube” baby in England in 1978. Doctors removed an egg from Lesley Brown, placed it in a laboratory dish, and added John Brown’s sperm; after fertilization, the doctors placed the egg back into Lesley’s uterus. In 1984 in Australia, Zoe Leyland was the first child to be born from a frozen embryo. Today, *in vitro* fertilization is commonly practiced throughout much of the world. Individuals can select a range of characteristics, including: height, eye color, intelligence, race, and body type. A commercial surrogacy market has developed in a number of countries. See generally Ronald Kotulak & Peter Gorner, *Babies By Design*, CHI. TRIB., Mar. 3, 1991, at C14; D.S. HALACY, JR., *GENETIC REVOLUTION: SHAPING LIFE FOR TOMORROW* (1974).

4. The term “biotech century” has become synonymous with Jeremy Rifkin’s 1998 book, *THE BIOTECH CENTURY*. In this definitive work on the biotechnology revolution, Rifkin explores the current state of biotechnology and the immense impact it may have on our future. As Rifkin concludes, “The biotech revolution will affect every aspect of our lives. The way we eat; the way we date and marry; the way we have our babies; the way our children are raised and educated; the way we work; the way we engage in politics; the way we express our faith; the way we perceive the world around us and our place in it—all of our individual and shared realities will be deeply touched by the new technologies of the Biotech Century.” JEREMY RIFKIN, *THE BIOTECH CENTURY* 236-37 (1998).

abilities to process information and to cope may become significant and common occurrences.<sup>5</sup>

The ethical issues created by biotechnology are vast and growing. Our present moral systems labor mightily to reconcile the new world order into their established patterns of accepted behavior. The ethics of biotechnology raises immensely complex issues; the biotechnology of ethics raises even more intractable ones. Our current scientific advances promise to allow us to engineer the most basic of our life processes. This includes the genetic alteration of our ingrained behavioral predispositions, including our emotions and sense of justice.<sup>6</sup> It is our biology that creates the moral animal, and it is our biology that generates our capacity for ethical discourse. Indeed, what we refer to as morals may be but the reflections of ingrained algorithms formed by eons of evolutionary development. Biotechnology may soon provide us with the ultimate ability to “design” our individual moral senses and biologically “grow” implanted ethical codes of behavior within the human. The more commanding focus thus centers on the genetics of ethics, rather than on the ethics of genetics.

Genes cause behavior; they instill in us our behavioral predispositions and thereby direct the most deeply personal of our moral sentiments.<sup>7</sup> This paper will provide a brief background on the genetic basis of behavior. It will also argue that biology produces our capacity for ethics as well as serves as the basis of our ethical and legal norms. Humans are moral agents because of their genes, not despite them (as is commonly stated). Although we are far from understanding the specific interactions among our genes that account for most behavioral traits, biotechnology promises to establish the bases of our most personal beliefs, emotions, and attitudes, including religion, within this century. This raises the prospect of creating populations with instilled “designer” ethics and families who genetically alter their child’s ethical predilections. “Ethical doctoring” may become a common practice. This test-tube creation of ethics, somewhat circularly and somewhat comically,

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5. Already, Generation X-ers of the 1980s have been widely characterized as maintaining self-serving ethical constructs and a “me-based” world view. See generally Kim Manning & Leila Miller, *X Marks Spot Where 60’s Come To Roost*, THE ARIZONA REPUBLIC, July 2, 1995, at E3; Marianne M. Jennings, *What’s Behind the Growing Generation GAP?* USA TODAY (MAGAZINE), Nov. 1, 1999, at 14; Arlie Russell Hochschild, *Coming of Age, Seeking an Identity*, N.Y. TIMES, Mar. 8, 2000, at H1; Jeff Giles et al., *Generalizations X*, NEWSWEEK, June 6, 1994, at 62.

6. Behavior genetics indicates that many variations in behaviors among humans correlate with genetic variations. Great strides are being made in understanding the pathways that exist between the gene and behavior. Recent findings indicate that differences in personality traits, social attitudes, moral capacity, and spirituality may have genetic bases. See Ronald S. Cole-Turner, *The Genetics of Moral Agency*, in THE GENETIC FRONTIER: ETHICS, LAW, AND POLICY 161 (Mark S. Frankel & Albert H. Teich eds., 1994); Troy Duster, *Human Genetics, Evolution Theory, and Social Stratification*, in THE GENETIC FRONTIER: ETHICS, LAW, AND POLICY, 131 (Mark S. Frankel & Albert H. Teich eds., 1994).

7. See generally MATT RIDLEY, THE ORIGINS OF VIRTUE (1996); MORALITY AS A BIOLOGICAL PHENOMENON (Gunther S. Stent ed., 2d ed. 1980); EDWARD O. WILSON, ON HUMAN NATURE (1978); WRIGHT, *supra* note 1; THE SENSE OF JUSTICE: BIOLOGICAL FOUNDATIONS OF LAW (Rodger D. Masters & Margaret Gruter eds., 1992) [hereinafter SENSE OF JUSTICE]; RICHARD D. ALEXANDER, THE BIOLOGY OF MORAL SYSTEMS (1987).

raises ethical dilemmas of its own—at least to us here and now. This paper will examine the ethics of using biotechnology to engineer our ethical and legal selves. These issues are uncomfortable and disquieting. They force us to confront the core of our humanity. The biology of ethics questions who we imagine ourselves to be—Copernicus had it easy.

## I. THE ETHICS OF BIOTECHNOLOGY

Perhaps biotechnology's greatest threat lies in the speed at which its advances are occurring. The commercialization of biology has produced a Demsetzian race<sup>8</sup> to acquire market rights over gene resources. We now have the ability to manipulate the building blocks of life and thereby produce new world orders almost as quickly as re-washing our test tubes. New discoveries occur almost daily with little time for reasoned reflection on their implications to current society. Science is simply moving faster than our ability to understand its ramifications or its significance, leaving a convoluted labyrinth of social, legal, and ethical issues in its wake.

A large part of the dissonance that exists between biotechnology and current social mores is the result of our failure to adequately gain a perspective about what these technological changes mean to our world in general and we humans in particular. The world we live in, this rich networking of “gene survival machines” and its corresponding abundant, but declining, biodiversity, is the consequence of billions of years of evolution. Life in the sea occurred only after approximately three billion years of chemical and biological interactions; our lush rain forests took over an additional 300 million years to develop.<sup>9</sup> Current life has been sculptured by natural selection through an incomprehensible matrix of events, each life form intricately designed to survive and reproduce within a limited environment. Ninety-nine percent of all species that ever existed are now extinct; current life is the progeny of these ancestral forms, the successful descendants of organisms that emerged over 3.8 billion years ago.<sup>10</sup> We and the biology that surrounds us have managed to survive the extinctions of history and have been engineered throughout these eons of natural selection to interact with the world in limited, defined ways. We need to recognize the extraordinary uniqueness of current life forms and how highly special and precious they remain. To the extent that modern science threatens the delicate symbiosis of our natural world, it is imperiling billions of years of

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8. Demsetz's theory of private property would predict that applying a “rule of capture” to the biotechnology market would encourage a race to gain first property entitlements. Common or communal ownership of gene resources would not promote the speed or thoroughness of current technological progress. Private property in the resources develops, in part, to “internalize” costs and thereby make research, development, and commercialization efficient. See Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 347-57 (1967).

9. A rich overview of biodiversity and evolution is contained in E.O. Wilson's *THE DIVERSITY OF LIFE*. See EDWARD O. WILSON, *THE DIVERSITY OF LIFE* 344-45(1999).

10. *Id.*

evolution and an almost incomprehensible number of gene-environment interrelationships.

Biotechnology promises so much. Indeed, the potential good that can result from reasoned, reflective innovation is enormous; and the potential profits to be realized in a market economy is even more staggering. For the first time in human history, we seem on the threshold of feeding the masses, reseeding the planet, and redesigning the human.<sup>11</sup> To date, we have genetically engineered a wide assortment of growth hormones that have been placed in animals and plants to make them bigger, tastier, meatier, and (at times) more intelligent.<sup>12</sup> We have genetically engineered a broad array of plants so that they ripen without rot, tolerate drought, and repel insects.<sup>13</sup> Animal clones promise a rich harvest of organs for human

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11. Genetically engineered foods are seen as the solution to the world's shortage of food and rampant malnutrition in unindustrialized countries. In addition to malnourishment, lack of proper nutrients is a widespread epidemic. About 100 million children suffer from Vitamin A deficiency. However, recently scientists succeeded at introducing genes that produce beta-carotene into the rice-grain. This transgenic rice grain now contains sufficient beta-carotene to meet human vitamin A requirements from rice alone. Gordon Conway, *Food for All in the 21<sup>st</sup> Century*, ENVIRONMENT, Jan. 1, 2000, at 818. Even in the industrialized United States, over 90 million acres of farmland are currently dedicated to genetically modified crops. As a result, genetic engineering is enhancing all types of mainstream American products, ranging from tortilla chips, corn-muffin mix, veggie burgers and even baby formula, all of which are now made from genetically modified corn and soya bean. Steve Wilson, *How Murdoch Gave in to Monsanto*, NEW STATESMAN, Jan. 10, 2000.

12. Scientists have developed the "Flavr Savr" tomato by genetically altering the levels of auxin, a plant hormone, which slows down the ripening process, which allows the tomato to last longer and ultimately allows the flavor of the tomato to develop further. Jerry Cohen, *Controlling Hormone Levels Optimizes Tomato Taste*, LIFE EXPECTANCY, EMERGING FOOD R&D REP., July 1, 1999. See also Anita Manning, *FDA Rules Today on Gene Food*, USA TODAY, May 26, 1992, at 1A; Sylvia Thompson, *The New Food Technology*, THE IRISH TIMES, Mar. 27, 1995, at 10. Tomatoes are also being genetically altered with fish genes in an attempt to create a tomato that can be frozen and thawed without becoming mushy, but instead retaining its texture. Terry Hennessy, *Science's Bountiful Harvest*, PROGRESSIVE GROCER, July 1, 1996, at 85. Scientists have also genetically altered animals to produce larger animals and healthier meat. For example, by injecting DNA into the nuclei of surgically removed fertilized eggs of pigs and sheep, scientists are able to regulate the growth hormones produced by the respective animal's own pituitary gland and thus regulate its size. Caird E. Rexroad, Jr., *Transgenic Livestock in Agriculture and Medicine*, CHEMISTRY AND INDUSTRY, May 15, 1995, at 372. Scientists are also experimenting with injections of high levels of growth hormones into these animals to improve the growth rate, feed efficiency, and quality of the meat. Richard Orr, *Hormone-fed Lambs Leaner but Meatier, Expert Says*, CHI. TRIB., Feb. 6, 1989, at 3. Scientists at Monsanto discovered that cows with higher levels of BGH produced more milk than those with lower levels of BGH. To produce greater quantities of milk from the same amount of cows, scientists engineered the growth hormone BGH which, when injected into cows, allows them to produce up to 30% more milk. Wilson, *supra* note 11.

13. Genetic material from the venom of scorpions has been intermingled with the genetic structure of corn to produce a strain of corn that contains its own internal insect repellent. See Josh Dickey, *Strange DNA Creates Killer Veggies*, U-WIRE, May 25, 1999. Scientists in Europe have genetically engineered a hybrid seed corn that is now resistant to the European corn borer insect. See *Getting Food Output Through Genetically Engineered Crops*, CHEMICAL MARKET REP., June 2, 1998, at 3. One of the more controversial genetically engineered foods is the "Round-Up Ready" soya bean which is resistant to Glyphosate, a powerful weed killer. See Tom Baldwin & Victoria MacDonald, *Genetically Engineered Food Escapes Labeling*, DAILY TELEGRAPH (London), July 21, 1996, at 10. Scientists have also isolated a protein gene in Golden Delicious apples, which makes them resistant to rot. By cloning and manipulating this gene, scientists are trying to produce an apple that staves off rot as it matures. See Robert Langreth, *High-Tech Harvest*, POPULAR SCI., Nov. 1992, at 104.

transplantation;<sup>14</sup> genetically engineered drugs promise both the end of disease and the beginning of absolute health;<sup>15</sup> genetically-spliced embryos promise smarter, more physically capable, and more attractive progeny.<sup>16</sup>

But we are just beginning to understand the potential costs and dangers of making life itself the guinea pig. The results of our technological advances are too often unknown, the interrelationships between the natural and the genetically-altered too uncertain. Such fast moving technological progress in the face of so little real knowledge of either short-term or ultimate consequences raises deep ethical issues. The risks inherent in engineering crops serve as examples. We are introducing genes into the food stores of both plants and animals that have never been a part of their diet. The effects of this are highly unpredictable and, in today's science, largely untestable. Some of the risks and realities of this new biotechnology are already surfacing in our bioengineered crops. This so-called "Frankenfood" is being linked to human health concerns and environmental degradation. Manipulation of a plant's genome may strengthen natural toxins in unexpected ways. Rats fed potatoes that were genetically modified to control the potatoes' natural pests were found to suffer numerous health problems such as stunted growth and damaged immune systems.<sup>17</sup> Allergic reactions may coincidentally be caused by seemingly innocuous gene-splicing. Soybeans genetically engineered to contain a gene from the Brazil nut created an allergic reaction in individuals allergic to nuts.<sup>18</sup> Thus, food allergens can be transferred from one plant or animal, inadvertently exposing individuals to highly

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14. The ability to mass produce animals that contain human genes promises to transform the practice of organ transplantation. Organs will become more compatible and less likely to be rejected. The commercial market for xenotransplants is extraordinary—hundreds of thousands of people die each year because human organs are not available; the commercial value of a transgenic pig liver has been estimated to be as high as \$18,000. See Martha Groves, *Transgenic Livestock May Become Biotech's Cash Cow*, L.A. TIMES, May 1, 1997, at A12; Gina Kolata, *Lab Yields Lamb With Human Gene*, N.Y. TIMES, July 25, 1997, at A18.

15. Genetically engineered drugs and medicines have been used for years. Genetically engineered human insulin is used for millions of individuals with diabetes. Gene-spliced products are also commonly used for treating multiple sclerosis, kidney failure, and cystic fibrosis. See Robert Lee Hotz & Thomas H. Maugh, II, *Biotech: The Revolution Is Already Underway*, L.A. TIMES, Apr. 27, 1997 at A28. The potential in this area is so enormous that corporations are "prospecting" the ecosystems of the tropics to find plants and animals with unusual genetic traits that might be the foundation for new drug therapies. See Hope Shand, *Patenting the Planet*, MULTINATIONAL MONITOR, June 1994 at 10; see generally VANDANA SHIVA, *BIOPIRACY: THE PLUNDER OF NATURE AND KNOWLEDGE* (1997).

16. The charting of the human genome and breakthroughs in reproductive technology make genetic manipulation of sex and embryonic cells certain. Physicians should soon be able to alter an individual's genetic inheritance by slipping "genetic cassettes" directly into cells. We should then be able to shop for our children's predominant physiological and psychological attributes. See HALACY, *supra* note 3; ALBERT ROSENFELD, *THE SECOND GENESIS: THE COMING CONTROL OF LIFE* 29-30 (1969).

17. See Laura Tangley, *Of Genes, Grain, and Grocers*, U.S. NEWS & WORLD REP., Apr. 10, 2000, at 49.

18. In a study by scientists at the University of Nebraska, blood serum from individuals allergic to Brazil nuts reacted to soybeans that had been genetically altered to contain the Brazil nut gene. See Julie A. Nordlee, et al., *Identification of a Brazil-Nut Allergen in Transgenic Soybeans*, 334 NEW ENG. J. MED. 688 (1996). In an editorial about the study, *The New England Journal of Medicine* opined that "food allergens could indeed be transferred from one plant to another by transgenic manipulation." Marion Nestle, *Allergies to Transgenic Foods: Questions of Policy*, 334 NEW ENG. J. MED. 726 (1996).



serious repercussions. Market forces are encouraging the replacement of countless varieties of species with their retail super-form—a “super-tomato” or “super-banana” that is acceptably flavorful and easily grown, easily shipped, and easily stored anywhere in the world. In this way, the market is displacing one of nature’s prime characteristics (diversity of form), decreasing our biodiversity and disrupting the natural gene pool available to provide new sources of drugs and food as well as to respond to new threats of environmental degradation. Such depletion of our gene pool restricts genetic diversity and thus limits future evolutionary options when faced with new environmental challenges. Likewise, cross-fertilization of biologically engineered crops can also produce unwanted “super-forms,” such as “superweeds” that may prove almost impossible to control and can have devastating effects on other life forms.<sup>19</sup>

The ethical concerns raised by such “tinkerings” are enormous. What tradeoffs are acceptable when dealing with such a strong social goal as the relief of hunger? How can we weigh market advantage against naturally occurring organisms that have been meticulously engineered through a few billion years of natural selection? Is there intrinsic value to naturally occurring life forms or to wide-ranging biodiversity? Should Muslims or Jews know if their foods contain a pig gene or vegetarians know their greener, more enriched spinach has been “tainted” with an animal protein? Is market manipulation of food design and aesthetics acceptable? Should we be exposing present and future generations to an array of environmental and health possibilities that are not yet understood or thoroughly researched? Such moral questions shadow an even larger field of legal issues. Toxic reactions to accidental gene interactions invite strict product liability and negligence torts.<sup>20</sup> Externalities created by spread of certain of these new gene-forms raise issues of both private and public nuisance. The facility and extent of gaining a market monopoly for gene sequencing stretches the underlying policies of current patent law and stimulates further investigation into the social ordering underlying our legal norms. The transboundary movement of living modified organisms strains international legal concepts and order.<sup>21</sup> Where, and how far, to go with our new

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19. See Allison A. Snow et al., *Cost of Transgenic Herbicide Resistance Introgressed from Brassica Napus into Weedy B. Fapa*, 8 MOLECULAR ECOLOGY 605 (1999). According to a recent study, the pollen from altered corn has a direct impact upon the feeding behavior and mortality rates of monarch butterflies. Monarch butterflies live on the pollen deposited on milkweed plants by corn. Corn, to which has been added genetic material to make it pest resistant, expresses this genetic addition in its pollen. In an experiment, butterflies which fed upon this pollen had a significantly lower survival rate than those fed pollen from genetically unaltered corn. John E. Losey, *Transgenic Pollen Harms Monarch Larvae*, NATURE, May 20, 1999, at 214.

20. See generally Davies & Levine, *Biotechnology’s Challenge to the Law of Torts*, 32 MCGEORGE L. REV. 221 (2000).

21. The recent Cartagena Protocol on Biosafety (approved in Montreal after negotiations had initially broken down in Cartagena) attempts to address some of the concerns of transboundary movement of genetically altered living organisms. “The objective of [the] Protocol is to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity . . . and specifically

science is reshaping more than our biological world. The bases of our ethical and legal systems are being severely overburdened by these advances.

Food modification may be the easiest issue to address. It is important to keep in mind that humans evolved with the rest of life.<sup>22</sup> Although we tend to think of ourselves as different from the rest of nature, we simply are not. Humans also are genetic “survival machines,” imprinted with the force of natural selection. Biologically adapted to our environment,<sup>23</sup> our genes are of this world. We too are biological constructs; we too can be genetically modified. And we have been. Biotechnology has been applied to human genome for several decades. While countless individuals are using genetically engineered drugs to combat a variety of diseases, science is now peering into the genetic bases of specific diseases and developing new cells so that our body itself can intercept the affliction or prevent it entirely. We are beginning to “farm” our skin and may soon be able to fabricate other organs such as the heart and liver from human cells.<sup>24</sup> By linking more than 2000 diseases to single gene defects, modern technology promises unimaginable strides in health and life style. But as our knowledge of the human genome and its functioning rapidly progresses, our ability to deal with the ethical and legal issues raised continues to lag.

The ability to diagnose human genetic defects carries with it the question of what to do with the knowledge gained. Certainly, the prospects of containing the symptoms or curing the disease are universally heralded. However, problems of decision-making and access loom large. If technology allows us to learn whether an individual has the recessive genes for hemophilia or muscular dystrophy, who is

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focusing on transboundary movements.” Cartagena Protocol on Biosafety to the Convention on Biological Diversity (visited June 25, 2000) <[www.biodiv.org/biosafe/Biosafe-Prot.html](http://www.biodiv.org/biosafe/Biosafe-Prot.html)> (copy on file with the *McGeorge Law Review*).

22. Organic molecules originated about 3.8 billion years ago. The so-called “higher organisms” (eukaryotic organisms, their DNA enveloped in membranes) developed about 1.8 billion years ago. The Cambrian explosion of macroscopic animals occurred about 500 million years ago. The next 100 million years evidenced the evolution of amphibians and early reptiles, the early dinosaurs coming about 100 million years later, and then the first primates about 100 million years after that. Our hominid ancestors separated from the primate tree approximately eight million years ago and the first *Homo sapiens* (“modern humans”) appeared 300,000 years ago. Humans remained hunter-gatherers until about 10,000 years ago when the shift to an agricultural-pastoral existence occurred. See generally RICHARD COWEN, *HISTORY OF LIFE* (2d ed. 1995); *THE CAMBRIDGE ENCYCLOPEDIA OF HUMAN EVOLUTION* (Steve Jones et al. eds., 1992).

23. It is important to note that the environment to which we are most closely adapted is the environment of 10,000 years ago. We are engineered to be very good hunter-gathers. Our emotions and desires, from our sexual jealousy to our fondness for sweets, became engineered as a part of us because of the evolutionary advantages they offered at some point in our history. It is interesting to note that most of our present phobias are of things that once proved menacing but no longer continue to be significantly dangerous in modern society—such as spiders and snakes. We also seem poised to continually attempt to recreate the topography of our past, by placing plants inside our homes and offices and growing trees in our yards that resemble the low-branched, spreading flora of the African savannah. Because our environment has so rapidly and significantly changed, many of our current behavioral predispositions are maladaptive. See STEVEN PINKER, *HOW THE MIND WORKS* 42 (1997).

24. Rifkin reports that researchers “are already well along in research to fabricate human heart valves, breasts, ears, cartilage, and noses.” Experimenters are also researching fabricated lungs, hearts, livers, and pancreases made of human cells. See RIFKIN, *supra* note 4, at 24. Experimenters are also researching . . . cells. *Id.* at 24-32.

entitled to this knowledge and how can it be used? In addition to privacy matters, concerns of genetic discrimination loom large. In the 1970s, studies raised the concern that individuals with sickle-cell anemia could have reduced reactions in the thinner oxygen of higher altitudes. Based upon this genetic patterning, a disproportionately large number of African-Americans were prohibited from entering the Air Force Academy.<sup>25</sup> Similar discrimination caused African-Americans to be restricted to ground jobs for commercial airlines and charged higher premiums by insurance companies. Indeed, such genetic discrimination is destined to become a central social and legal issue within the next decade. Should employers have access to information regarding the fitness of prospective employees for a specific job or work environment? Should individuals with inherited biochemical disorders be denied insurance, even if the same can be treated? Should individuals with genetic neuromuscular disorders be charged higher auto rates even if they have yet to suffer any physical disability? The importance of this issue is underscored by a 1993 survey by the Harvard Medical School that found over 30 current instances of genetic discrimination.<sup>26</sup> Indeed, given the real likelihood that classes of genetically unemployable individuals will arise, legal responses are demanded. The likelihood of genetic scarlet letters will tax the jurisprudential base of our legal system. Current discrimination law is ill-equipped to handle these novel situations; and the scope of our privacy laws to protect against these disclosures is only now being examined.

Perhaps a more troubling aspect of utilizing biotechnology in the human realm is its potential for positive eugenics. We should soon be able to design babies that are “superior” to those blindly conceived. The genetic enhancement of a wide variety of traits such as intelligence and beauty will enable us to engineer a population of Einsteins and Barbies. Prior eugenic issues such as sterilizing to weed out biologically inferior stock from the population base promise to continue to task our moral sense. The globalization of the economy may result in new legal “spins” such as enabling developing nations more eugenic freedom on “birth quality,” given their more restricted economic base and greater needs for disease control and resource allocation. But new, novel issues will quickly arise and separate technological ability even further from its ethical and legal foundations. What are, and how can we determine, the human characteristics that we should splice into the human genome? Who should make the decision regarding “corrective” gene therapy: the individual, the parent, the community, or the state? Upon what “values” should these decisions be grounded? Should gene engineering be based upon market forces, allowing the economically well-off who can afford the technology to produce more “competitive” sons—taller and more muscular and therefore more attractive to women and employers? Should we allow the thinning of the rich human gene

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25. See generally DANIEL J. KEVLES, IN THE NAME OF EUGENICS: GENETICS AND THE USES OF HUMAN HEREDITY 278 (1995).

26. See generally Daniel J. Kevles, *Social and Ethical Issues in the Human Genome Project*, PHI KAPPA PHI J., Spring 1993, at 20.

pool, a pool upon which future generations may need for their own evolutionary adaptations? Eugenics is becoming a part of the human landscape. Biotechnology is creating a “Brave New World”<sup>27</sup> where we can “lego-ize” our physical traits and manufacture hybrid inventories of “positive” attributes. Manipulation of our evolutionary destiny is clearly at hand.

The greatest challenge to our ethical and legal norms comes from the speed of biotechnology’s revolution. Our moral and legal sentiments have evolved over thousands of years of selective interactions. New, daily scientific advances leave a moral order ill-equipped to respond. Ethical choices are the result of deeply ingrained predispositions and a lifetime of cultural adaptation. When faced with new situations, we tend to respond slowly, viewing any significant departure from the moral status quo as a threat. The law also inherently moves slowly, proceeding through careful analysis and studied reflection. Legal precedent and a hierarchical judicial system lend additional brakes to an already sluggish, orthodox order. With such intrinsic conservatism, it should come as no surprise that we are today continuing to struggle, both ethically and legally, with technological breakthroughs that are decades old. Contraception and abortion are, at their core, denials of our biological selves<sup>28</sup> and thus we continue to be uncomfortable with the ramifications inherent in the utilization of the technology. Contraception is still vigorously debated in many societies, though the technology involved is now antiquated. *Roe v. Wade*<sup>29</sup> was decided over thirty years ago, but continues to be a popular cause for civil disobedience and to evoke significant legal challenge.<sup>30</sup> Reproductive rights persist in consuming the moral energies of many societies although in vitro fertilization techniques have been utilized throughout the world for several decades.<sup>31</sup> Currently, biotechnology, among many other things, is enabling us to begin prenatal testing for fetal genetic conditions and to begin artificial manipulation

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27. See generally ALDOUS HUXLEY, BRAVE NEW WORLD (1932). In *Brave New World*, Huxley presented a world where people were fertilized, hatched, and mass produced. Every aspect of an individual, from physical stature to social status, was controlled by subjecting the embryo to various procedures.

28. Dawkins observed that our brains “rebel” against our genes whenever we use contraception. See RICHARD DAWKINS, THE SELFISH GENE 332 (1989). More cautiously, Peter Singer stated that “the growth of modern contraceptive techniques is a splendid example of the use of reason to overcome the normal consequences of our evolved behavior.” See Leslie Paul Thiele, *Evolutionary Narratives and Ecological Ethics*, POL. THEORY, Feb. 1, 1999.

29. 410 U.S. 113 (1973).

30. Since *Roe v. Wade*, the Supreme Court has continued to consider issues surrounding abortion on a regular basis. See generally *Planned Parenthood v. Casey*, 505 U.S. 833 (1992); *Webster v. Reproductive Health Servs.*, 492 U.S. 490 (1989); *Ohio v. Akron Ctr. For Reprod. Health*, 497 U.S. 502 (1990).

31. “The Vatican [has] denounced a wide range of birth techniques and practices: artificial insemination except to supplement the conjugal act, in vitro fertilization, surrogate motherhood, cloning, attempts at genetic engineering, the use of amniocentesis for the purpose of aborting malformed fetuses, and experimentation on embryos.” See Sandra Evans, *Birth Edict: Some Catholics Unswayed*, WASH. POST, Mar. 15, 1987, at A1. In addition to being morally wrong, the Catholic Church believes these techniques are not an expression of the specific conjugal act. See JOHN PAUL II, EVANGELIUM VITAE (1995). This position of the Catholic Church has created a moral dilemma for couples unable to conceive a child and wanting to seek other alternatives which the church opposes.

of an unborn's genotype. The intractable social, moral, and legal issues posed by only these two technological advances illustrate the potential impact of biotechnology on our society. When is such testing viable and to whom should it be made available? Which genetic disorders or diseases will allow (require?) state regulated abortions or invasive procedures? How are the rights of a "good-gene" child to be weighed against maternal health and reproductive freedom? Who should bear the economic costs of raising a child conceived with certain knowledge of the genotype-disorder? Is there a duty for individuals to test *in vitro* so they may reject embryos that pose significant health costs over the embryo's lifetime? What is a "bad" gene trait and how do we decide which embryos are "good"? Such questions guarantee many decades of ethical and legal wrangling. We are living beings designed to forward our biological selves; when technology changes the landscape too quickly, we tend to become confused and resist what are often perceived as threats to our self-identity. Technological interference with, or enhancement of, natural processes is, simply, something that frustrates us. And while we are attempting to resolve the momentous issues raised, technology speeds ahead leaving a perplexed and somewhat paralyzed society in its wake.

While the speed of technological advance assures that its ethical and legal contexts will remain unexamined and unresolved by the broader society, at least for a while, decisions regarding the form, content, and direction of biotechnology are being made. Scientists and bio-technocrats control the direction of this re-invention of nature. Biologists are first and foremost interested in advancing biology; ethical and legal issues are habitually secondary at best. Likewise, corporate bureaucrats are often fixated on developing products and services that produce acceptable profit levels period.<sup>32</sup> Scientists focus on the "how" rather than the "ought"; premium is placed on being first to discover or being first with a market application. Corporate directors concentrate on short-term profit-margins rather than long-range consequences. The ability to instantly capitalize on technology is often more valuable than the precaution of lengthy trials. The interests of both these parties thus encourages both the maximum exploitation of current technology and the maximum speed of technological advance. Arguably, the issues inherent in biotechnology are too important and affect society too profoundly to be surrendered to these market actors. As the adage states, if you want to build a bridge across a river, you should hire a company that specializes in bridge building and employs the best and brightest bridge engineers. But if you want a group to consider whether or not to build the bridge in the first place, you do not want it to consist solely, or mainly, of that company's directors and engineers. Their interests simply are at conflict with more reasoned and reflective analysis regarding the underlying purposes and goals of the undertaking. In the biotechnology arena, many of the decisions are being

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32. Clearly, however, corporations can be responsive to societal reactions to their products. Consumer perception translates into market shares; corporations want to be viewed as good citizens and have a positive perception in the public's eye.

made by the scientists and businesses involved. Principles of first discovery and profit predominate. While genetic engineering has continued at a furious pace, often in secret and often with haste, our moral sense has not been allowed to reflect upon the acceptability, desirability, or ultimate objectives of the new technology. Ethical and legal ramifications must be explored at the outset. The issues are just too momentous to be left to the researchers and market players themselves.

## II. THE BIOTECHNOLOGY OF ETHICS

Biotechnology offers more than the creation of new life forms with novel physical characteristics. The scientific advances occurring within biotechnology raise the prospect of genetically engineering human emotions, ethical perspectives, and even “designer” senses of justice. Clearly, technology has allowed us to moderate certain behaviors for a long time. Moods, memory, attention, and intelligence can currently be “adjusted” by drugs which affect our internal biochemical interactions and networking. The immediate future promises extraordinary developments in such drug therapies.<sup>33</sup> But the opportunity to genetically control our most basic behavioral and psychological predispositions truly does introduce a brave new world. We already are identifying the genes and gene interactions that serve as the bases for many physical and mental traits. We are on the verge of discovering how genes contribute to the formation of our basic human characteristics such as creativity, love, anger, and hope. The day may not be far off when, through various forms of gene manipulation, we can “grow” selected ethical codes of behavior within hybridized embryos or implant individual moral senses in our offspring to maximize their success in specific environments. Parents who dream of having a doctor-son may engineer a more cooperative, less aggressive, communicative male; those who desire a politician-daughter may engineer a highly trustworthy, rule-following, assertive female. Such “behavioral-doctoring” challenges our view of ourselves and calls into question the essence of who we are. Biotechnology thus not only offers the prospect of raising our standard and quality of living, but also threatens to change our very notion of life and what it means to be human.

Our moral systems are not separate from our biology. Genes cause behavior. Genetic interactions created the human form, an animal with inherent predispositions toward defined moral capacities and sentiments. Who we are, and what we have and can become, are essentially a result of evolutionary forces.<sup>34</sup>

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33. Rifkin noted that in 1995 over 284 new gene-spliced medicines were tested, an increase of 20% over the prior year. See RIFKIN, *supra* note 4, at 22. The drug Ritalin is commonly prescribed to children and adults who suffer from attention-deficit disorder or hyperactivity. Children who take Ritalin are less easily distracted, more patient, and interrupt less in class. Robert Pear, *Effort on Mood Drugs for Young Is Backed*, N.Y. TIMES, Mar. 21, 2000, at A18. See also Judith Schlesinger, *The Epidemic of Ritalin: A Cure For Brattiness?*, THE BALTIMORE SUN, Jan. 17, 1999, at 13F.

34. Evolution results from the interaction between an organism’s biology and its environment. While culture influences, and may create, human behavior; this Article will focus only on biological processes.

Natural selection has engineered a species with particular physical capabilities and defined modes of adaptive behavior. Not only human instincts, but also human emotions, moral sensibilities, and capacity for both ethics and law are rooted in our genetic composition. In order to understand this relationship between genes and ethics, some foundation is needed.

The genes we have are the genes that enabled our ancestors to succeed in their environment.<sup>35</sup> The process of natural selection is based on the simple reality of variation, that within any species there is difference among the individuals.<sup>36</sup> To the extent that certain genetic variations leave more surviving offspring, these variations become more numerous in the environment in which they find themselves.<sup>37</sup> The genes of reproductively successful ants tend to endure, replacing the genes of the less reproductively successful individuals. Usually, the better an organism is adapted to its environment, the greater its reproductive success and consequently the greater its ability to transmit its genes to future generations. Small differences among individuals of a species can provide advantages that can increase their reproductive success.<sup>38</sup> Slightly blacker tree moths may be less visible to birds and therefore more likely to reach adulthood and have offspring.<sup>39</sup>

Importantly, natural selection is not the result of any cognizance; it is the constant “enhancer,” devoid of consciousness, filtering traits that cultivate environmental fitness. This “blind watchmaker”<sup>40</sup> moves ever so gradually toward complexity, providing the foundation not only for an organism’s physical characteristics but also for its behavioral predispositions. Just like the proliferation

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35. Success means reproductive success: having offspring that themselves reproduce.

36. This variation is a result of both mutation and sex. It takes only 265 generations for a simple trait that gives an organism a one percent reproductive advantage over its contemporaries to expand from a 1% representation in the population to a 99% representation. See ROBERT TRIVERS, SOCIAL EVOLUTION 28-29 (1985).

37. More specifically, surviving offspring who themselves reproduce. Although many species like the salmon have thousands of offspring, only a few of these, if any, themselves reproduce. Stable, or growing, populations are less the result of offspring number and more the result of fertile offspring.

38. Note that a single difference of .001 (that bestows some environmental advantage) takes only 300 generations to become dominant.

39. In a classic study on industrial melanism in moths, Kettlewell demonstrated that a completely black form of the moth *Biston betularia* had become more numerous in Britain, replacing the previously typical salt-and-pepper form in many areas near big cities. Kettlewell explained that the melanic form spread because it was less conspicuous to bird predators because the woodland had become blackened with soot from urban factories. The traditional salt-and-pepper form remained abundant in non-polluted forests since its white wings blended in better against the pale tree trunks. JOHN ALCOCK, ANIMAL BEHAVIOR: AN EVOLUTIONARY APPROACH 355 (5th ed. 1993).

40. A favorite conundrum of creationists is how to explain the development of complexity. How can something as intricate as an eye develop from nothing? What, they argue, is the use of half an eye? But based on various computer models and starting from a single light sensitive cell, it has been shown that it would take fewer than 400,000 generations to evolve a fish eye. In essence, it would take less than half a million years to evolve a good camera eye from flat skin. See Nilsson & Pelger, *A Pessimistic Estimate of the Time Required for an Eye to Evolve*, PROC. OF THE ROYAL SOC’Y OF LONDON, B (1994). Dawkins points out that image-forming eyes have evolved between forty and sixty times, independently from scratch, in many different invertebrate groups. “Among these . . . at least nine distinct design principles have [evolved], including pinhole eyes, curved-reflector eyes, compound eyes,” and camera-lens eyes. RICHARD DAWKINS, RIVER OUT OF EDEN 78 (1995). See also RICHARD DAWKINS, THE BLIND WATCHMAKER ch. 4 (1986).

of “brownness” in tree moths, some behavioral traits become more widespread because they are more favorable to survival and reproduction. Cat-friendly mice tend not to proliferate while cat-averse mice do. Because evolution fashions not only what an organism looks like but how it is capable of acting, evolution limits an organism’s choices and defines its interactive propensities. Cooperation can develop as a basic behavioral predisposition when such behavior leads to successful reproduction in the midst of scarce resources and recurrent competition. Even dominance-based species such as the great apes are naturally social, a mechanism that leads to resource acquisition, bodily protection, and, consequently, higher reproductive success.<sup>41</sup>

Humans too are the result of the evolutionary process. The genes we have are those that enabled our predecessors to have their genes forwarded.<sup>42</sup> Opposable thumbs and molars aided our ancestors in succeeding within their particular habitat. Each of our organs is constructed in its specified way because such design contributed to our ancestors’ fitness. The human brain is one of these organs, channeling our species into somewhat limited forms of adaptive behavior. And this is true not only for our more basic “animal impulses,” such as hunger and lust, but also for our higher forms of consciousness, such as aesthetics and morality. Humans sport neurologically similar brains with prescribed algorithms. As a species, we orient ourselves in the world in specific manners, predisposed toward certain behaviors in certain contexts, toward other behaviors in different contexts. These predisposed behaviors have been selected for their adaptive value. Our basic feelings, the manner in which we perceive our world, and how we interact with others are all tailored by their past contributions to reproductive success. Love, hate, empathy, shame, and pride all are the result of hereditary biases in mental development, feelings that help orient the individual within the environment to maximize the individual’s reproductive success.

A simple example may be helpful.<sup>43</sup> A genetic marker in humans, as in many species, that is predictive of a cacophony of behavioral predispositions is sex. Females are more coy; males are more aggressive. Such behavior is a reflection, in part, of the economies of the reproductive effort. Women have only a limited number of eggs and can have only a limited number of offspring, given their nine month period of gestation and several month post-birth period of lactation. For each fertilized egg, the female potentially experiences a very high resource investment and a limitation on her opportunities for future reproductive success. Consequently, it is to the females’ advantage to select “fitter” males to insure the “fittest” offspring.

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41. See FRANS DE WAAL, *GOOD NATURED* ch. 3 (1996). See generally EDWARD O. WILSON, *ON HUMAN NATURE* (1978).

42. Again, it is important to remember that genes do not consciously attempt to recreate themselves; when placed within the influence of natural selection, genes naturally are replicated if adaptive to the environment. One is reminded of Samuel Butler’s adage, “A chicken is only the egg’s way of making another egg.”

43. The following discussion comes from DAVID SYMONS, *THE EVOLUTION OF HUMAN SEXUALITY* (1979).



She thus becomes more reserved, more discriminatory, more coy. Because males can mass produce sperm and share significantly less parental responsibility, they are less sexually reserved, are more easily aroused, practice more infidelity, and are generally more sexually aggressive. In addition, because female selection makes the fertilization of her egg a highly limited resource, males must compete with each other for the chance of getting their genes into the next generation. Male aggression is again adaptive.

With the high value of her eggs, the female is interested in not only the physical attributes of her mate (the more symmetrical, i.e., handsome, the healthier; the healthier the less chance of disease), but also his post-sex investment.<sup>44</sup> In a species with a long child-dependency period, the female becomes very concerned with what the male will bring to her offspring after birth. In addition to the male's wealth, status, ambition, and industry, she is broadly concerned with a male's willingness to assist her in child rearing.<sup>45</sup> Seduction and abandonment are always a threat, especially given the inexpensive cost of male sperm. Females therefore look for indications of generosity, trustworthiness, and commitment. Accordingly, male displays of these traits (in the context of the male-female bond) deliver reproductive benefits and proliferate.<sup>46</sup> Conversely, if the male makes a parental investment, with all its sacrifice of time and resources, he is extremely concerned that the child be his. The male is particularly obsessed that his mate be faithful; and thus the female must exhibit traits that convey this message. Honesty, chastity, and fidelity are esteemed, naturally channeling the selective process toward producing females with at least the appearance of "Victorian" sexual propensities.<sup>47</sup>

Our biology thus forms the basis of most human behavior. We have been designed by millions of years of natural selection to feel certain ways and make certain choices when confronted with specific environmental stimuli—all in the

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44. See generally David Buss, *Sex Differences in Human Mate Preferences: Evolutionary Hypotheses Tested in 37 Cultures*, 12 BEHAV. AND BRAIN SCI. 1 (1989).

45. In species with low male parental investment, females focus primarily on the "quality" of the males genes—whether he appears healthy, is carrying disease, etc. The female's concerns can be dealt with quickly and usually the courtship, if any, is short. Human females look for high male parental investment because of prolonged infant dependence. Correspondingly, the courtship period is significantly longer while the female looks for signs of generosity, honesty, and dedication. In a pioneering study by David Buss, he found that in thirty-seven cultures around the world females placed significant emphasis on a potential mate's financial status. See *id.*

46. Seduction and abandonment can make genetic sense for males, especially if their offspring have a good chance of reaching reproductive age (where for instance his mate can gain the investment of another male who is led to think that the child is his). Consequently, natural selection may favor males that are good at deceiving females about their future commitment. And what more persuasive manner to deceive than to believe yourself that you are "committed, kind, and sincere." Devotion and true-love become marketable commodities of males. On the other hand, natural selection may favor females that are good at spotting male deception. For a more in depth analysis of the male-female courtship dialectic, see WRIGHT, *supra* note 1, at 55-72.

47. Males are concerned that any child they invest in is theirs. Men want their mates to be chaste and devoted so their parental investment is in their own genes. Thus, natural selection inclines men to discriminate against promiscuous women as mates, although they may be fine as sex partners for the short-term. This leads to the so-called Madonna-whore dichotomy found in most males—the tendency to perceive "two kinds of women," the kind they respect and the kind they sleep with. See DAVID SYMONS, *THE EVOLUTION OF HUMAN SEXUALITY* 241 (1979).

name of reproductive success. The biological roots of moral behavior also are based on maximizing the survival of an individual's genetic materials. Kin reciprocity and non-kin cooperation, the foundation of most moral orders, lead us away from the pure selfishness of the Prisoner's Dilemma<sup>48</sup> and explain notions of altruism and morality in the face of Dawkins' selfish gene.<sup>49</sup> In short, humans have a genetically endowed capacity to experience moral sentiments that predispose them to cooperate.<sup>50</sup> Moral codes are a reflection of strong biological feelings and predispositions, conforming or suppressing human action to reap the rewards of inclusive fitness.<sup>51</sup>

Ultimately, our moral predilections originate in the brain, the forms and functions of which have been tailored by natural selection to respond to the difficulties faced by our evolutionary predecessors.<sup>52</sup> Emotions too are part of our evolutionary heritage, designed as shortcuts to intractable problems and as commitment devices to impress others about the strength of our resolution in certain circumstances.<sup>53</sup> Our emotions have been "customized" by natural selection to influence behavior by affecting our tastes and preferences. Anger, greed, fear, love, and desire all influence our behavior and thereby affect reproductive success. Our species' inherent, evolved psychology reflects biologically effective symbiosis with the external (and, to some extent, internal) world. Humans are genetically programmed to be social beings and to display species-typical patterns of behavior. How we act, how we view our and others' actions, the emotions generated, and our awareness of these are all limited, and to a great extent controlled, by our genotype.

Humans are guided throughout their lives by their species' predispositions, instinctual algorithms, and emotions. Moral sentiments have been developed

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48. The Prisoner's Dilemma is a famous problem of game theory. Essentially, it attempts to explain how individuals might cooperate when it is in their self-interest to defect. In the classic situation, two individuals are held, accused of performing a crime. They are held separately and each is asked to implicate the other. If neither does, both are set free. If both confess, each is imprisoned. If one implicates the other, and not vice versa, then the other receives a harsher sentence. Rational thought would encourage each to implicate the other. The dilemma is that this makes each worse off than if they had decided to trust each other. See TRIVERS, *supra* note 36, at 389-92.

49. See DAWKINS, *supra* note 28. In his groundbreaking book, Dawkins argues that the fundamental unit of natural selection is the gene, rather than the species, the group, or the individual. Dawkins' basic analysis is widely accepted among today's biologists.

50. See Robert Frank, *Emotion and the Costs of Altruism: The Economic Foundations of the Sense of Justice*, in SENSE OF JUSTICE, *supra* note 7, at 47-66.

51. Inclusive fitness is the sum of an individual's direct and indirect fitness. Direct fitness is the measure of the genes contributed to the next generation by an individual via personal reproduction. Indirect fitness is the measure of the genes contributed by an individual indirectly by helping non-descendant kin (brothers, aunts, etc.), in effect creating relatives that exist because of the assistance of the individual. See ALCOCK, *supra* note 39, at 506-21.

52. See PINKER, *supra* note 23.

53. The human brain is an information processor designed by natural selection to be good at solving specific types of problems and to produce emotional realities that led to adaptive behavior (at least on the part of our ancestors in the environments they faced). The brain thus mediates human behavior by predisposing humans to correlate emotional states with environmental stimuli. Owen Jones, *Law, Emotions, and Behavioral Biology*, LAW AND EVOLUTIONARY BIOLOGY, 269-79 (1999).

throughout our evolution, products of the interactions of genes and the environment. Given the generational time-lag between reproductive advantage and species-wide proliferation of any characteristic, the moral sentiments we exhibit today are probably best suited to our paleolithic ancestors. Humans exhibit a “belonging identity,” reflecting the efficiency and evolutionary advantage of the small group in hunter-gather society.<sup>54</sup> We have a genetically-based inclination to favor kin or close phenotypes as this encourages our genotype being passed to succeeding generations.<sup>55</sup> Our moral sentiments naturally evolved to be selective given the commonality of purpose and kin recognition so important to hunter-gatherer social transactions.<sup>56</sup> We are not willing to cooperate indiscriminately with others, but cooperate most primarily with our kin and then, typically, with our “in-group” or those who share a similar physical appearance. Consequently, compassion towards, and trust for, strangers are difficult goods for our species. Even though we are a highly social species whose existence depends largely on cooperative living, we exhibit a genetic bias for ethnocentrism and are innately xenophobic. All of these predispositions restrict our objectivity and ground our ethics. Conscience, empathy, shame, outrage and humility all confine us within narrow behavioral conventions. Quite simply, our morals have been engineered to assist us in efficiently solving the problems of survival and reproduction. Any “ought” is a reification of a real-world genetic advantage.

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54. See generally Robin Dunbar, *Sociobiological Explanations and the Evolution of Ethnocentrism in ETHNOCENTRISM*, 48 (1987); Wolfgang Tonnesmann, *Group Identification and Political Socialization in ETHNOCENTRISM*, 175 (1987).

55. See generally Dunbar, *supra* note 54; Tonnesmann, *supra* note 54.

56. Wilson illustrates the evolution of moral sentiments with the following story:

Imagine a Paleolithic band of five hunters. One considers breaking away from the others to look for an antelope on his own. If successful, he will gain a large quantity of meat and hide—five times as much as if he stays with the band and they are successful. But he knows from experience that his chances of success are very low, much less than the chances of the band of five working together. In addition, whether successful alone or not, he will suffer animosity from the others for lessening their prospects. By custom the band members remain together and share equitably the animals they kill. So the hunter stays. He also observes good manners in doing so, especially if he is the one who makes the kill. Boastful pride is condemned, because it rips the delicate web of reciprocity.

Now suppose that human propensities to cooperate or defect are heritable: some people are innately more cooperative, others less so. In this respect moral aptitude would simply be like almost all other mental traits studied to date. Among traits with documented heritability, those closest to moral aptitude are empathy with the distress of others and certain processes of attachment between infants and their care givers. To the heritability of moral aptitude add the abundant evidence of history that cooperative individuals generally survive longer and leave more offspring. Following that reasoning, in the course of evolutionary history genes predisposing people toward cooperative behavior would have come to predominate in the human population as a whole. Such a process repeated through thousands of generations inevitably gave rise to moral sentiments. With the exception of psychopaths (if any truly exist), every person vividly experiences these instincts variously as conscience, self respect, remorse, empathy, shame, humility, and moral outrage. They bias cultural evolution toward the conventions that express the universal moral codes of honor, patriotism, altruism, justice, compassion, mercy, and redemption.

Edward O. Wilson, *The Biological Basis of Morality*, ATLANTIC MONTHLY, Apr. 1, 1998, at 53.

As biotechnology unravels the secrets of gene interaction, we are beginning to understand the biochemical bases of our behavior. Instincts and emotions clearly have a neurobiological source. Our brain's genetic evolution chronicles the creation of belief, moral purpose, spirituality, and religion.<sup>57</sup> To the extent that biotechnology can influence our evolved brain circuitry or alter our existing genetic template, it promises to allow us to do something we have yet to accomplish—separate us from our evolutionary heritage. Our evolved biology allows us to flourish only within a narrow range of belief systems and ethical precepts. Technological manipulation of our genotype promises to open new linkages between behavior and feelings. We might engineer new behavioral predispositions that could maximize fitness in a modern society. We could “grow” children who are “naturally” bonded to the state, rather than to their biological parents; or who have “naturally” egalitarian sentiments, rather than their biologically-based deference to dominance, power, and status. Instincts could be modernized, so that individuals become inherently fearful of cars and electricity rather than spiders and snakes.<sup>58</sup> We might “redesign” humans so that they feel “right” when practicing deception that is to their reproductive advantage and shameful when practicing heroism that is to the advantage of others. The day may not be far off when Calvin Klein “designer genes” wage market battles with Tommy Hilfiger customized moral precepts. Parents might choose not only the color of their daughter's eyes but also her capacities for politeness, garbage recycling, cheating, and parental respect. Ethnic and racial discrimination might be minimized by manipulating gene patterns that show a proclivity for heterogenous affiliation. Select ethical precepts might be made more resistant to environmental corruption. The list is almost endless. In short, in the not too distant future, we may no longer be focusing primarily on the ethics of biotechnology, but instead be creating our own personal ethical dispositions by biotechnological doctoring. Indeed, even the question of whether such bioengineering is moral may be rendered innocuous by generating genotypes which experience such doctoring as “right”. The great religions and philosophers that have been such an integral part of the human animal may have met their match. Such “high” thoughts and ideals became a part of the human experience because of the evolutionary advantages such belief systems and brain algorithms brought. When we reinvent our basic evolutionary selves, we overstep the limitations of natural selection and ourselves become the god that, until now, we have been biologically predisposed to acknowledge.

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57. Wilson posits that religious behavior is hereditary, implanted in humans as biases in mental development that are encoded in their genes. Empirically, he notes that one form of brain disorder is associated with hyper-religiosity, in which cosmic significance is seen in everything, including the most trivial of everyday events. *Id.* See generally RICHARD ALEXANDER, *THE BIOLOGY OF MORAL SYSTEMS* (1987).

58. Wilson observed that the “imprint” of our past “cannot [be] erased in a few generations of urban life.” He noted that people acquired phobias to the objects and circumstances that threatened them in their past natural environments: heights, closed spaces, open spaces, running water, wolves, spiders, and snakes. They rarely form phobias to the recent objects of modern society that are far more dangerous, such as guns, knives, cars, and electric sockets. See WILSON, *supra* note 9, at 349.

### III. THE FUTURE OF LAW

The law concerns itself with the regulation of human behavior. As such, the law often attempts to limit, or encourage, certain behaviors that are genetically packaged within us. External social restraints can be beneficial to a species that displays innate impulses toward aggression and deception. Cooperation may need to be fostered where complex social relationships make reciprocity indirect. But it would be a mistake to understand the law as something completely external to the individual. Humans are legal creatures because their biology supports rule-based behavior.

Ethology mirrors the laws and rules of the human community. Much of human behavior has evolved from the rich traditions of animal society. Reciprocity, guilt, incest taboo, and status consciousness are all found in the behavioral repertoire of our great ape cousins.<sup>59</sup> Animals which exhibit a capacity for individual recognition and an awareness of history demonstrate a sense of moralistic aggression, the foundation of social regularity and the precursor to a sense of justice. The recognition of unbroken evolutionary development from primate to human underscores this comparison. Primate societies contain a multitude of prescriptive rules, with individual members clearly displaying and utilizing notions of retribution, justice, contrition, remorse, and revenge.<sup>60</sup> They, as we, seem regulated by an “unwritten constitution” fixed within a triune brain.<sup>61</sup>

The sense of justice which forms the basis of human legal behavior is grounded in the comparison between experience and expectation. Violations of reciprocity or

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59. Frans de Waal chronicles how many nonhuman primates develop an intricate sense of regularity through social rules. Chimpanzees clearly keep mental records of social events and adjust their behavior according to rules of reciprocity applying to both beneficial and detrimental acts. Coalitions form and delayed retaliation helps establish rules of conduct within their community. See generally FRANS DE WAAL, CHIMPANZEE POLITICS: POWER AND SEX AMONG APES (1989); FRANS DE WAAL, GOOD NATURED: THE ORIGINS OF RIGHT AND WRONG IN HUMANS AND OTHER ANIMALS (1996).

60. As one example, in one chimpanzee colony in Arnhem, all members of the colony must enter their building sleeping quarters in the evening. Failure to do this promptly leads to a delay in their evening meal. Having learned this, the chimpanzees themselves assist their caregivers in getting every colony member to enter the building in the evening. Late comers meet with a great deal of hostility from the hungry members. On one occasion, two adolescent females stayed out late for hours. Knowing the angry reception they would have met from their famished colony, the human caretakers isolated them in separate cages for the night, hoping to prevent punishment. However, when all were released the following morning, the colony took its revenge on the two for their delayed meal. Frans de Waal, *The Chimpanzee's Sense of Social Regularity and Its Relation to the Human Sense of Justice* in SENSE OF JUSTICE, *supra* note 7, at 241.

61. A comparison of the brains of existing vertebrates show that the human brain has evolved to its current size while retaining the anatomical and chemical features of three basic historical formations, ones that reflect ancestral relationships to reptiles, early mammals, and late mammals. See Paul MacLean, *A Triangular Brief on the Evolution of Brain and Law*, LAW, BIOLOGY & CULTURE: THE EVOLUTION OF LAW 74-80 (Gruter & Bohannon eds., 1983). As an example, the proto-reptilian part of the fore-brain plays a crucial role in the display of power and the defense of territory. This R-complex plays a basic role in displays used in social communication. The stilted, staccato steps seen in the goose steps of many military parades is a form of reptilian challenge display that has been “genetically packaged and handed up the phylogenetic tree of mammals.” *Id.* at 82. In humans, such behaviors are expressed in obsessive-compulsive acts, ceremonial re-enactments, and obeisance to precedent in legal matters. *Id.* at 81.

expected behavior elicit strong emotional responses that lead to certain efficiencies in the ordering of resources and opportunities. Indeed, human behavior, like most primate behavior, reflects a sense of how others should or should not behave. Our biology contains a complex of algorithms and predispositions that define a set of expectations about how we and others should be treated and how resources should be distributed.<sup>62</sup> Deviation from these ingrained expectations to an individual's detriment leads to a negative response, a sense of perceived injustice, and moral reproach.<sup>63</sup> Legal systems tend to standardize our inherent behavioral expectations, aimed at fulfilling needs which are fundamental to self-preservation.

Our physiology evidences a neural and chemical basis for law-abiding behavior.<sup>64</sup> Endogenous opiates are released by the brain when behavior matches expectations.<sup>65</sup> Just as food and sex are needed rewards in most species, so too is rule-compliance within the human. Indeed, so powerful is the "rule response" that even behavior that we are strongly predisposed to avoid, such as infanticide, can feel "good" when expectations for such behavior are met.<sup>66</sup> Our brains are genetically programmed to release rewarding chemicals when rules are followed. Just as animals learn to be careful around fire because touching it causes pain, humans follow the law because so doing feels "right." Quite simply, when humans comply with laws, even with "bad" laws, they receive an opiate reward.

Law reinforces socially beneficial behavior, maintaining the individual's adaptability and forwarding the individual's reproductive fitness. While there are, at most, only a few gene programs that dictate a specific law or rule, we are programmed to obey laws and rules. Our evolved emotions reinforce this basic directive. We are pre-structured to expect certain connections between ourselves and the world and ourselves and each other. When these connections are made, we engage in regular, lawful behavior and are rewarded with pleasurable feelings. To ourselves, justice is "served." On the other hand, when behavior and expectation are in dissonance, we may experience various emotions such as outrage, guilt, or both. Even though neither feeling has anything to do with establishing our underlying idea of what is just, each serves to reinforce our rule-abiding nature. Ultimately, our sense of justice seems to "know" what is right even though we have a hard time explaining why. Emotionally and rationally, we want and expect to be ruled by law.

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62. See Bartley Hoebel, *The Neural and Chemical Basis of Reward: New Discoveries and Theories in Brain Control of Feeding, Mating, Aggression, Self-Stimulation and Self-Injection*, LAW, BIOLOGY & CULTURE (Gruter & Bohannon eds., 1983.)

63. *Id.*

64. *Id.* at 111, 126-27.

65. *Id.* at 127.

66. Helmrich illustrates the case of infanticide in the Yanomamo Indian culture. The husband of a Yanomamo mother who had just given birth but returned without her child explained that their other child was still being nursed and needed the milk. Herbert Helmrich, *An Ethological Interpretation of the Sense of Justice on the Basis of German Law*, in SENSE OF JUSTICE, *supra* note 7, at 211, 215-17. When infanticide is used as a means of population control to help assure the survival of other children, it continues to be important that it be done before the mother's attachment to the child can grow. *Id.*

Biotechnology will enable us to artificially create opiate-rewards. Although we can already do this pharmaceutically, biotechnology offers the prospect of constructing human genotypes with “enhanced” or “depressed” legal tendencies. Genetic manipulation of protein fragments could result in situational ethics and situational obedience. We even may be able to “tweak” our biology to produce discriminatory rule-following, allowing preselection of the type and extent of allegiance to follow designated emotions and circumstances. Conformity could be promoted to an even greater degree than our evolutionary heritage. Genetically programmed brain circuitry could insure a scrupulously law-abiding society.

Perhaps less disturbingly, biotechnology also provides new means to reconnect law with its origins in human behavior. By offering a clearer understanding of the behavioral predispositions that are built into our species by our evolutionary past, biotechnology should yield many insights to help us evaluate our legal rules and their effectiveness. Our behaviors and predispositions are the ones that led to our ancestors’ reproductive success; in today’s environment, they can sometimes lead to irrational and maladaptive results. By contextualizing our behavior within our evolutionary history and by understanding the origins of our sense of justice, we can utilize this new technology to produce efficient expectations, more carefully tailored to the needs of today. This in turn can aid in developing legal systems that more effectively regulate these behaviors. Rather than changing our biological selves, we can utilize the science to understand how we perceive and process environmental stimuli to help us design more functional legal and social systems.

#### IV. CONCLUSION

Biotechnology has almost instantaneously transformed yesterday’s science fiction into today’s reality. And today’s reality is becoming almost incomprehensible to the ordinary human. Our evolutionary and cultural heritage has left us particularly unequipped to respond to the new biotech century. Science has outstripped our ability to understand its significance or its merit. Our means of comprehending the world, our biologically-contoured corridor of perception and reality, is not designed to assist us in making efficient technological choices; rather we are exquisitely designed to position ourselves well in the non-technological world of our distant past. We “gene machines” are fashioned to efficiently gain reproductive success within the hunter-gatherer groups of the African savannah. Our emotions, instincts, and behavior have been crafted over countless generations to provide advantage within the specific, defined environments of our past. The complexities of modern society strain our abilities to situate ourselves effectively in today’s world and create dissonance within our established notions of meaning and self-identity.

The human mind has evolved to embrace morality and believe in the spiritual. Genetically, we have been constructed to accept ethical paradigms and order our actions around legal parameters. Religion and law are necessary outcomes of our

basic biological nature. We have not evolved to believe in technology or to readily found our belief systems on scientific truths. As E. O. Wilson stated, “the essence of humanity’s dilemma is that we evolved genetically to accept one truth and discovered another.”<sup>67</sup> It may well be that technology has outstripped our ability to comprehend or imagine. The human mind and human behavioral predispositions may be maladapted to the realities of modern innovation.

Nonetheless, science is allowing us to understand who we are and how we have positioned ourselves in this world. By gaining a clearer understanding of the predispositions inherent within ourselves and the reasons for their selective development, we are better positioned to make, administer, and critique our ethical systems and laws. Insights into the bases of our moral, social, and legal constructs should allow us to more readily evaluate their effectiveness and to more meaningfully modify their principles.

We humans position ourselves in this world in defined ways. We are the descendants of individuals who gained reproductive success by utilizing certain behavioral strategies. These choices are encoded in our genes and show up as the capabilities and limitations of our species. To this extent, we do what our biology permits. Biotechnology promises to allow us to change this very biology. Unrestrained by the force of natural selection, the possibilities of what we can become are almost limitless. Within this century, we will be able to choose not only the physical characteristics of our children but also much of their personality. Our “pediatric grocery lists” will include genetic combinations that create selected predispositions toward love, aggression, faith, hope, and empathy. These designer children will reflect more than a next-generation combination of their parents’ genes. They will reflect the inherent biases of their first generation ancestors. This is perhaps biotechnology’s greatest challenge. How and when we utilize our technological possibilities are questions of the utmost importance. Today’s ethics provides few answers. It is yet to be seen whether our species is capable of adapting to its new environment. We are born to dream, and to trust, and to hope; but we must remember that extinction has been a frequent occurrence throughout evolution.

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67. See Wilson, *supra* note 56, at 17.