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An Agricultural Law Research Article

**Patenting Life: Biotechnology, Intellectual
Property, and Environmental Ethics**

by

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Originally published in BOSTON COLLEGE ENVIRONMENTAL AFFAIRS LAW
REVIEW
22 B.C. ENVTL. AFF. L. REV. 267 (1995)

www.NationalAgLawCenter.org

PATENTING LIFE: BIOTECHNOLOGY, INTELLECTUAL PROPERTY, AND ENVIRONMENTAL ETHICS

Ned Hettinger*

I. INTRODUCTION

Human beings must determine an appropriate relationship to the earth and live accordingly. This task is more important now than ever before. Nonhuman forms of life and nonhumanized habitats are disappearing fast. The rate of anthropogenic species extinction is hundreds—perhaps thousands—of times greater than normal background extinction rates, resulting in a possible loss of one-quarter of all species on earth within fifty years.¹ One eminent scientist suggests that “we are in the midst of one of the great extinction spasms of geological history.”² Our species, *Homo sapiens*, one species among millions of others,³ now appropriates between twenty and forty per-

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The author thanks Karen Burnett, Gary Comstock, Pete Hinckley, Dale Jamieson, and David Kline for stimulating comments and criticisms. The author benefited greatly from discussions of draft versions of this Article with philosophers at the Center for Values and Social Policy at the University of Colorado at Boulder and with the participants at a Symposium on Ethics and Patenting of Transgenic Organisms sponsored by the National Agricultural Biotechnology Council and the Center for Biotechnology Policy and Ethics at Texas A&M University.

¹ See EDWARD O. WILSON, *THE DIVERSITY OF LIFE* 280 (1992); Paul R. Ehrlich & Edward O. Wilson, *Biodiversity Studies: Science and Policy*, 253 *SCIENCE*, 758, 760 (1991).

² WILSON, *supra* note 1, at 280. There have been approximately a dozen mass extinctions chronicled in the fossil record. See NEIL CAMPBELL, *BIOLOGY*, 500 (2d ed. 1990). It typically has taken between 2 and 10 million years for the earth to rebuild its former diversity after major catastrophic extinctions. *Homo sapiens* are only about 250 thousand years old. For discussion, see Steven Jay Gould, *The Golden Rule—A Proper Scale for our Environmental Crisis*, *NAT. HIST.*, Sept. 1990, at 24–30.

³ 1.4 million species have been identified worldwide and estimates of total global species diversity range from 5 to 100 million. See William K. Stevens, *Species Loss: Crisis of False Alarm?*, *N.Y. TIMES*, Aug. 20, 1991, at C1, C8.

cent of the photosynthetic energy produced by land plants.⁴ Human population, currently at 5.6 billion, is projected by the United Nations to more than double by the middle of the next century.⁵

Along with these problems has come an attempt to reconceptualize humans' relationship to other life forms in moral terms by developing what is often called an "environmental ethic."⁶ Perhaps the first to articulate the need for such a "land ethic" was Aldo Leopold,⁷ who in 1949 wrote:

The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.

. . . .

In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such.⁸

Without such a land ethic, Leopold contends, we will not be able to heal our relationship to the earth:

Conservation is getting nowhere because it is incompatible with our Abrahamic concept of land. We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the esthetic harvest it is capable, under science, of contributing to culture.⁹

This Article uses an environmental ethic to evaluate recent changes in intellectual property protection for biotechnology. Biotechnology—or "life technology"—is a particularly fruitful and appropriate subject of analysis for an ethic founded on respect for life.¹⁰ Questions about the ownership of the fruits of biotechnology should be of special

⁴ See PAUL R. EHRLICH & ANNE H. EHRLICH, *HEALING THE PLANET* 34 (1991); see also WILSON, *supra* note 1, at 272. Humans appropriate this photosynthetic energy which powers virtually all living organisms on the planet by consuming plants directly or through animal intermediaries, by reducing the energy as with the clearing of tropical forests for pasture lands, or by destroying the energy as with the construction of parking lots and shopping malls.

⁵ LESTER BROWN, ET AL., *STATE OF THE WORLD, 1994: A WORLDWATCH INSTITUTE REPORT ON PROGRESS TOWARD A SUSTAINABLE SOCIETY* 7 (1994).

⁶ The academic, philosophical version of this attempt is represented by the journal *Environmental Ethics*, now in its seventeenth year of publication.

⁷ Precursors to Leopold include Henry David Thoreau and John Muir. For a useful history of environmental ethics, see RODERICK NASH, *THE RIGHTS OF NATURE* (1989).

⁸ ALDO LEOPOLD, *A SAND COUNTY ALMANAC AND SKETCHES HERE AND THERE* 204 (1987).

⁹ *Id.* at viii.

¹⁰ Biotechnology is of growing economic importance. By the turn of the century, annual sales

concern for those who, like Leopold, think conceptualizing the earth and its life forms as commodities must be resisted if humans are to find a proper place in the earth's community of life. Relying on this respect for life ethic and also on a philosophical analysis of justifications for intellectual property, this Article questions the appropriateness and desirability of human societies issuing patents in organisms and genes.

Section II examines the benefits and significance of biotechnology and traces troubling recent changes in biotechnology patent practice. Section III evaluates three rationales for intellectual property that may be used in defense of biotechnology patents. They are (1) the natural entitlements to the fruits of labor rationale, (2) the desert rationale, and (3) the consequentialist-incentive rationale. Section IV examines the costs and risks of biotechnology. Section V explores the negative impacts of biotechnology patents themselves. Section VI offers some conclusions.

II. THE DEVELOPMENT AND GROWTH OF BIOTECHNOLOGY PATENTS

A. *A Flurry of Biotechnology Patents*

In 1987, the United States Commissioner of Patents announced that "the Patent and Trademark Office now considers nonnaturally occurring nonhuman multicellular living organisms, including animals, to be patentable subject matter."¹¹ The Commissioner was simply following the Supreme Court's lead. In allowing the patenting of a genetically-altered oil-eating bacterium seven years earlier, the Court claimed Congress intended patentable subject matter to "include anything under the sun that is made by man."¹² "Utility patents"¹³ for plants

worldwide of products produced using recombinant DNA technology alone is projected to exceed \$40 billion. See J. Leslie Glick, *The Industrial Impact of the Biological Revolution*, in TECHNOLOGY AND THE FUTURE, 364 (Albert H. Teich ed., 5th ed. 1990).

¹¹ OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, PUB. NO. OTA-BA-370, NEW DEVELOPMENTS IN BIOTECHNOLOGY: PATENTING LIFE—SPECIAL REPORT, 93 (1989) [hereinafter NEW DEVELOPMENTS].

¹² *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980), reprinted in, PROPERTY: CASES, CONCEPTS, CRITIQUES 5-8 (Lawrence Becker & Kenneth Kipnis, eds. 1984) (quotation from p. 7). Notice that the Patent and Trademark Office was more circumspect than was the Court: the Patent and Trademark Office excluded human organisms from patentable subject matter. *Id.* Human organisms are, after all, "made by man" and woman.

¹³ Utility patents are the ordinary type of patent issued for inventions of processes, machines, manufactures, and compositions of matter. Thomas Edison received such a patent for the light bulb. There are other, more specific, types of patents, including "plant patents" which are legal

came next,¹⁴ and by the end of the decade Harvard University received the first patent on animal life. Its patent was for a mouse genetically altered to be susceptible to breast cancer.¹⁵ As the project's major sponsor, Du Pont possesses commercial rights and the chemical company is selling the patented research specimen for fifty dollars apiece.¹⁶ The Patent and Trademark Office has recently issued three additional patents on types of animals, all for mice to be used in biomedical research.¹⁷

Although human organisms have not been patented,¹⁸ human material routinely is patented.¹⁹ One particularly controversial example is the University of California at Los Angeles's patent of a cell line

instruments prohibiting the asexual reproduction of protected plant varieties. *See infra* note 59 and accompanying text.

¹⁴ Kenneth Hibberd received a patent for a variety of corn that contained a high level of an amino acid and whose progeny did as well. For a discussion of this patent, see R.S. CRESPI, PATENTS: A BASIC GUIDE TO PATENTING IN BIOTECHNOLOGY 113 (1988).

¹⁵ The "oncomouse," as it is known, was developed by Harvard researchers Philip Leder and Timothy Stewart. *See* SHELDON KRIMSKY, BIOTECHNICS AND SOCIETY: THE RISE OF INDUSTRIAL GENETICS 44-45 (1991).

¹⁶ *See* Elizabeth Corcoran, *A Tiny Mouse Came Forth*, SCI. AM., Feb. 1989, at 73.

¹⁷ The patents are for mice altered to develop enlarged prostate glands, which is a disorder that frequently occurs in male humans; for mice that fail to develop fully functioning immune systems; and for mice altered to constantly produce a protein that attacks viruses and helps prevent infection. Over 180 applications for animal patents are being reviewed by the Patent and Trademark Office. *See* The Associated Press, *U.S. Patents Are Granted for Three Laboratory Mice*, WASH. POST, Dec. 30, 1992, at A4; *see also* Edmund Andrews, *US Resumes Granting Patents on Genetically Altered Animals*, N.Y. TIMES, Feb. 3, 1993, at A1. By beginning with patents on mice used to study human disease, the Patent and Trademark Office has succeeded in dampening public opposition to animal patenting. People are particularly unsympathetic toward "rats," and research that has real promise for curing human disease is the most likely of any harmful uses of animals to be morally justifiable. Experimental use of animals is also the closest we come to treating animals as tools and so animal patents seem the least inappropriate in this context. What would the public and Congressional reactions have been if the first animal patents were for varieties of dogs or horses?

¹⁸ The Office of Technology Assessment (OTA) remarks that patent "claims directed to or including a human being will not be considered," because owning human beings is prohibited by the Thirteenth Amendment to the Constitution which banned human slavery. *See* NEW DEVELOPMENTS, *supra* note 11, at 22, 24. This, however, does not definitively settle the question of patents on human organisms. One commentator asks, "[s]ince cloned human embryos are not persons protected by the Constitution and theoretically at least could be as 'immortal' as cloned cell lines, could a particularly 'novel' and 'useful' human embryo be patented, cloned and sold?" *See* George J. Annas, *Of Monkeys, Man, and Oysters*, 17 HASTINGS CENTER REP., Aug. 1987, at 20, 22. Furthermore, given that patents on animals containing human genes are permitted, will we allow patents on human-animal hybrids? For discussion, see Rachel E. Fishman, *Patenting Human Beings: Do Sub-Human Creatures Deserve Constitutional Protection?*, 15 AM. J.L. & MED. 461, 461-82 (1989). *See also generally* Michael D. Rivard, *Toward A General Theory of Constitutional Personhood: A Theory of Constitutional Personhood for Transgenic Humanoid Species*, 39 UCLA L. REV. 1425 (1992).

¹⁹ A well-known analyst of patents in biotechnology claims that the practice of patenting

produced from a spleen removed from a Leukemia patient named John Moore.²⁰ Although the commercial potential of the pharmaceuticals that this cell line can produce is several billion dollars, the California Supreme Court has ruled that Moore has no ownership interests in these cells after they have been removed from his body.²¹ In addition, a biotechnology company has patented human bone marrow "stem cells," thereby obtaining a monopoly on their commercial use.²² The National Institutes of Health's (NIH) attempt to patent several thousand gene-fragments constituting about five percent of the human genome is another example of this frenzy for life patents.²³ Although the Patent and Trademark Office rejected NIH's applications, other more careful patent applications on human genes have been and will continue to be granted.²⁴ The environmental and international political significance of the biotechnology patenting issue is clear from the United States' refusal to sign the biodiversity treaty during the United Nations Conference on Environment and Development in Rio De Janeiro in 1992 because of perceived inadequacies in the treaty's handling of biotechnology patenting rights and royalties.²⁵

human genetic material is "commonplace and raises no moral issue." R.S. Crespi, *The Patenting of Genetic Resources*, 158 *IMPACT OF SCI. ON SOC'Y* 175, 183 (1992).

²⁰ For useful discussions of this case, see Carl Cranor, *Patenting Body Parts: A Sketch of Some Moral Issues*, in *OWNING SCIENTIFIC AND TECHNICAL INFORMATION*, 200-12 (Vivian Weil & John Snapper eds. 1989), and see George J. Annas, *Outrageous Fortune: Selling Other People's Cells*, 20 *HASTINGS CENTER REP.* Nov./Dec. 1990, at 36, 36-39.

²¹ *Moore v. Regents of the University of California*, 793 P.2d 479, 488-93, 271 Cal. Rptr. 146 (Cal. 1990).

²² The company developed a procedure to isolate a pure strain of the stem cells and received a patent not only in the particular process for isolating them, but in the stem cells themselves: no one can use stem cells *commercially* without getting a license from SyStemix, even if they come up with a new way to obtain the cells. See Shannon Brownlee, *Staking Claims on the Human Body*, U.S. NEWS & WORLD REP., Nov. 18, 1991, at 89.

²³ See Leslie Roberts, *NIH Gene Patents, Round Two*, 255 *SCIENCE* 912, 912-13 (1992); Edmund L. Andrews, *Dr. Healy's Big Push on Patents*, N.Y. TIMES, Feb. 16, 1992, at F12.

²⁴ The Patent and Trademark Office rejected the National Institute for Health's (NIH's) patent applications because the gene fragments were neither novel—NIH had taken them from existing DNA libraries—nor useful in themselves. Although the fragments allow for the identification of complete genes, the genes' functions were unknown. They also found NIH's proposed "inventions" obvious. Thus, NIH had failed to satisfy any of the three criteria for patenting: novelty, utility, and nonobviousness. See *Intellectual Property, Obviously Not*, THE ECONOMIST, Oct. 3, 1992, 90, 90-91. Under a new director, the NIH has decided not to appeal this ruling and has withdrawn its patent applications for an additional four thousand human gene-fragments. See Natalie Angier, *U.S. Dropping Its Efforts to Patent Thousands of Genetic Fragments*, N.Y. TIMES, Feb. 11, 1994, at A16.

²⁵ See Stanley P. Johnson, *THE EARTH SUMMIT: THE UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT (UNCED)* 81 (1993); see also *Policing Thoughts*, THE ECONOMIST, Aug. 22, 1992, at 55. In a reversal of the Bush Administration's decision, the Clinton Administration has signed the biodiversity treaty. The United States Senate, however, has not

B. *Biotechnology's Benefits and Significance*

The new biotechnologies promise a lot; in some cases they have already delivered. Medical benefits of biotechnology include the development of new drugs and enhanced production of old drugs that combat cancer, A.I.D.S., dwarfism, diabetes, hepatitis, and even aging.²⁶ Genetically-altered pigs produce human hemoglobin that might be used to develop a human blood substitute.²⁷ Genetically-altered mice produce an extractable protein in their milk that dissolves blood clots.²⁸ Both creatures exemplify a trend toward turning animals into living drug factories. The new biotechnologies also make it easier to identify genetically-caused diseases and permit the replacement of defective genes.²⁹ Ultimately, such technology will allow us to choose our children's genetic makeup.

In agriculture, biotechnicians have altered plants and animals for improved nutritional value. Biotechnicians have produced potatoes with more starch³⁰ and pigs with an increased protein-to-fat ratio.³¹ Researchers are also attempting to produce larger, faster growing, and more productive agricultural animals that require less feed.³² Biotechnicians are already altering plants to withstand pests and disease, and they hope to be able to produce plants that fix their own nitrogen and resist drought and cold.³³ The first genetically-altered whole food-product has recently appeared on supermarket shelves in the form of a tomato that spoils less quickly than unaltered tomatoes.³⁴

yet ratified it. For discussion, see the editorial *Biodiversity Pact on the Ropes*, N.Y. TIMES, Sept. 26, 1994, at A16.

²⁶ See KRIMSKY, *supra* note 15, at 223; Glick, *supra* note 10, at 359.

²⁷ See Philip J. Hilts, *Gene-Altered Pigs Produce Key Part of Human Blood*, N.Y. TIMES, June 16, 1991, at A1.

²⁸ See Lisa J. Raines, *The Mouse That Roared: Patent Protection for Genetically Engineered Animals Makes Legal, Moral, and Economic Sense*, ISSUES SCI. & TECH., Summer 1988, at 64, 65.

²⁹ Gene therapy has been approved on an experimental basis for somatic cells. The future promises germ-line gene therapy, alterations that will be passed on to future generations. See Leslie Roberts, *Ethical Questions Haunt New Genetic Technologies*, 243 SCIENCE 1134, 1154 (1989).

³⁰ See David M. Stark et al., *Regulation of the Amount of Starch in Plant Tissues by ADP Glucose Pyrophosphorylase*, 258 SCIENCE 287, 287-92 (1992).

³¹ Henry J. Miller, *Patenting Animals*, ISSUES SCI. & TECH., Winter 1988-89, at 24, 24.

³² Experiments are also under way to make chickens and pigs with flesh more suitable for microwaving. See Kathleen Hart, *Making Mythical Monsters*, THE PROGRESSIVE, March 1990, at 22.

³³ William K. Stevens, *Bioengineering Points to Better Rice Plant*, N.Y. TIMES, Feb. 6, 1990, at C1.

³⁴ For a description of Calgene Inc.'s Flavr Savr tomato, see Union of Concerned Scientists,

These developments raise hopes for an increase in the world's food supply and a decrease in the use of chemicals in agriculture.³⁵

Genetically-altered microbes that eat toxic wastes and degrade synthetic compounds may be useful in waste treatment.³⁶ Genetic technologies can help preserve endangered species.³⁷ Biotechnology even provides economic incentives for preservation, as it makes possible commercial uses of genetic material that previously lacked economic value.³⁸ Biotechnologies could lessen human dependence on other forms of sentient life by providing genetically altered, insentient life-forms as substitutes.

Biotechnology is an old technology. The use of living organisms to make bread, wine, and cheese is a longstanding human practice. People have "genetically-engineered" plants and animals, including humans, by selective breeding for desirable characteristics for thousands of years.³⁹

It is sometimes suggested that the new biotechnologies⁴⁰ are not radical departures from these historical practices. One defender of biotechnology claims that "centuries of selective breeding have altered domestic animals far more than the next several decades of transgenic modifications are expected to alter them."⁴¹ Another of biotechnology's defenders argues that nature routinely reshuffles genetic material by combining genes in new ways during sexual repro-

FDA Approves the Calgene Tomato, No Labeling Required, THE GENE EXCHANGE, June 1994, at 1.

³⁵ See KRIMSKY, *supra* note 15, at 88-89; Stevens, *supra* note 33, at C1.

³⁶ *Id.*

³⁷ See OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, PUB. NO. OTA-F-330, *TECHNOLOGIES TO MAINTAIN BIOLOGICAL DIVERSITY* (1987).

³⁸ See generally Roger Sedjo, *Property Rights, Genetic Resources, and Biotechnological Change*, 35 J.L. & ECON. 199, 199-213 (1992).

³⁹ See ANDREW GOUDIE, *THE HUMAN IMPACT ON THE NATURAL ENVIRONMENT* 15-20 (4th ed. 1990).

⁴⁰ Recombinant DNA techniques are perhaps the most exciting of the new biotechnologies and certainly are what has attracted the most popular attention. Recombinant DNA techniques include gene identification, isolation, splicing, cloning, chemical synthesis, and insertion into already existing organisms to produce desirable, heritable traits. Significant advances have also been made in tissue and cell culture techniques, including the production of "immortal" cell lines and the fusion of cells from different sources; the creation of storage technologies that involve freezing cells or embryos and successful thawing decades later; and the production of pure and high concentrations of various biological agents, for example, antibodies. For a description of these technologies, see OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, PUB. NO. OTA-BA-337, *NEW DEVELOPMENTS IN BIOTECHNOLOGY: OWNERSHIP OF HUMAN TISSUES AND CELLS—SPECIAL REPORT* (1987).

⁴¹ Reid G. Adler, *Controlling the Applications of Biotechnology: A Critical Analysis of the Proposed Moratorium on Animal Patenting*, 1 HARV. J.L. & TECH. 1, 20 n.126 (1988).

duction, by altering genes through mutations, and by transferring foreign genes into already existing organisms.⁴²

Still, there are notable differences between contemporary biotechnologies and both past human practice and what nature does by itself. Recent techniques for genetic manipulation are much faster and far more precise than is traditional, whole-organism crossbreeding.⁴³ Modern biotechnicians can produce organisms that possess specific desirable characteristics, while traditional, whole-organism crossbreeders produce organisms with a variety of new traits, many of which are undesirable and difficult to breed out.⁴⁴ While selective breeding necessarily takes place within a species or closely-related species, the new biotechnologies permit the combination of genetic material from significantly different species. Consider, for example, the sheep-goat chimeras produced from mixing the embryonic cells of goats and sheep.⁴⁵ Genes can also be moved directly between the plant and animal kingdoms, something nature never does.⁴⁶ For example, tobacco plants have been made to glow after a firefly gene was inserted into them.⁴⁷

⁴² Raines, *supra* note 28, at 67.

⁴³ NEW DEVELOPMENTS, *supra* note 11, at 13.

⁴⁴ *Id.*

⁴⁵ Produced at the University of Wyoming, these "geeps" have the horns of a goat and a sheep's body. See *What Do You Get If You Cross . . . ?*, THE ECONOMIST, Aug 15, 1987, at 67-68; Keith Schneider, *Where There Can Be a Patent on Life*, N.Y. TIMES, Oct. 30, 1987, at A10.

⁴⁶ One commentator speculates on the basis of similarity between genes that genes have moved between the plant and animal kingdoms without human assistance. There is no suggestion, however, that this movement was direct rather than a slow migration. See Winston J. Brill, *Why Engineered Organisms Are Safe*, ISSUES SCI. & TECH., Spring 1988, at 44, 47. Stephen Jay Gould thinks our new ability to move genes around is unique:

Evolution has a definite geometry. . . . Lineages split and diverge like the branches of a tree. A species, once distinct, is permanently on its own; the branches of life do not coalesce. . . . Biotechnology . . . place[s] genes of one species into the program of another, thereby combining what nature has kept separate from time immemorial. . . . What are the consequences, ethical, aesthetic, and practical, of altering life's fundamental geometry and permitting one species to design new creatures at will, combining bits and pieces of lineages distinct for billions of years?

Steven Jay Gould, *On the Origin of Specious Critics*, DISCOVER, Jan. 6, 1985, at 34, 34.

⁴⁷ See CAMPBELL, *supra* note 2, at 400. Consider another example:

The first genetically engineered plant to be approved for field-testing in the United States . . . was a herbicide-tolerant tobacco strain constructed using genetic material from a bacterium (a *Salmonella* species that had become resistant to the herbicide), controlled by additional genetic sequences from a mammal (sheep) and another plant (soybean) unrelated to tobacco, all inserted using a second species of bacterium [*Agrobacterium*].

Robert K. Colwell, *Natural and Unnatural History: Biological Diversity and Genetic Engineering*, in SCIENTISTS AND THEIR RESPONSIBILITIES 1, 9 (William R. Shea & Beat Sitter eds. 1989) (citation omitted).

These techniques allow genes to be synthesized "from scratch" using "gene machines" that "can string together the building blocks of DNA in any specified order."⁴⁸ One analyst predicts that the biotechnology industry will in the near future move beyond mimicking nature to the production of novel genes and gene products that have never before existed in nature.⁴⁹ The novelty of these new biotechnologies has been summed up thus: "While dramatic changes in organisms or progeny can be induced chemically, surgically, by controlling the environment, or controlling breeding, the potential of these agents of change remains a subset of the prospects opened up through genetic manipulation, which in principle permits all possible biological changes to be actualized."⁵⁰

Some commentators suggest that the changes in the planet resulting from the creation, use, and release of biotechnical products could dwarf the changes that have resulted from the use of petrochemical products.⁵¹ The World Resources Institute sees genetic material as the "oil of the Information Age."⁵² "Natural resources are going to matter less," says one commentator, "the real action is going to be in the gathering of genes."⁵³ Another sees modern biotechnology as resulting in "the second end of nature," and finds great significance in this manipulation of nature "from the inside out."⁵⁴ A well-respected biologist suggests that "our descendants may see the present period as the beginning of a massive reshuffling, under human direction, of the 'evolutionary inventions' that 3,000 million years of natural selection have produced in the earth's biota."⁵⁵ Given the significance of these new biological techniques, the decisions we make about biotech-

⁴⁸ John M. Czarnetzky, *Altering Nature's Blueprints for Profit: Patenting Multicellular Animals*, 74 VA. L. REV. 1327, 1333 n.26 (1988).

⁴⁹ Glick, *supra* note 10, at 363. Biologist Thomas Eisner of Cornell University takes a more sober view: "The future lies not in biotechnology's power to create new life forms, but in finding and preserving what already surrounds us. . . . We don't know enough to design compounds from scratch for this or that disease. . . . We've neglected the surefire approach, which is to look to nature." Joel Ray, *Good Chemistry*, 15 THE AMICUS J., Spring 1993, at 18, 18.

⁵⁰ Benjamin Freedman & Marie-Claude Goulet, *New Creations? Commentary*, 21 HASTINGS CENTER REP., Jan./Feb. 1991, at 34, 35.

⁵¹ Jeremy Rifkin, *Creating the Efficient Gene*, in PHILOSOPHY OF BIOLOGY 222, 223 (Michael Ruse ed., 1989).

⁵² See Jack Kloppenburg, *No Hunting: Scientific Poaching and Global Biodiversity*, Z MAGAZINE, Sept. 1990, at 104.

⁵³ Attributed to Jack Doyle. See Ward Sinclair, *Jack Doyle: A Warning Voice Amid the Biogenetic Revolution*, WASH. POST, Mar. 2, 1987, at A9; see also JACK DOYLE, *ALTERED HARVEST: AGRICULTURE, GENETICS, AND THE FATE OF THE WORLD'S FOOD SUPPLY* 21 (1985).

⁵⁴ BILL MCKIBBEN, *THE END OF NATURE* 162 (1989). McKibben sees global climate change as the first "end of nature." See *id.* at 7-8.

⁵⁵ Colwell, *supra* note 47, at 27.

nology will have serious ethical, social, and environmental implications.

C. *The New Biotechnology Patents as a Significant Change from Past Patenting Practice*

Proponents of biotechnology patenting suggest that the new biotechnology patents, or "biopatents," are minor and logical extensions from past practice, not radical revisions.⁵⁶ Proponents claim that the puzzlement, shock, and outrage often expressed when people first become aware of the patenting of animals and human genes are inappropriate if such patents are understood in proper historical and economic context.⁵⁷ Proponents point out that patents on biotechnical process such as fermentation have been issued in the United States since the early 1800s.⁵⁸ In addition, Congress passed a Plant Patent Act (PPA) in 1930,⁵⁹ as well as the Plant Variety Protection Act (PVPA) in 1970,⁶⁰ and both provide for patent-like protection for new types of plants.

⁵⁶ See, e.g., Raines, *supra* note 28, at 65-68.

⁵⁷ See generally Adler, *supra* note 41, at 1-61; Crespi, *supra* note 19.

⁵⁸ One such patent, issued to Louis Pasteur in 1873, included a claim for a yeast as an article of manufacture. This suggests that Chakrabarty's 1980 patent was not the first patent on an organism per se. Pasteur's yeast patent, however, was an anomaly. Prior to the *Chakrabarty* decision, the Patent Office would not issue patents for living organisms themselves independent of their use, but only for compositions containing living things, such as waste disposal systems containing bacteria. See P.J. Federico, *Louis Pasteur's Patents*, 327 *SCIENCE* 86, 86 (1937); see also *NEW DEVELOPMENTS*, *supra* note 11, at 7, 31, 51.

⁵⁹ Plant Patent Act, ch. 950, 66 Stat. 804 (1952) (codified as amended at 35 U.S.C. §§ 161-164 (1988)). At the time, plants appeared to be unsuitable for utility patent protection. In response to industry pressure, Congress enacted the Plant Patent Act (PPA) as an alternative mechanism to stimulate the plant breeding industry. The PPA protects against only the unauthorized asexual reproduction of plants; for example, by rooting clippings. For useful discussions of the history behind both the PPA and the Plant Variety Protection Act (PVPA), and their differences from the new utility patents for plants, see Glenn Bugos & Daniel Kevles, *Plants as Intellectual Property: American Practice, Law, and Policy in World Context*, HUMANITIES WORKING PAPER 1944 (Pasadena, CA: Division of Humanities and Social Sciences, California Institute of Technology, October 1991), and see generally Frederick H. Buttel & Jill Belsky, *Biotechnology, Plant Breeding, and Intellectual Property: Social and Ethical Dimensions*, in *OWNING SCIENTIFIC AND TECHNICAL INFORMATION* 110, 110-39 (Vivian Weil & John Snapper eds. 1989). For a useful chart summarizing the differences between the PPA, the PVPA, and utility biopatents, see *NEW DEVELOPMENTS*, *supra* note 11, at 12.

⁶⁰ Plant Variety Protection Act, Pub. L. No. 91-577, 84 Stat. 1542 (1970) (codified as amended at 7 U.S.C. §§ 2321-2583 (1988 & Supp. V 1993)). This act is administered by the United States Department of Agriculture rather than the Patent Office (which administers utility patents and plant patents). 7 U.S.C. § 2321. The Act provides for the issuance of "certificates of protection to breeders" not "patents to inventors," and it protects against both sexual and asexual reproduction of plants. *Id.* §§ 2481-2483.

Although there has been a steady trend in this century toward privatizing biological material, the recent biopatents are a significant and troubling change. These new utility patents provide far more aggressive property rights in biological entities than have previously existed.

Utility patents treat any type of living being—other than persons—as patentable subject matter.⁶¹ In addition to organisms, one can patent as *products* organism parts, such as flowers, fruits, seeds, and fertilized eggs.⁶² Genes and other DNA⁶³ can be patented, whether natural, recombinant, or synthetic.⁶⁴ Cells and cell lines can be patented,⁶⁵ as well as gene and cell products, such as proteins and antibodies.⁶⁶ One can also patent specific *uses* of any biological agent, whether the agent is novel or preexisting.⁶⁷ Examples are patenting a bacterium for use as an insecticide or human stem cells to treat disease. Additionally, biotechnical processes for manipulating these biological materials and organisms, such as gene-splicing techniques, can be patented.⁶⁸

Utility patents are not restricted to a specific type of organism, such as red-delicious apple trees, as is the case under the PPA and the PVPA.⁶⁹ Utility patents can establish property rights in broad classes of organisms in radically different species as long as the organisms have the same traits and functional properties.⁷⁰ Harvard's oncomouse patent is actually an "oncomammal" patent.⁷¹ Harvard owns *any mammal with any recombinant, cancer-causing gene*—and there are about forty known—inserted into the mammal or its ancestors at an

⁶¹ See *supra* notes 1–15 and accompanying text.

⁶² NEW DEVELOPMENTS, *supra* note 11, at 76.

⁶³ Ninety-five percent of human DNA does not code for genes. But this nongenetic DNA, as well as parts of genes, can be useful in, for example, identifying genes. See Crespi, *supra* note 19, at 183.

⁶⁴ *Id.* at 178–81.

⁶⁵ See *supra* notes 21–22 and accompanying text.

⁶⁶ See Lisa J. Raines, *Protecting Biotechnology's Pioneers*, ISSUES SCI. & TECH., Winter 1991–92, at 33, 34; see also NEW DEVELOPMENTS, *supra* note 11, at 56.

⁶⁷ See NEW DEVELOPMENTS, *supra* note 11, at 61; Crespi, *supra* note 19, at 176.

⁶⁸ See Raines, *supra* note 66, at 35.

⁶⁹ For PPA, see PATENT & TRADEMARK OFFICE, U.S. DEPARTMENT OF COMMERCE, MANUAL OF PATENT EXAMINING PROCEDURE § 1610 (5th ed. rev. 1993). For PVPA, see 7 U.S.C. § 2541 (1988), where infringement is specified in such a way that only the new variety is protected. See also NEW DEVELOPMENTS, *supra* note 11, at 72, 73, 76.

⁷⁰ See Czarnetzky, *supra* note 48, at 1354, 1358.

⁷¹ Harvard received a patent for "any transgenic nonhuman mammal all of whose germ cells and somatic cells contain a recombinant activated oncogene sequence introduced into said mammal, or an ancestor of said mammal, at an embryonic stage." See NEW DEVELOPMENTS, *supra* note 11, at 99 (quoting from U.S. Patent No. 4,736,866).

embryonic stage.⁷² Thus, biotechnicians can patent organism-types that they have never actually produced.⁷³

Furthermore, utility patents prohibit farmers from the common practice of saving and using seeds from previous crops or from breeding animals.⁷⁴ Generally, utility patents allow any organism-patent holder to prohibit those to whom they sell the organism from breeding it, whether the buyer be a farmer, family, or researcher.⁷⁵ Utility patents also lack a research exemption that is present under PPA and PVPA, thus erecting a barrier to further innovation.⁷⁶

III. RATIONALES IN DEFENSE OF BIOPATENTS

A. *The Need for Justifying Biopatents*

The legal changes in biotechnology patenting during the last fifteen years are not minor and logical extensions of past practice. Rather, they are brazen forays into uncharted moral, legal, social, and environmental territory. The new biopatents constitute a significant change in society's relation to living beings, including ourselves. Questions of justification loom large. We cannot simply assume the permissibility and appropriateness of such patents because of our longstanding practice of issuing quasi-patents on certain types of plant

⁷² See Corcoran, *supra* note 16, at 73.

⁷³ How broad a utility patent claim can legitimately be depends on the extent to which the patented idea "could reasonably be expected to work more broadly than has been demonstrated in the examples of the patent disclosure." See John H. Barton, *Patenting Life*, SCI. AM., Mar. 1991, at 40, 44. In the three most recent mouse-type patents, the Patent Office allowed patenting only of the particular species altered. See Sally Lehrman, *Ruling Narrows US View of Animal Patents*, 361 NATURE 103, 103 (1993).

⁷⁴ To prevent patent infringement by buyers breeding their own oncomice, Du Pont had considered selling only one sex or sterilizing the mice it sells. In the end, Du Pont decided to rely on the honor system. They will write to the buyers of oncomice who reproduce them—and presumably to those who produce oncomammals of any sort—and request a user's licensing fee. See Corcoran, *supra* note 16, at 73.

⁷⁵ Selling patented organisms is also to sell a means by which the buyer can infringe the patent, at least when the organisms self-replicate "true-to-type." Asexual reproduction—because it produces genetically identical offspring—would always infringe the patent. With sexual reproduction, allele swapping may result in an offspring lacking the patented features, and thus patent infringement may or may not occur. For a discussion, see Robert G. Zimbelman, *Patenting Animals*, ISSUES SCI. & TECH., Winter 1988–89, at 26, 26.

⁷⁶ Unlike the PPA and the PVPA, utility patent statutes prohibit the use of patented organisms for experimental breeding and research. Most other nations have such a research exemption. The only exemption under the United States patent statutes is case law that allows for experimentation to satisfy academic curiosity; experimentation for commercial purposes is not allowed. One commentator sees this as "unfortunate" and argues that progress and science are best served if all laboratories, including commercial ones, have the right to experiment freely with patented organisms. See Barton, *supra* note 73, at 43–44.

innovations. This section, therefore, evaluates potential justifications for these new biopatents.

There exists another reason why the need for justifying biopatents is particularly poignant. Intellectual property, such as biopatents in oncomammals, unlike tangible property, such as wrist watches, is nonexclusive.⁷⁷ Researchers throughout the world could use Du Pont's oncomammals. Whereas with tangible property, one person's use excludes others from using the property. Thus, intellectual property faces a special burden of justification not shared by justifications for owning tangible property. It is *prima facie* irrational for society to grant monopoly rights to something that all could use at once.⁷⁸

Without intellectual property, market incentives may not work adequately to stimulate the production of innovations. Because of this, the burden of justification against monopoly rights in nonexclusive objects brings with it a *prima facie* case in favor of public funding for innovation. Thus, the defender of biopatents has a special burden of proof to show that such monopoly rights are acceptable, while the defender of public funding for biotechnology invention holds a position with initial plausibility that needs to be defeated if biopatents are to be justified.

B. *The Natural Entitlement to the Fruits of Labor Rationale*

One justification often used in favor of property rights in general is that people are naturally entitled to the fruits of their labor. This originally Lockean argument boils down to the intuition: I made it and hence it is mine; it would not have existed but for me.⁷⁹ Both philosophers and the United States Congress's Office of Technology Assessment have appealed to this argument to defend biopatents.⁸⁰

⁷⁷ For a fuller treatment, see Edwin C. Hettinger, *Justifying Intellectual Property*, 18 PHIL. & PUB. AFF. 31, 34-35 (1989).

⁷⁸ By establishing a monopoly in types of self-replicating entities, organism patents are especially wasteful. In controlling access to the organism type, the patent owner also controls a means of producing more instances of the organism. Issuing organism patents is analogous to giving someone a copyright in a song and at the same time a patent in an audio-copying machine designed to duplicate that song.

⁷⁹ For the original statement of the argument that laborers are naturally entitled to the fruits of their labor, see JOHN LOCKE, *THE SECOND TREATISE OF GOVERNMENT AND A LETTER CONCERNING TOLERATION* ch. 5 (J.W. Gough ed., 3d ed. 1966). For a useful summary and interpretation of various strands of Locke's labor argument for property, see Lawrence Becker, *PROPERTY RIGHTS* ch. 4 (1977).

⁸⁰ Baruch Brody uses this rationale in defense of patenting transgenic animals. Although Brody's main argument is that animal patents stimulate useful, animal-related inventions, he also says that "these consequentialist considerations may be reinforceable by an appeal to

But patents and the market value of patents are socially-constructed phenomena created by the legal system, enforcement mechanisms, and the demand of others. The laborer did not create the patent or its market value, and thus she cannot be naturally entitled to either as the fruits of her labor.⁸¹ Labor may naturally entitle a person to possess and personally use the product of her labor. But it does not naturally entitle a person to exclude everyone else from using things of the same type as what she produced. This is precisely what a patent monopoly involves.⁸²

In the case of those whose labor involves the alteration of living beings, the natural entitlement to the fruits of labor rationale fails to justify a natural property right in even the particular organism manipulated. The relationship between an inventor and the mechanical device invented is different in morally significant ways from the relationship between a biotechnician and the organism altered. People who create physical objects may possess *prima facie* claims of natural entitlement to those objects. There is a plausible case for this natural entitlement if (1) the object would not have existed but for the individual's productive activity, (2) the materials used were readily available to anyone, and (3) no other individual has a plausible claim of natural entitlement to the object.

In contrast, those who manipulate living beings are not plausibly viewed as possessing natural property rights in those living beings. If anything is naturally entitled to a living organism, it is that organism itself. The right to use and benefit from one's body is a paradigm case of natural entitlement.⁸³ John Moore,⁸⁴ not his doctor, possesses a naturally and metaphysically grounded claim—an inherent property right—in the cells of his body. Similarly, other living beings come into the world with a claim to use their physical characteristics for their

patents as a way of satisfying the inventor's entitlements to the fruits of his or her labor." See *Should We Allow The Patenting of Life?*, AGRIC. BIOETHICS F. (Iowa State Univ.), Aug. 1991, at 4. For the Office of Technology Assessment's appeal to the natural entitlement argument, see NEW DEVELOPMENTS, *supra* note 11, at 130.

⁸¹ For a fuller development of this argument, see Hettinger, *supra* note 77, at 36–40.

⁸² Are people naturally entitled to sell the particular instance of their innovation—for example, the individual organism that has been genetically altered—under a licensing agreement that prohibits the purchaser from revealing the innovation to others or from reproducing or selling it? Once we ask whether society should enforce such agreements, we see that the question is not one of individual natural rights, but of social policy. See Hettinger, *supra* note 77, at 39 n.21.

⁸³ When Locke argued for a natural property right in the fruits of labor, he did so by starting from the assumption that we have a natural property right in our own bodies and then extending this right first to the activity of our bodies—that is, our labor—and second to the fruits of this activity. See LOCKE, *supra* note 79, at ch. 5, ¶ 27.

⁸⁴ See *supra* notes 20–21 and accompanying text.

benefit. The DNA in a bacterial cell naturally belongs to that bacterium and not to the researcher; the trunk of a tree is something to which the tree, not the lumber company, is naturally entitled; the calf, not the rancher, naturally owns the flesh of its body.⁸⁵

I do not deny that humans may legitimately own organisms in certain senses. For example, in order to acknowledge that people have special claims and responsibilities to determine what happens to certain organisms, talk of ownership rights is appropriate. A person has rights and responsibilities to determine what happens to her dog or her child that are not possessed by others. However, I do deny the appropriateness of the idea of owning organisms in the way that people own their bodies or in the way that artificers own created utilitarian artifacts. A human body exists as a manifestation of a person and, in this sense, exists for the use of that person. A utilitarian artifact exists to serve the purposes of its creator or users. But an organism and its parts are not appropriately understood as existing solely to serve the purposes of its human owner. The characteristics of an organism are not things that people may use for their benefit without also considering the possible conflicting benefits those characteristics provide the organism. There is moral dimension in determining what people may do with organisms because the interests of the owned organism must be considered in this decision. Thus, people are not naturally entitled to use an organism as they please. These points hold true even when humans cause the organism's existence or have manipulated its characteristics.

1. Biocentrism and Patenting Organisms

A full development of this argument requires a defense of the environmental ethic known as "biocentrism." As I will use the phrase, biocentrism holds that all living beings possess morally-considerable interests that we ought to respect. This Schweitzerian⁸⁶ ideal of re-

⁸⁵ What if a biotechnician chemically synthesizes DNA and then inserts it into an organism? In such a case, the DNA does not naturally belong to the receiving organism and—at least prior to insertion—would seem to naturally belong to the biotechnician. Once the organism begins to use the DNA for its own benefit, questions of natural ownership become unclear. In any case, as Robert Nozick has pointed out, mixing what you own with something you do not own does not obviously result in ownership of the mixture. See ROBERT NOZICK, *ANARCHY, STATE, AND UTOPIA* 174–75 (1974).

⁸⁶ 1952 Nobel Peace Prize winner and Swiss physician Albert Schweitzer may be the most well known proponent of biocentrism. For Schweitzer's defense of what he called "reverence for life," see his *THE PHILOSOPHY OF CIVILIZATION* 240–64 (Am. ed. 1950).

spect for all life has had many recent philosophical defenses.⁸⁷ I will only briefly sketch the argument.⁸⁸

All organisms possess individual welfares served by their physical features. Unlike artifacts such as gene sequencing machines, inanimate natural substances such as chemical compounds, or parts of organisms such as genes or cells, living beings possess goods of their own or welfare interests, and thus may be benefited or harmed without reference to the good of any other being. For example, crushing the roots of a tree with a bulldozer harms the tree itself; this is a setback for the tree's welfare and is not bad simply for the interests of the homeowner who wants the tree's shade.

Despite possessing artificial features programmed into them by biotechnicians to serve human purposes, genetically-altered organisms possess numerous original genetic traits and consequent biological systems whose proper functioning constitutes their good. For example, the proper functioning of the system that allows a tobacco plant to glow in the dark—after a firefly gene has been inserted into it—does not specify the plant's own good. However, the proper functioning of the tobacco plant's water transport system and its photosynthetic ability continue to be goods of the tobacco plant itself, in addition to being good for the farmer.

That all organisms possess goods of their own does not by itself show that people have *prima facie* duties to respect organisms' welfare.⁸⁹ Nonetheless, if the welfare interests of human beings ground *prima facie* duties prohibiting thwarting those interests—apart from

⁸⁷ See HOLMES ROLSTON III, *ENVIRONMENTAL ETHICS* 94–126 (1988); PAUL W. TAYLOR, *RESPECT FOR NATURE: A THEORY OF ENVIRONMENTAL ETHICS* 14–25 (1986); Kenneth Goodpaster, *On Being Morally Considerable*, 75 *J. PHIL.* 308, 308–25 (1978). Joel Feinberg is perhaps the most prominent opponent of the claim that living beings such as plants and microbes have interests that we could morally consider. Feinberg does think that sentient animals have such interests. In addition to his earlier, *The Rights of Animals and Unborn Generations*, in *PHILOSOPHY AND THE ENVIRONMENTAL CRISIS* 43–68 (William T. Blackstone ed. 1974), see generally 1 *HARM TO OTHERS: THE MORAL LIMITS OF THE CRIMINAL LAW* (1984). Feinberg has said that he has received more criticism for his view that plants do not have interests than for anything else he has written. Each of the works cited at the top of this footnote criticizes Feinberg's claim about plants.

⁸⁸ For what is perhaps the most careful defense to date of the claim that all and only living organisms have welfare interests that we should morally consider, see generally Gary E. Varner, *Biological Functions and Biological Interests*, 28 *THE S. J. PHIL.* 251–70 (1990). For an earlier discussion of some of the important ideas on which Varner relies, see generally Harley Cahen, *Against the Moral Considerability of Ecosystems*, 10 *ENVTL. ETHICS* 195, 195–216 (1988).

⁸⁹ For an argument that such a conclusion does not immediately follow, see TAYLOR *supra* note 87, at 71–72. John O'Neill argues that "one can recognize that something has its own goods, and quite consistently be morally indifferent to these goods." See John O'Neill, *The Varieties of Intrinsic Value*, 75 *MONIST* 119, 131–32 (1992). One way to establish a connection between value

any preference interests humans may have—⁹⁰then the welfare interests of other organisms grounds such duties to them.

Because all organisms—including genetically-altered ones—possess morally-considerable interests, organisms are not mere resources that people are naturally entitled to own in the way people own their bodies or own artifacts.⁹¹ Thus, the rationale that justifies property rights on the grounds that an individual is naturally entitled to the fruits of her labor not only fails to justify patents in types of organisms, but also fails to properly specify the ownership relationship between biotechnicians and the individual organisms they modify. Biotechnicians are not naturally entitled even to the individual organisms they manipulate.

Advocates of animal patents appeal to the moral innocence of owning individual animals in attempts to legitimize patenting animal-types:

Owning animals is legitimate and traditional in our culture, and human dominion over the animal kingdom is even a common biblical theme. Animals are bought and sold daily, valued in the marketplace on the basis of their rarity and utility. We eat them, wear them, perform biomedical research on them, put them on leashes. As bioethicist LeRoy Walters of Georgetown University Kennedy Institute for Bioethics has suggested, patenting them “seems relatively benign.”⁹²

But that certain ways of understanding human ownership of other individual organisms are morally unobjectionable does not entail that all such conceptions are appropriate. Nor does the legitimacy of certain types of ownership of individual organisms imply that patenting

and obligation is to embrace a principle of nonmaleficence requiring moral agents to avoid causing a loss of value.

⁹⁰ Note that nutrition and water are good for a person whether or not that person is aware of these needs or cares about having them satisfied. Thus, an individual wanting its needs to be satisfied is not necessary for their satisfaction to be good for that individual. That a tree does not want or desire or care about getting nutrition or water does not show that these things fail to benefit it. More technically, welfare interests—that is, what is good for a being—do not necessarily depend on preference interests—that is, what a being wants or prefers, if anything.

⁹¹ It is incongruous to acknowledge that an organism has *prima facie* claims on us to respect its welfare while denying that it is naturally entitled to use its own body for its own benefit. If we grant, for example, that a tree has a morally considerable interest in getting water, how can we deny that it is naturally entitled to use its vascular cells for water transport and claim that we are naturally entitled to use it as lumber? This claim would be analogous to admitting that John Moore has a morally considerable need for the breakdown of old blood cells, but denying that he is naturally entitled to use his spleen for this purpose on the grounds that his doctors are naturally entitled to use his spleen cells for cancer research. See *supra* notes 20–21 and accompanying text.

⁹² Raines, *supra* note 28, at 68.

organism-types is morally acceptable. An important theme in contemporary environmental philosophy and policy is that moral questions about treatment of *kinds* are different from—and often more serious than—questions about treatment of individuals.⁹³ The special concern our society has with preserving endangered species illustrates this. There is no inconsistency in being comfortable with people owning individual blue spruces, for example, and being appalled by the idea of a person owning and monopolizing all blue spruces.

That all organisms—including genetically-altered ones—possess morally-considerable interests and thus are not tools, instruments, or mere resources that people are naturally entitled to own explains why patenting organisms-types is not benign. A patent is a several-hundred year old, legal and moral category developed for and applied to our relations with newly created inanimate—typically mechanical—devices.⁹⁴ People patent new tools that exist to serve human purposes. By allowing patenting of new organism-types, we inappropriately conceptualize such organisms as tools. This legally enshrines a morally mistaken way of thinking about our relation to these organisms.⁹⁵

Some readers may find the biocentric environmental ethic underlying this argument unpersuasive.⁹⁶ A more widely held—and easier to

⁹³ See ROLSTON, *supra* note 87, at 126–60, for an argument that concern with preserving species is far more important than concern for the lives of individual organisms. This nonindividualistic approach to the moral status of nonhumans is widespread in the literature and often goes by the name of “environmental holism.” For another example, see generally J. BAIRD CALLICOTT, *IN DEFENSE OF THE LAND ETHIC: ESSAYS IN ENVIRONMENTAL PHILOSOPHY* (1989).

⁹⁴ The very language describing what is patentable subject matter expresses this. One can patent “any new and useful process, machine, manufacture, or composition of matter.” See 35 U.S.C. § 101 (1988). For some support of this interpretation of the patent institution, see LEON KASS, *TOWARD A MORE NATURAL SCIENCE: BIOLOGY AND HUMAN AFFAIRS* 128–53 (1985) (especially pp. 143–44).

⁹⁵ A Canadian court’s bald-faced acceptance of the tool concept inherent in patenting was expressed in the following ruling:

If an inventor creates a new and unobvious insect which did not exist before (and thus is not a product of nature), and can recreate it uniformly and at will, and it is useful (e.g., to destroy the spruce bud worm), *then it is every bit as much a new tool of man as a micro-organism.*

quoted in David Vaver, *Intellectual Property Today: Of Myths and Paradoxes*, 30 (1989) (unpublished manuscript, available from Vaver at Osgoode Hall Law School, York University, Toronto) (emphasis added). Another explicit statement of the organism-as-tool idea can be found in Crespi, *supra* note 19, at 177: “Attempts were made to patent the micro-organisms themselves, these being seen as industrial tools or intermediates useful in the process of producing the final products for marketing.”

⁹⁶ Some may even think biocentrism is absurd. Duties to individual, insentient organisms, such as a carrot plant, even if the duties are *prima facie*, overridable, and weak, may nonetheless seem beyond the pale. One philosopher argues in this spirit when he claims that “it is not the

defend—position on moral considerability is “sentientism,” the view that all and only sentient beings possess morally-considerable interests.⁹⁷ Those who accept sentientism should limit the scope of this argument against organism patents to the patenting of sentient animal life. Animals who feel pain and possess preferences are clearly not mere resources to which people may be naturally entitled.⁹⁸ To conceptualize a sentient animal as a mere resource would be to conceive of it as morally analogous to a utilitarian artifact. On this view, the moral issues involved when a neighbor pounds his pet dog with a hammer are the same as when he pounds his step ladder with a hammer. This is not a morally enlightened position. Thus, sentient animals—even when they are modified for human purposes—are not appropriately conceptualized as tools or instruments. If I am right that patenting an entity involves conceptualizing it as a mere resource or tool that lacks moral standing in its own right, then patenting sentient animals is clearly not appropriate.

Although I subscribe to the biocentric ethic that all organisms are morally considerable, I do not accept biocentric egalitarianism.⁹⁹ I allow that individual organisms have different degrees of moral significance.¹⁰⁰ Thus, in general, I find animal patents to be more troubling than either plant or microbe patents. Still, I reject the idea that the moral problems with justifying organism patents become serious only when patenting our closest cousins, the sentient animals. In any

case that the goods of viruses should count, even just a very small amount.” See O’Neill, *supra* note 89, at 132.

⁹⁷ The most prominent defenders of this position are philosophers Peter Singer and Tom Regan. Both argue forcefully that all sentient beings—that is, beings who can feel pleasure and pain—are morally important in their own right. Singer also argues that only sentient beings are morally considerable. On this latter point, Regan’s position is more ambiguous. The classic readings are PETER SINGER, *ANIMAL LIBERATION* (2d ed. 1990) and TOM REGAN, *THE CASE FOR ANIMAL RIGHTS* (1983). While these philosophers’ positions on the practical implications of sentientism are highly controversial, the idea that animals who can feel pleasure and pain count morally in their own right is not. There is considerable disagreement about whether and to what extent we should use sentient animals for food or medical research. But few argue that, for example, a dog’s pain is not in itself a morally relevant consideration. For a development of this latter position, see generally WILLIAM F. BAXTER, *PEOPLE OR PENGUINS: THE CASE FOR OPTIMAL POLLUTION* 1–15 (1974), ch. 1. Baxter defends “anthropocentrism,” the idea that all and only humans count morally in their own right. On such a view, animal pain has no direct moral relevance and only matters if it affects the interests of some human.

⁹⁸ Perhaps the best and most succinct statement of this argument is Tom Regan’s article, *The Case for Animal Rights*, in *IN DEFENSE OF ANIMALS* 13–26 (Peter Singer ed. 1985).

⁹⁹ Biocentric egalitarianism is the view that all living beings are equally morally important. For a powerful defense of this view, see TAYLOR, *supra* note 87, at 129–56.

¹⁰⁰ For the distinction between moral significance and moral considerability, see Goodpaster, *supra* note 87, at 311–12.

event, to move from microbe patents to animal patents in eight years¹⁰¹ without serious public debate about possible morally relevant differences is distressing and insensitive public policy.¹⁰²

2. Patenting Genes

Genes are not living beings with goods of their own, and thus the above argument against patenting organisms—that patents inappropriately conceptualize organisms as mere resources—does not apply to gene patents. But other reasons suggests that patenting genes may also be inappropriate. Genetic material is the information structure underlying the three and a half billion year old story of the development of life on this planet, including the emergence of the human life form.¹⁰³ Proper appreciation of that story, and respect for the processes of evolution and speciation that drive life's development, count against gene patenting.¹⁰⁴

Naturally occurring genes are not human inventions or creations that people may rightfully own. Just as it is presumptuous to patent laws of nature, so too it is presumptuous to patent genes, which are equally fundamental to nature. Ideally, gene-types should be treated as a common heritage to be used by all beings who may benefit from them. As previously existing, nonexclusive objects that may be used beneficially by everyone at once, no one should possess the right to monopolize gene-types with patents or to “lock up” genes though any other property arrangements.

¹⁰¹ The first microbe patent was issued in 1980 as a result of the Supreme Court's decision in *Diamond v. Chakrabarty*, 447 U.S. 303 (1980). See *supra* note 58 for a discussion of an anomalous earlier microbe patent. See also NEW DEVELOPMENTS, *supra* note 11, at 51–53. Harvard University's oncomammal was the first animal patent and it was issued in 1988. *Id.* at 99.

¹⁰² One of the arguments for patenting microbes that was used in the debate leading up to the Supreme Court's *Chakrabarty* decision was that allowing such patents would *not* result in patents on higher life forms. A judge claimed then that it was “far fetched” to think that patenting microbes would make patentable “all new, useful and nonobvious species of plants, animals, and insects created by man.” See Bugos & Kevles, *supra* note 59, at 22. There has been some public debate on this issue: several bills dealing with animal patenting were introduced in Congress in 1987 and 1988. One that called for a moratorium on animal patents passed the Senate but was dropped in a House-Senate conference. For discussion, see KRIMSKY, *supra* note 15, at 51.

¹⁰³ See CAMPBELL, *supra* note 2, at 516–18, for a discussion of the origin of genetic material and the antiquity of life. For a discussion of how life depends for its replication on transmission of genetic material, see CAMPBELL, *supra* note 2, at 228–29. For a discussion of genetic material more generally, see CAMPBELL, *supra* note 2, at chs. 12–19.

¹⁰⁴ The idea that one might respect *processes* is foreign to traditional contractarian, Kantian, and utilitarian ethics. Even biocentrism—which only respects individual organisms—does not justify it. But respect for natural processes is an important theme in recent environmental philosophy. For arguments supporting the view that respect for natural processes is even more important than respect for living individuals, see generally ROLSTON, *supra* note 87, at 160–246.

The policy implications of accepting this view are significant. Genetic material found on private land should not belong exclusively to landowners.¹⁰⁵ Landowners possess rights to use the genes for their own benefit, but landowners do not possess the right to exclude others from copying and using the genes. Accordingly, not only should biotechnology firms from the North be prohibited from patenting genes taken from the rural, poor, or indigenous peoples of the South,¹⁰⁶ but ideally—although not practically—these countries should also not restrict access to the genetic material found on their lands.¹⁰⁷ Additionally, not only should John Moore's doctors be prohibited from patenting the cell line produced from Moore's spleen,¹⁰⁸ but Moore—and anyone else—should not prohibit others from accessing the valuable traits that his genes can provide. This assumes that noninvasive methods, such as taking a piece of hair, can be employed to obtain copies of genes.¹⁰⁹

¹⁰⁵ In the United States, property rights in land do not give one identical property rights in the wildlife on that land. The geese that fly over the property or the deer that move through it cannot be disposed of as the owner sees fit: the state controls what happens to such wildlife. Hunting regulations are an example. Even plants that can not move off the land are under state control if they are members of an endangered species. I am suggesting that genes located in organisms on the land should also be held in public trust. For an argument that respect for endangered species limits property rights in land, see generally Holmes Rolston, *Property Rights and Endangered Species*, 61 U. COLO. L. REV. 283, 283–306 (1990). For a discussion of how property rights in land do not extend to the wildlife on the land, see Holmes Rolston III, *Wildlife and Wildlands: A Christian Perspective*, CHURCH & SOC'Y, Mar.-Apr. 1990, at 16–40 (especially pp. 23–29).

¹⁰⁶ By "the South" I mean the nonindustrialized countries that are typically located in the Southern Hemisphere. By "the North" I mean the industrialized countries that are typically located in the Northern Hemisphere, such as the United States, Japan, and the nations of Europe.

¹⁰⁷ Given the present situation where biotechnology firms from the North patent genes taken from the South and then sell them back to those countries, it is appropriate for these countries to demand royalties for the genes found on their lands. Also, given that the genetically rich countries are often poor economically, distributive justice supports payments from the North for the genetic resources contained on the lands of the South. Many developing countries have opportunity costs associated with preserving biological diversity in their countries. Allowing them to charge royalties for the genes extracted from their lands would also provide compensation for foregone opportunities. Furthermore, when the genes are extracted from plants cultivated by peoples in the South, then those who have cultivated the plants deserve some reward for their labor—as do those in biotechnology companies who turn the genes into useful products. For a discussion of these issues, see Hope Shand, *Agbio and Third World Development*, BIO/TECHNOLOGY, Mar. 1993, at S13, and see Hope Shand, *There is a Conflict between Intellectual Property Rights and the Rights of Farmers in Developing Countries*, 4 J. AGRIC. & ENVTL. ETHICS 131–42 (1991).

¹⁰⁸ See *supra* notes 20–21 and accompanying text.

¹⁰⁹ The Human Genome Project intends to make copies of the genes of indigenous peoples from around the world. Ideally these peoples should freely allow the world to benefit from their genes. But biotechnology firms and the United States government are trying to patent and profit from these genes. "Currently, there are at least two patent applications, submitted by

3. Patenting Products of Nature

One might expect that patenting naturally occurring entities would not be permitted. Patentable subject matter must be “novel” and there is a well established doctrine in patent law that “products of nature” are not patentable.¹¹⁰ Moreover, to the extent that patent law relies on the natural entitlement to the fruits of labor rationale, patents should not be issued for *discoveries*, but only for *inventions*. “I discovered it and so this sort of thing is mine” is even a less plausible justification than is “I made it and so this sort of thing is mine.” Thus, patenting naturally occurring genes or organisms that have been discovered rather than invented would seem to be inappropriate.

Patent law, however, allows patents for “whoever *invents or discovers* any new and useful process, machine, manufacture, or composition of matter.”¹¹¹ Even the Constitution runs together the distinction between invention and discovery by giving Congress the power of “securing . . . to inventors the exclusive right to their . . . discoveries.”¹¹² The product of nature doctrine has been rendered vacuous by allowing that the isolation, purification, or alteration of an entity or substance from its natural state turns the entity or substance into something not “found in nature.” Thus, genes are patentable when isolated from their “impure form,” that is, fused with other DNA in an organism’s cells. By placing foreign genes into organisms, these

United States agencies, that are pending on portions of genomes of Third World peoples (Papua New Guinea and Solomon Island peoples, respectively).” See Philip L. Bereano, *Shamans and Patent Lawyers*, 263 SCIENCE 1358 (1994). Will these peoples share in the profits made from their genes and will they be allowed free access to the beneficial uses of the genes extracted from their bodies? Given that these peoples are poor and are being driven to extinction by a world that is not much interested in what happens to them, indigenous peoples have every right to keep the resources nature has provided to them and use their genes as bargaining chips with the North. If the North is to play the property game with genes, then surely the South in its relationships with the North should also play this game. Given that people generally do not freely share their natural endowments with others—something, I am arguing they theoretically ought to do—it would be wrong to expect that indigenous, rural, or poor peoples do this. Thus, in the present context, indigenous peoples are perfectly justified in refusing to let others access their genes. For a discussion of this issue, see Rural Advancement Foundation International, *The Patenting of Human Genetic Material*, RAFI COMMUNIQUE (RAFI, Suite 504, 71 Bank St., Ottawa, Ontario K1P 5N2, Canada), Jan.-Feb. 1994.

¹¹⁰ For a discussion, see Karl Bozicevic, *Distinguishing ‘Products of Nature’ from Products Derived from Nature*, 69 J. PAT. & TRADEMARK OFF. SOC’Y 415–26 (1987), and see Charles Berman & Nancy Lambrecht, *Can You Patent a Product That Occurs Naturally?* THE LOS ANGELES DAILY J., Feb. 15, 1991, at 7.

¹¹¹ 35 U.S.C. § 101 (1988) (emphasis added).

¹¹² U.S. CONST. art. I, § 8, cl. 8.

organisms also become “substantially altered” and hence patentable “works of man.”¹¹³

Although “bioengineering” is a difficult and, in some cases, creative labor, it does not produce creations or inventions. The isolation of a gene is not the same as the invention of a gene.¹¹⁴ Placing a gene or several genes into an embryo and allowing the organism to develop and express the gene is an alteration, not a creation.¹¹⁵ Isolating a gene for straightness from one species of tree and placing the gene into another is more like transplanting a tree species to a new habitat than it is like creating or inventing a new tree. Furthermore, bioengineering only alters a tiny fraction of an organism’s genome.¹¹⁶ Until biotechnology advances well beyond its current state, the root idea of the Lockean labor argument for property—I created it and so it belongs to me—does not apply to the genes or organisms that biotechnicians manipulate.¹¹⁷

There is a substantial disanalogy between biopatents and the traditional subject matter of patents. Edison really did *invent* the light bulb. The Wright brothers *did create* a flying machine. But Harvard biotechnicians did not *invent or create* the oncomouse. Biotechnicians alter, modify, assist, or manipulate nature. Biotechnicians are not inventors of organisms or genes that could be appropriate objects for patents.

¹¹³ For a discussion, see Barton, *supra* note 73, at 42–43. Barton there suggests that the Patent and Trademark Office is unlikely to issue “a patent for the use of a gene in a species in which it evolved naturally or in a species to which it can be transferred by normal breeding.” *Id.*

¹¹⁴ Nor is chemically synthesizing a gene that exists in a natural form to invent a new gene. True invention of a gene would involve creating a gene coding for a characteristic that no organism possesses.

¹¹⁵ Concerning the insertion of a foreign gene into an animal, Mark Sagoff says, that “rather than invent a different animal, it leaves the original virtually unchanged.” See Mark Sagoff, *On Patenting Transgenic Animals* 15 (1990) (unpublished manuscript, available from Sagoff at the University of Maryland’s Center for Philosophy and Public Policy).

¹¹⁶ Granted, small changes in genotype can produce large and dramatic changes in phenotype. For example, humans differ from chimpanzees genetically by less than 2%. But mammals typically have about one-hundred thousand genes. Manipulating twenty of these, the most that animal research is likely to involve for the foreseeable future, is a change in a mammal’s genome of only 0.02%. The simple *E. coli* bacterium has about twenty-five hundred genes. Modifying twenty of its genes would be a change of 0.8%. See *NEW DEVELOPMENTS*, *supra* note 11, at 14.

¹¹⁷ Property rights in naturally occurring genes also may violate a Lockean restriction on property ownership. One of Locke’s provisos on original acquisition of material from the common stock is that after the appropriation there must be “enough and as good left in common for others.” See LOCKE, *supra* note 79, at ch. 5-¶ 27. A patent right to the use of a particular gene deprives all others of the use of that gene. Although there is other genetic material that could be appropriated and used, only the patent holder can now use that gene. Even those who discover the gene independently are prohibited from using it by patent law. For an attempt to respond to this type of objection, see Crespi, *supra* note 19, at 181.

C. *The Desert Rationale*

According to the desert rationale for property rights, laborers, including biotechnicians, deserve to benefit from their labors, at least when their efforts aim to produce something socially useful.¹¹⁸ Biotechnicians have put time, energy, and resources into their labor and so they deserve something in return for what they have done. Perhaps patents in genes and organisms may be justified as just deserts for biotechnicians' labor.¹¹⁹

But patents are likely to give biotechnicians far more than they deserve. Consider a biotechnician who discovers that a combination of two bacterial genes inserted into legumes allows the legumes to grow with only twenty percent of the water previously needed. If what the biotechnician deserves is a reward proportional to the effort expended, a patent would give the biotechnician far too much of a reward, given the huge market value of these drought-resistant legumes and the relatively modest effort involved in the discovery. Valuable biotechnologies can result from flashes of genius and years of diligent effort can prove fruitless. Thus, awarding patents in biotechnological innovations to those who produce them is likely to be a highly imprecise way of proportioning rewards to the effort biotechnicians expend.

If what biotechnicians deserve is not rewards proportional to the efforts they expended, but rather the value their labor adds to the world, patents are still likely to give biotechnicians far more than they deserve. Consider once again the production of the genetically-altered legumes. Unless we accept the implausible view that human labor creates all value, we should acknowledge that much of the value of these drought-resistant legumes originated in the bacterial genes and the plants themselves. Genes and organisms are highly valuable natural givens. They constitute a "vast library of tried-and-true evolutionary inventions of the millions of species in natural ecosystems."¹²⁰ When biotechnicians manipulate these entities and patent the results, the biotechnicians capture value far beyond what their innovative activity added to the world. A botanist objects to patent rights for plants on these grounds:

¹¹⁸ For a philosophical analysis of what people deserve, see generally George Sher, *DESERT* (1987).

¹¹⁹ For the arguments in this section applied to intellectual property in general, see Hettinger, *supra* note 77, at 40-43.

¹²⁰ Colwell, *supra* note 47, at 9.

Such legislation gives credence to breeders who can manipulate one or two genes of a traditional land race that evolved over thousands of years and then claim that something novel has been created. . . . Few of the edible, nutritional characteristics of the seed plants that now sustain us evolved for our benefit, under selective pressure from our forebears or through conscious breeding by scientists. We are literally living off the fruits of other creatures' labors—those of the birds, bugs, and beasts that loosely coevolved with seed plants over the last hundred million years.¹²¹

Additionally, given the social character of innovation, much of the value brought into the world by these drought-resistant legumes is attributable to the intellectual predecessors of the biotechnicians, for example, Darwin and Mendel.¹²² To claim that the biotechnician is responsible for the entire value of the modified organism or gene is like saying that the last person needed to lift a car should get full credit for lifting it. Undoubtedly biotechnicians sometimes add value to the world through their innovative activity, but such value is small when compared to the natural value of the materials that biotechnicians manipulate and the social value contributed by others. In short, biopatents allow biotechnicians to capture value way beyond their contribution or their effort.¹²³

D. *The Consequentialist-Incentive Rationale*

Although defenders of patents generally—and biopatents specifically—will often appeal to the laborer's entitlements and deserts, the arguments that have the most force in policy debates appeal to the beneficial consequences of patents. Defenders of biopatents are likely to argue that even if the above arguments are correct and that biopatents are disrespectful of life, misconstrue the nature of biotechnical innovation, and render inappropriate deserts for such innovation, the tremendous social utility of biopatents outweighs these considerations.¹²⁴

¹²¹ GARY NABHAM, *ENDURING SEEDS: NATIVE AMERICAN AGRICULTURE AND WILD PLANT CONSERVATION* 6 (1989).

¹²² Consider, as well, that a great deal of the biological research underlying private biopatents is publicly funded.

¹²³ The patent monopoly is limited to seventeen years. After this, any one can freely appropriate the innovation. Perhaps this limitation is an acknowledgement that innovators are only partially responsible for the value of innovations.

¹²⁴ Although my arguments against biopatents have so far been nonconsequentialist in nature, I accept that these considerations could be overridden if biopatents provide sufficient social utility that is not achievable in less costly ways.

The argument, in its most prominent form, is that biopatents are necessary incentives for the production of socially optimal levels of biological innovation.¹²⁶ If we want new wonder drugs, oil-eating bacteria, and leaner, cheaper pigs, the best way to obtain them is to allow biotechnicians to patent these innovations and sell them in the market. Without the patent incentive, such innovation would drastically slow. Competitors would let others innovate, copy the final product, and then undersell the innovator because competitors need not recoup the product's research and development costs.¹²⁶

Notice the paradoxical, self-undermining strategy of this approach. The approach involves trying to maximize social benefits from innovation by putting constraints on society's ability to use and thus benefit from innovation. It grants monopolies that restrict the availability and use of innovations in order that there be new innovation and ultimately greater use and benefit from innovation.¹²⁷

Public funding as an alternative mechanism to induce innovation does not possess this drawback, because the results of publicly-funded innovation could be—and presumably should be—freely available to all. Public funding also gives society greater control over what form

¹²⁶ Related arguments include: (1) Patents prevent socially wasteful duplication of research efforts, because competitors will not waste time reinventing what another firm already has invented and patented, and thus patents increase the output of the resources put into technological innovation; (2) Private sector patents on government research results provide an inducement to risk an attempt to commercialize a public-sector innovation; and (3) Patents induce further related innovation by providing incentives to invent around the patent. Much of what I say in the text also applies to these versions of the consequentialist argument for biopatents.

¹²⁶ A variant of this argument uses the nonconsequentialist language of preventing unfair competition. "There is considerable weight in the argument that the patent system provides the opportunity for individuals to transfer their discoveries to the market place without fear of unfair competition." See *Patently Responsible*, NEW SCIENTIST, Nov. 2, 1991, at 9. For example, if Monsanto Corporation were to copy Calgene Inc.'s Flav'r Savr tomato instead of developing its own firm tomato, this would be cheating. But what counts as fair play in business is not independent of which rules lead to the most socially useful results. If maximum social utility would be achieved in a business climate where sharing ideas and appropriating other firms' designs were the norm, such behavior would not constitute unfair competition. Thus the debate over the consequences of a patenting regime underlies even the preventing-unfair-competition rationale for patents.

¹²⁷ Economist Joan Robinson puts the point this way:

A patent is a device to prevent the diffusion of new methods before the original investor has recovered profit adequate to induce the requisite investment. The justification of the patent system is that by slowing down the diffusion of technical progress it ensures that there will be more progress to diffuse. . . . Since it is rooted in a contradiction, there can be no such thing as an ideally beneficial patent system, and it is bound to produce negative results in particular instances, impeding progress unnecessarily even if its general effect is favorable on balance.

quoted in DOROTHY NELKIN, SCIENCE AS INTELLECTUAL PROPERTY 15 (1984).

a technology takes. Public control is particularly important for technologies—such as biotechnology—that possess significant social and ethical dimensions. Although there exist significant possible drawbacks to public funding,¹²⁸ it is not obvious that public funding is an inferior way to provide for technological innovation.

Consider the ways that biopatents may undermine rather than promote biotechnical innovation. Privatization of biological knowledge inhibits the scientific sharing of ideas and thus slows innovation. University-business joint ventures result in secrecy in university laboratories. One commentator notes a growing reluctance among researchers to freely exchange plasmids and cell lines.¹²⁹ Furthermore, publication of scientific results is delayed until after the application for and receipt of patents, a process that takes years to complete.¹³⁰

In response, defenders of biopatents will point out that if patents are unavailable, then people engaged in biological innovation will instead rely upon trade secrets. In terms of disclosure of knowledge underlying biotechnological innovation, trade secrets are far worse than patents. Patents require disclosure of the patented technology.¹³¹ In contrast, trade secrecy protection requires nondisclosure. Thus, supporters of biopatents will argue that patents in biotechnological innovation encourages the release of biological information that would otherwise have been kept secret. This “exchange for secrecy”¹³² defense of patents suggests that innovators be given a limited monopoly in their innovations in exchange for revealing the nature of the invention and thus allowing society to build upon this new knowledge. It is far from clear, however, whether the disclosure required with biopatents gives society enough of a benefit to justify the costs of granting patent rights in return.¹³³

¹²⁸ Drawbacks of public funding for innovation include a possible narrowing of the variety of technological approaches taken and the problem of generating revenue to pay for the innovative research.

¹²⁹ See A.J. Lemlin, *Patenting Microorganisms: Threats to Openness*, in *OWNING SCIENTIFIC AND TECHNICAL INFORMATION*, 193, 193–99 (Vivian Weil & John Snapper eds. 1989).

¹³⁰ See Rebecca Dresser, *Ethical and Legal Issues in Patenting New Animal Life*, 28 *JURIMETRICS J.* 399, 422 n.164 (1988). In 1989, it took an average of forty-two months for the Patent and Trademark Office to complete the examination process for a biotechnology patent application. See *NEW DEVELOPMENTS*, *supra* note 11, at 60.

¹³¹ Patents require that what is patented be described in sufficient detail “to enable any person skilled in the art . . . to make and use the same.” 35 U.S.C. § 112 (1988).

¹³² See Rochelle C. Dreyfuss, *General Overview of the Intellectual Property System*, in *OWNING SCIENTIFIC AND TECHNICAL INFORMATION*, 17, 19 (Vivian Weil & John Snapper eds. 1989).

¹³³ One patent attorney has argued that because a written description is often not sufficient for reproducing many biotechnology “inventions,” recent court decisions failing to require

A recent editorial in a prominent economics magazine suggests that patents threaten to “crush” innovation.¹³⁴ For example, patents provide incentives for companies to take resources that they might otherwise have spent on innovation and to put those resources into patent development and defense.¹³⁵ Allowing patents in an industry may also suppress competition in that industry. Firms may buy up the patents of potential competitors in order to protect their current products.¹³⁶ With the proliferation of patents, an industry becomes an increasingly difficult place to do business.¹³⁷ The determination of what patents must be licensed and from whom consumes time and money. Fear of litigation shapes and hinders the innovative activity in such an industry.¹³⁸ Thus, patents can act as barriers to entry into an industry, especially for small firms who cannot afford a staff of patent specialists.¹³⁹ One commentator suggests that “playing with patents is like playing poker” and that “patent negotiation is brinkmanship.”¹⁴⁰

deposits of biocultures “breaks the patent bargain” between the inventor and society to reveal the nature of the innovation. See Rudy Baum, *Knotty Biotech Issues Receive Attention*, CHEMICAL & ENGINEERING NEWS, Apr. 27, 1992, at 30, 31. Furthermore, United States patent law has no general research exemption allowing use of patented innovations for experimental purposes. See Barton, *supra* note 73, at 43. Thus deposits of patented organisms or genes would seem to do little to stimulate further innovation.

¹³⁴ *The Harm of Patents*, THE ECONOMIST, Aug. 22, 1992, at 17.

¹³⁵ See FRITZ MACHLUP, PRODUCTION AND DISTRIBUTION OF KNOWLEDGE IN THE UNITED STATES 169 (1962). Machlup writes:

In reply to the question whether patents are essential to the continuity of large expenditures for research and development, an officer of a large company stated that he might cut down these expenditures to perhaps one half of the amount spent at that time if patent protection were removed. It happened, however, that approximately one half of the R & D budget of that company was then devoted to the tasks of securing patents and enforcing the exclusive rights which they were supposed to confer.

Id.

¹³⁶ For one statement of this suggestion, see DAVID F. NOBLE, AMERICA BY DESIGN: SCIENCE, TECHNOLOGY AND THE RISE OF CORPORATE CAPITALISM 85 (1977).

¹³⁷ See “Policing Thoughts,” *supra* note 25, which points out that it is no defense against a patent infringement suit that one came up with the idea independently, without any knowledge of the patent-holder’s innovation. Patents give the patent-holder exclusive rights of use even against independent inventors. Thus, before biotechnicians who come up with new biotechnological innovations can use them, they must do patent searches to make sure they are not infringing on others’ patent rights.

¹³⁸ *Business Week* reported a fifty-two percent increase in patent litigation in the 1980s. See Michele Galen, et al. *Legal Affairs*, BUS. WEEK, Dec. 2, 1991, at 110, 110.

¹³⁹ Fritz Machlup suggests that sometimes “the patent position of the big firms makes it almost impossible for new firms to enter the industry; patent litigation carried on by big firms makes it difficult for small firms to defend their own patents successfully.” See MACHLUP, *supra* note 135, at 170.

¹⁴⁰ Barry Fox, *Patents in the Pending Tray*, GUARDIAN, Feb. 9, 1989, quoted in VAVER, *supra* note 95, at 25 n.54.

Are patents the best way to stimulate innovation? Do they work better than alternative mechanisms such as public funding? These are empirical questions with unknown answers.¹⁴¹ Thus, when considering how to insure an appropriate level of biotechnical innovation we must keep an open mind. We should not simply assume that an increased rate of protection will spur biotechnical innovation. Rather, as the above discussion suggests, increased patent protection may stifle biotechnical innovation and actually harm the biotechnology industry.

IV. BIOTECHNOLOGY'S COSTS AND RISKS

The argument that biopatents are the best way to stimulate biological innovation assumes that society will benefit from the profusion of biotechnical products. Even granting the significance of biotechnology's potential benefits, we must not assume that biotechnology is an unadulterated good. If biotechnology's critics are right about even some of their objections to biotechnology,¹⁴² it would be a mistake to stimulate this technology indiscriminately through offers of broad and lucrative utility patent grants.

A. *The Relevance of Biotechnology's Costs and Risks to Biopatents*

Defenders of biopatents point out that to allow patenting of a technology does not rule out regulatory control of that technology.¹⁴³ Thus they suggest that the costs and risks of biotechnology, although relevant to issues concerning the regulation of biotechnology, are not relevant to the patenting question. A patent is not a right to use a

¹⁴¹ This is a frequently made point. For example, according to Rebecca Dresser, "there is a lack of empirical data to establish definitively that patenting does stimulate innovation." See Dresser, *supra* note 130, at 404 n.26. For arguments that the patent system "does not play anything like a dominant role among the various mechanism by which returns from innovation are captured" and that it "functions differently in different manufacturing industries," see Sidney G. Winter, *Patents in Complex Contexts: Incentives and Effectiveness*, in OWNING SCIENTIFIC AND TECHNICAL INFORMATION, 41, 41-60 (Vivian Weil & John Snapper eds. 1989). One study commissioned by Congress in the 1950s—the Melman study—concluded that the patent system was "a restraint rather than an impetus" to research. For a discussion, see Charles Weiner, *Patenting and Academic Research: Historical Case Studies*, in OWNING SCIENTIFIC AND TECHNICAL INFORMATION, 87, 99-103 (Vivian Weil & John Snapper eds. 1989). Even a strong defender of biotechnology patents admits that "[a]lthough a hope of slowing biotechnology research is advanced by most of the opponents to the patenting of living organisms, the extent to which a moratorium on patenting might affect the rate of technological development or minimize perceived risks is entirely speculative." See Adler, *supra* note 41, at 2 n.6.

¹⁴² See *infra* notes 150-71 and accompanying text.

¹⁴³ See Raines, *supra* note 28, at 66-67.

particular technology, but a right to exclude others from using the technology. Thus, patenting and regulatory control of biotechnology may exist simultaneously and harmoniously.¹⁴⁴

Although theoretically sound, this point is practically suspect. If patents really are the powerful incentive their proponents claim them to be, then biopatents are likely to contribute to biotechnologies being introduced and exploited before their negative impacts can be properly assessed. This in turn will make it more difficult for society to steer biotechnology in a sustainable and morally appropriate direction. Biopatents foster sentiments against the regulation of biotechnology. Commercial interests that have heavily invested in developing and patenting biotechnologies will exert considerable pressure on government not to regulate these patented biotechnologies.¹⁴⁵ This pressure will be considerable, because once biopatents are issued, government regulation of that biotechnology becomes government restriction of private property rights.¹⁴⁶

Here we may learn from the European practice of settling certain moral questions before issuing patents. The European Patent Convention prohibits patents for inventions that are "contrary to public order or morality."¹⁴⁷ When determining whether to issue animal patents, for example, the European Patent Office conducts a cost-benefit analysis that weighs the costs in animal suffering and risks to the environment against the expected benefits to humans and other animals.¹⁴⁸ Ethical and environmental scrutiny of biotechnical innovations should be part of patenting decisions in this country as well.¹⁴⁹

¹⁴⁴ Paul Thompson makes the point that if we think certain biotechnologies are inappropriate, then we should prohibit such technologies outright rather than simply prohibiting patenting these technologies. See Paul Thompson, *Designing Animals: Ethical Issues for Genetic Engineers* 8 (1992) (unpublished manuscript, available from Thompson at The Center for Biotechnology Policy and Ethics, Texas A&M University).

¹⁴⁵ Consider, for example, the industry's apparently successful campaign against mandatory labelling of biotechnological food products, and its victory with the Food and Drug Administration policy that gene-altered foods will not be required to undergo a special review process. See Philip J. Hiltz, *U.S. to Speed Gene-Product Approvals*, N.Y. TIMES, Mar. 6, 1992, at D9.

¹⁴⁶ The recent backlash against environmental regulations because they allegedly constitute "takings" of private property without just compensation illustrates the special difficulties in regulating uses of private property.

¹⁴⁷ The Convention on the Grant of European Patents was signed in October 1973 and came into force in 1977. The quoted provision comes from Article 53(a). For a discussion of the convention, see NEW DEVELOPMENTS, *supra* note 11, at 158. For a discussion of the provision, see Susan Mayer & Daniel Alexander, *Mice, Morals and the Environment*, NEW SCIENTIST, Nov. 23, 1991, at 12.

¹⁴⁸ *Id.*

¹⁴⁹ For a helpful discussion about whether the Patent Office should morally evaluate an

B. Costs

One might think that biotechnology, like other technologies, is intrinsically neutral and that only the consequences of biotechnology's uses could have positive or negative value. But there exist reasons for disapproving of biotechnology apart from any unfortunate results biotechnologies may produce. Modern biotechnology is a significant change in, as well as enhancement of, humankind's ability to manipulate and control nature. It allows us to manipulate nature "from the inside out."¹⁵⁰ In many people's eyes, too much of the world is already domesticated and manipulated by humans.¹⁵¹ A significant loss of value occurs when, instead of encountering other natures, we find human nature, purpose, and design wherever we turn. Thus, although specific uses of biotechnology will be of positive value on balance, these benefits will come at the cost of further human manipulation of the planet.

Another cost of biotechnology is the potential for greater suffering of nonhuman animals. For example, a major use of animal biotechnology involves the deliberate production of diseased animals.¹⁵² What is the quality of life of an oncomouse, genetically altered to develop breast cancer? A Food and Drug Administration official approvingly speaks of "a veritable L.L. Bean catalogue of transgenic mice . . . for the study of genetic diseases, developmental abnormalities, and oncogenesis," and of "animals tailored to be hypersensitive to a variety of carcinogens, mutagens, teratogens, or other poisons."¹⁵³ Another major use of animal biotechnologies involves altering animals that humans use for food to make them larger or more productive.¹⁵⁴ Consider the "Beltsville pigs" into whom the United States Department of Agriculture placed a human growth hormone gene: "[t]he pigs were bowlegged, cross-eyed, arthritic, and had dysfunctional immune systems that made them susceptible to pneumonia."¹⁵⁵ There is also concern about the welfare of dairy cows who have been injected with

innovation when determining if the innovation satisfies the patent criterion of utility, see KASS, *supra* note 94, at 140-43.

¹⁵⁰ See *supra* note 54 and accompanying text.

¹⁵¹ See Ned Hettinger & Bill Throop, *Can Ecocentric Ethics Withstand Chaos in Ecology* (1994) (unpublished manuscript, available from the author).

¹⁵² Three of the first four animal patents are for animals altered to be disease prone and intended to be used as research specimens. See *supra* notes 15-17 and accompanying text.

¹⁵³ Miller, *supra* note 31, at 24.

¹⁵⁴ NEW DEVELOPMENTS, *supra* note 11, at 98.

¹⁵⁵ For a careful description of these pigs, see Gary Comstock, *Should We Genetically Engineer Hogs*, 8 BETWEEN THE SPECIES 196 (1992).

genetically engineered bovine growth hormone to increase an already extraordinary rate of milk production.¹⁵⁶

Biotechnology could be used, however, to lessen the suffering of nonhuman animals and to decrease human reliance on other animals. Bacteria genetically altered to make a substitute for rennet from calves' stomachs are currently used to age and coagulate up to thirty-five percent of the nation's cheese.¹⁵⁷ Mice altered to contain part of the H.I.V. virus can be used to substitute for chimpanzees in certain kinds of A.I.D.S research.¹⁵⁸ It remains to be seen, however, whether biotechnical innovation will shift the burden of our use of other life forms toward less sophisticated organisms or increase our dependence on sentient life. Biopatents are certainly not a mechanism for insuring that biotechnology leads to overall decrease in suffering.

Concerns exist about the kinds of organisms produced that transcend the issue of suffering. Even if no suffering is involved, there exists a presumption against producing creatures such as "geeps," chimeras with heads of goats and bodies of sheep.¹⁵⁹ A future where descendants of chickens are wired to the floor, connected to input and output tubes, and do not mind because their sentience has been biotechnologically removed is not a pleasing picture of what biotechnology may bring.¹⁶⁰ There exists a significant burden of justification against the production of such monstrous transformations of living beings into mechanical, artifactual modes of existence.¹⁶¹ *Prima facie*,

¹⁵⁶ For a discussion, see Michael Fox, *SUPERPIGS AND WONDERCORN* 123-24 (1992).

¹⁵⁷ See Rebecca Goldberg & Douglas Hopkins, *Why the U.S. Should Regulate Gene-Altered Foods*, ENVTL. DEFENSE FUND LETTER, Nov. 1991, at 7.

¹⁵⁸ Raines, *supra* note 28, at 68. Raines thinks it "most promising" that we might produce cattle who are resistant to shipping fever, thus reducing the suffering they undergo while being transported to feedlots. *Id.* So, instead of changing our transportation practice of crowding cattle together, we change the cattle so that they do not acquire disease as a result. This exemplifies a worrisome pattern in our genetic alteration of animals: instead of revising our questionable practices with animals, we genetically edit out their "troublesome" traits.

¹⁵⁹ See *supra* note 45.

¹⁶⁰ For a powerful development of this example, see Gary Comstock, *What Obligations Have Scientists to Transgenic Animals?* ETHICS AND PATENTING OF TRANSGENIC ORGANISMS (National Agricultural Biotechnology Council Occasional Papers #1), Sept. 1992, at 71. See also B. E. Rollin, *The 'Frankenstein Thing': The Moral Impact of Genetic Engineering of Agricultural Animals on Society and Future Science*, in *AGRICULTURAL BIOETHICS: IMPLICATIONS OF AGRICULTURAL BIOTECHNOLOGY* 306-07 (Steven Gendel et al. eds. 1990). Rollin argues that since intensification in animal agriculture will continue, the goal of engineering insentient agricultural animals is not morally problematic. Forced to choose between a world with insentient agricultural animals and one with sentient agricultural animals who greatly suffer, I too would choose the former. Perhaps this is Rollin's point. But this is compatible with judging the production of such animals as morally obnoxious. Rollin thinks the only possible objections to this scenario are aesthetic.

¹⁶¹ For similar suggestions, see generally J. Baird Callicott, *Animal Liberation: A Triangular Affair*, 2 ENVTL. ETHICS 311 (1980).

biotechnology should not be used to impoverish creatures, to strip away their capacities, or to diminish the richness of their lives.¹⁶² This objection is not limited to sentient life. Consider a genetically-engineered "apple tree" that possesses one giant apple that rests on the ground. Devoid of a trunk or branches, the organism possesses one large leaf for photosynthesis and a thick tap root for minerals and water. This also is not a desirable addition to the planet.

C. Risks

Claims by both advocates and critics concerning the environmental risks of biotechnology seem exaggerated. One advocate suggests that genetic engineering is safer than traditional crossbreeding because genetic engineering alters many fewer genes.¹⁶³ Some critics think that any use of genetically-altered organisms in open environments courts ecological disaster.¹⁶⁴ The safety of this technology is unclear. As one commentator has concluded:

Biologists continue to disagree about the possible hazards of testing and using genetically engineered microorganisms, plants, and animals in the open environment. Although no one contests the fact that the risks are highly case specific and that different kinds of organisms require different levels of oversight, overall assessments still range from confident reassurance to serious concern.¹⁶⁵

Although biotechnology has maintained a good safety record so far,¹⁶⁶ this should not lead us to conclude that there exist no significant

¹⁶² I say *prima facie*, because this obligation is not absolute. Sufficiently important benefits achievable in no other way could make such a use of biotechnology permissible.

¹⁶³ See Brill, *supra* note 46, at 46–47. This argument ignores the potential for risk resulting from combining genes from vastly different sources. That crossing closely related species has proven to be safe is not evidence that crossing genes from totally unrelated species will be safe. Brill raises numerous other arguments for the inherent and generic safety of genetically-altered organisms, many of which are persuasively rebutted in Leslie Roberts' *Ecologists Wary About Environmental Releases*, 243 *SCIENCE* 1141, 1141 (1989).

¹⁶⁴ Jeremy Rifkin thinks that each introduction of a genetically-altered organism into the environment is "tantamount to playing ecological roulette," because "like exotic organisms, it is not a naturally occurring life form. It has been artificially introduced into a complex environment that has developed a web of highly synchronized relationships over millions of years." See Rifkin, *supra* note 51, at 224. This argument is so general that it also applies to traditional selectively bred plants and animals. Although there have been cases of extremely detrimental consequences resulting from introducing these species into the natural environment—such as the effects of cattle on the western range—it is implausible to think that, for example, releasing a new breed of horse into a pasture is to risk ecological disaster.

¹⁶⁵ Colwell, *supra* note 47, at 25.

¹⁶⁶ As of 1991, there had been several hundred small-scale field tests of genetically engineered organisms, none of which had led to known adverse consequences. See Richard Hindmarsh, *The Flawed "Sustainable" Promise of Genetic Engineering*, 21 *ECOLOGIST* 196, 202 (1991). In August 1994, the Union of Concerned Scientists reported that there had been several thousand

risks associated with biotechnology.¹⁶⁷ The risks concern the potential effects of altered organisms on other organisms and on the structures of ecosystems. One problem is the difficulty of keeping introduced genes from migrating outside of genetically-altered organisms. For example, genes for disease or herbicide resistance could migrate from genetically-altered crops into their weedy relatives, resulting in vigorous and difficult to control pests. Research has shown that "crops can readily mate with related weeds over a thousand yards away" and that recalling such genes "may be close to impossible."¹⁶⁸

Another problem is the potential damage to ecosystems of genetically-altered organisms. Biotechnicians can genetically alter fish to grow forty percent larger.¹⁶⁹ How would such fish affect the tropic relationships in their ecosystems should they escape or be released? Problems caused by the intentional and unintentional introduction of exotics should humble us about our ability to predict and control the effects of our actions on ecosystems.¹⁷⁰ Even in cases where no adverse impacts on the ecological functioning of natural ecosystems occur, the mere presence of introduced genes and genetically-altered organisms degrades these ecosystems by diminishing the naturalness or wildness of these ecosystems.¹⁷¹

experimental releases of genetically-altered organisms in the United States alone. See Union of Concerned Scientists, *Experimental Release of Genetically Engineered Organisms*, THE GENE EXCHANGE, Aug. 1994, at 12. To my knowledge, none of these has resulted in harmful environmental consequences.

¹⁶⁷ For another discussion of the ongoing controversy over the safety of releasing genetically-altered organisms into the environment, see Keith Schneider, *Study Finds Risk to Environment in Making Plants Genetically Resistant to Viruses*, N.Y. TIMES, Mar. 11, 1994, at A16.

¹⁶⁸ Norman Ellstrand, *How Ya Gonna Keep Transgenes Down on the Farm?*, THE AMICUS J., Spring 1993, at 31.

¹⁶⁹ See *New Prospects for Gene-Altered Fish Raise Hope and Alarm*, N.Y. TIMES, Nov. 27, 1990, at C4.

¹⁷⁰ For example, Japanese kudzu vine which can grow two meters a week is considered a real problem across some parts of North America where it often overgrows native forests. See ROGER J. LEDERER, *ECOLOGY AND FIELD BIOLOGY* 142 (1984). Another example is the introduction of the Nile perch into East Africa's Lake Victoria. One wildlife ecologist suggests that this introduction may "result in as many extinctions as all the introductions of domestic cats onto the oceanic islands of the world." See Stanley A. Temple, *The Nasty Necessity: Eradicating Exotics*, 4 CONSERVATION BIOLOGY 114 (1990). The introduction of cats onto islands has a track record of producing highly detrimental effects. See GARY K. MEFFE & C. RONALD CARROLL, *PRINCIPLES OF CONSERVATION BIOLOGY* 224 (1994). Robert Colwell summarizes this concern when he says that "Ecologists have insisted that there are lessons to be learned from the record of long-term environmental effects of nonnative organisms introduced by humans on every continent and island." See Colwell, *supra* note 47, at 25.

¹⁷¹ For example, Robert Colwell argues that, at least for nondomesticated species living in reasonably natural ecosystems, "the intrinsic value of a species is diminished by its genetic alteration though human intervention." *Id.* at 29. Despite his cutting criticism of Jeremy Rifkin's attack on biotechnology, Stephen Jay Gould also argues for "respecting the integrity of evolutionary lineages." See Gould, *supra* note 46, at 34. For a philosopher arguing that significant

V. DIRECT COSTS OF BIOPATENTS

To determine if patent incentives are desirable, we must not only weigh the possible negative consequences of biotechnology against its much discussed benefits, but also consider the unfortunate consequences of biopatents themselves. Biopatents will further squeeze small farmers and increase the power and wealth of giant agribusinesses who are likely to own the new biopatents. With animal patents, farmers and ranchers must pay royalties on offspring of animals that they own and breed. This has led one Congressman to suggest that "major chemical, biotechnological, and pharmaceutical companies [will be] in the position to virtually take over animal husbandry in America."¹⁷² That biopatents prevent farmers from saving and using seeds from patented crops¹⁷³ suggests that the farmer "is on his way to becoming a 'tender' of genes owned by someone else."¹⁷⁴

The ability to patent genetic material also fuels "genetic prospecting" of the South by the North. Biotechnology companies freely collect genetic material from organisms in the South, isolate useful genes, patent the genes, and then sell the products based on these genes back to the countries from which the genes were extracted.¹⁷⁵ This practice is an embodiment of the mistaken view that only human labor creates value. On this view, before labor is added, genetic material is worthless and hence free for the taking.¹⁷⁶ The John Moore case discussed earlier is based on the same faulty thinking: Because

human interference in wild ecosystems diminishes their value, see Robert Elliot, *Faking Nature*, 25 *INQUIRY* 81-93 (1982).

¹⁷² *Patents and the Constitution. Transgenic Animals, Hearings Before the Subcommittee on Courts, Civil Liberties and the Administration of Justice, House Committee on the Judiciary, 100th Cong., 1st Sess. 108 (1988)* (statement of Representative Charles Rose). The bracketed material is my addition.

¹⁷³ This is a significant restriction given that almost half of wheat and soybeans crops are grown from farmer saved seeds. See *NEW DEVELOPMENTS*, *supra* note 11, at 79. Prohibiting farmers from using seeds from the crops they grow is incredibly wasteful and is analogous to computer companies insisting that the software they sell only be used once. One commentator claims that it is "unimaginable" that sellers of patented seeds will prohibit this use. Barton, *supra* note 73, at 43. But the owner of the first patented animal is requesting a license fee from those who buy and then breed its patented mouse. Prohibiting farmers from going into business selling the offspring of patented organisms is perhaps justifiable. But preventing farmers from themselves using offspring of patented organisms gives the producer undue control over the product after it has been sold.

¹⁷⁴ Quote attributed to Jack Doyle. See Sinclair, *supra* note 53, at A9.

¹⁷⁵ The *Monsanto Magazine* recently encouraged Monsanto Corporation employees who were traveling in exotic places to collect plant and soil samples. See Jonathan King, *Breeding Uniformity*, 15 *AMICUS J.*, Spring 1993, at 25.

¹⁷⁶ The United States refused to sign the biodiversity treaty at the June 1992 Earth Summit because the treaty encouraged the South to preserve its genetic diversity by giving it rights to profit from uses that might be found for the genetic materials extracted from its lands. This

his doctors, not Moore, labored to turn his diseased spleen into something useful, they enjoy the entire commercial value of the resulting cell line and Moore receives none of this value.¹⁷⁷

Consider further the kind of incentives patents provide. Perhaps half of agribusiness research into biotechnology aims at the production of herbicide-tolerant crops.¹⁷⁸ The vertically-integrated agribusiness industry dominated by petroleum, chemical, and pharmaceutical conglomerates puts its energy into genetically altering crops to withstand the chemicals sold by the industry. Herbicide-tolerant crops undermine a recent laudable trend toward organic farming and further entrench the chemical approach to agriculture.¹⁷⁹

More ecologically sound and just biotechnologies—such as developing nitrogen fixing plants that reduce the need for fertilizers or stress resistant rice that is important for the poor peoples of the South—are left to the public sector to develop. But even the public sector's incentives are distorted by patents and the increased reliance on industry funds.¹⁸⁰ According to one analyst, major public universities are not pursuing biotechnology safety research or research aimed at benefiting the peasants of the South. Rather, public universities are turning to “market relevant”—that is, patentable and profitable—biotechnology research.¹⁸¹

would lessen the value of patent rights for the researchers from the North most likely to find those uses. See *Policing Thoughts*, *supra* note 25, at 55. Unless one assumes that this genetic material has no value and only acquires value as a result of researchers discovering its uses, a sharing of the profit this material provides between the countries of origin and the laborers who add value seems appropriate. For discussion, see *supra* notes 25, 105–09 and accompanying text.

¹⁷⁷ See *supra* notes 20–21 and accompanying text.

¹⁷⁸ See Hindmarsh, *supra* note 166, at 197. The Union of Concerned Scientists reports that forty-seven percent of field tested transgenic crops between 1987 and 1994 were herbicide tolerant crops. See Union of Concerned Scientists, *Traits Most Commonly Tested in Transgenic Crop Field Trials*, THE GENE EXCHANGE, June 1994, at 7.

¹⁷⁹ According to Hindmarsh:

Worldwide, more than 79 corporate/state research programs are developing over 23 herbicide-tolerant crop lines . . . These will further entrench the chemical approach to agriculture, which in turn will further increase soil and water pollution, pest resistance and chemical residues in food. In the process, natural ecological process will be further distorted and the erosion of biodiversity accelerated.

See Hindmarsh, *supra* note 166, at 198.

¹⁸⁰ See A. David Kline, *Bioethics—Impact of Proprietary Rights on Public Research Goals*, INTELLECTUAL PROPERTY RIGHTS ASSOCIATED WITH PLANTS, (American Society of Agronomy Special Publication no. 52), 1989, at 25–34.

¹⁸¹ *Id.* For the last three years, the United States Department of Agriculture has been awarding grants to university scientists to evaluate the risks associated with agricultural biotechnology products. See Union of Concerned Scientists, *USDA Risk Assessment Grants Awarded*, THE GENE EXCHANGE, Aug. 1994, at 4.

Once patents are the means by which we stimulate biotechnology research and innovation, this research and innovation will serve the purposes of private gain, whether or not this coincides with the public interest. Given both the significant possible benefits and drawbacks of the new biotechnologies, do we really want to let the profit motive lead us into the future that biotechnology will create?¹⁸² Considering where the profit motive has led us in the past with environmental protection and respect for nonhuman nature, I think the answer is "No."¹⁸³

VI. CONCLUSION

There exist serious difficulties with justifying intellectual property in general and biopatents in particular. The rationales in favor of biopatents, although not totally without merit, have significant weaknesses. Biopatents cannot be justified as natural entitlements to the fruits of labor. That biotechnicians are naturally entitled to the fruits of their labor does not justify biopatents, because patents are social products not created by the laborer. Biotechnicians are not even naturally entitled to the individual organisms they manipulate, because genetically-altered organisms have morally-considerable welfare-interests and are not mere instruments for human benefit. Whether altered or isolated, neither organisms nor naturally occurring genes are humanly-created tools appropriately viewed as patentable inventions. Attempts to justify biopatents as deserved rewards for labor ignore the natural and social origin of most of the value of patented organisms and genes. Finally, the argument that biopatents are the best way to stimulate a socially optimal level of biotechnical innovation is not only empirically unproven but also fails to take seriously the ways biopatents stifle innovation, the costs and risks of biotechnology, and the antisocial nature of the incentives provided. The burden of justification on those who favor monopoly rights for nonexclusive objects has not been met by the arguments in favor of biopatents.

The attempt to assimilate these results of biotechnology to traditional inventions by including them under the utility patent system is a mistake. Such assimilation encourages us to think of living organisms and the essential instructions of living organisms as human

¹⁸² For a powerful statement of this point, see Annas, *supra* note 18, at 20-22.

¹⁸³ For support of the idea that an economic approach to environmental protection is inadequate and has failed miserably, see generally Mark Sagoff, *THE ECONOMY OF THE EARTH: PHILOSOPHY, LAW, AND THE ENVIRONMENT* (1988).

inventions and tools. We socially organize ourselves with respect to these altered forms of life as we do with any other new gadget: we issue a patent. This institutionalizes disrespect for life.

Treating genetically-altered organisms and genes as patentable inventions manifests the same vices that brought us to the degraded and impoverished condition of the natural world that exists today. Our selfish anthropocentrism is on display when patenting microbes, plants, and animals is thought to raise no moral issues, while the patenting of types of humans—including human-animal hybrids—is considered unthinkable. This social policy carries on the tradition of human possession, mastery, manipulation, and domination of nature. It perpetuates our conception of ourselves as conquerors of the land community, instead of helping us become plain members and citizens of that community. If we want to change how we think about other living beings and to heal our relationship with the earth, these biopatents will get in the way.

Technology is a lens through which we see the world. Biotechnology—both old and new—can and has changed our understanding of ourselves, nature, and our place in nature. Biotechnology is not simply another mechanical or chemical procedure aimed at making the world better for us. With biotechnology, we are not reshaping matter, but harnessing life. We take a 3,500 million year old process that shaped our existence and the existence of every other organism on the planet and restructure it for our benefit. We need a more thoughtful conceptualization of this technology and more careful control over its development and use than is allowed by gung ho biopatent policies.

Biotechnology does offer promise and hope for bettering human life and perhaps other life as well. Opposing biopatents does not entail opposing biotechnology. Organism and gene patents should be resisted not because biotechnology should be resisted, but rather because these biopatents are a morally dangerous and inappropriate way of thinking about and encouraging biotechnology.

Organism and gene patents have been the focus of my critical assessment. Without these two types of patents, biotechnical innovation would probably proceed substantially unhindered. Not only is the incentive effect of these patents unknown, but other types of biotechnology patents could continue to exist, including process patents, specific use patents, and organism-mixture patents. In addition, other forms of property protection—such as licensing agreements—could also continue to exist. Although these remaining patents suffer the defects that I have identified with patents in general, they are not so

clearly disrespectful of life or disanalogous with traditional inventions as are organism and gene patents.

Let us begin to reform our biotechnology incentive system by abolishing organism and gene patents. In addition, let us explore new mechanisms for stimulating the development of appropriate biotechnologies. Increased public funding for biotechnical research should be used to offset unwanted decreases in incentives to innovate, should they result. If public funding is undesirable or infeasible for important kinds of biological innovation, and if we truly need additional private incentives, then let us think creatively and develop new and appropriate incentives.¹⁸⁴ Let us rethink and rework our mechanisms for stimulating and directing biotechnology into more respectful and sensible institutions.

¹⁸⁴ For example, we could use some provisions of the Copyright Statutes or adapt features from the Plant Variety Protection Act. For discussion of using copyright law to protect biotechnology, see Donna Smith, *Copyright Protection for the Intellectual Property Rights to Recombinant Deoxyribonucleic Acid: A Proposal*, 19 ST. MARY'S L. J. 1083-113 (1988). See also Irving Kayton, *Copyright in Living Genetically Engineered Works*, 50 GEO. WASH. L. REV. 191-218 (1982). For discussion of the Plant Variety Protection Act, see *supra* note 60 and accompanying text.