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Owning the Secret of Life: Biotechnology and Property Rights Revisited

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Dancing around the fire may contain it but does not extinguish it.

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As we stand at the dawn of a new millennium, no subject seems to challenge the very essence, or *fonds et ergo* of, and policy justifications for, property as does biotechnological inventions, discoveries, or processes. At no time has the demand for a regime reassessment and a return to first principles been so pressing as now.\(^1\)

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1. With the systematic and piece by piece decoding of the genetic code of nature, serious questions are raised about whether the discoveries of nature’s blue print should be the subject matter of a private property regime. Indeed, the implications of putting such discoveries and inventions within the property regime are so monumental.
The question of whether biotechnological discoveries or inventions should be protected as property brings to the forefront some of the eternal policy issues that have eluded philosophers, jurists, and theologians for hundreds, if not thousands, of years. The concept of property in western legal systems emerged independent of state action and after centuries of intellectual and philosophical debate carried on through opposing pamphlets, religious disputations, and intense commentaries among schoolmen. With its origins and creation occurring independent of the state, the concept of property acquired the attributes of fundamental and inalienable rights insulated from the power of the state in the form of constitutional protections.

On the other hand, the notion that ideas, however developed or expressed, can be the subject of private property rights is not only recent in origin but also was not distilled from any intense intellectual or philosophical discourse on the nature, scope, or policy justifications for such rights. The concept of property in ideas owes its existence to the state or to legislative fiat and therein lie some risks. Whereas the
traditional concept of property appears to operate as a check on the power of the state, property in ideas appears to be at the mercy of the state. The state determines which ideas may be included or excluded from the regime of private property. The state also determines the nature and scope of those property rights. However, does the state have total and unrestricted powers in the creation of property rights in ideas? Can the state decree that any and every type of idea be proprietary. Or, are there ideas that, because of their nature or importance to humanity, should not be the subject of private ownership and, therefore cannot, be the subject of any legislated property rights? In other words, might there be certain things, including ideas, that are irreversibly in the public domain as common property of all humanity? These questions are particularly important because the exercise of the legislative powers of the state in this matter does not benefit from centuries of evolved and mature debate on the subject. Nor is the conduct of the state always motivated by the best interest of the society or humanity. Thus, legislation dealing with the proprietary nature of ideas may be too limited, short sighted, ill-advised, or even subversive of the fundamental needs of humanity.

The concerns expressed above become increasingly important in the case of biotechnology. The strategic mission of biotechnology is the decoding and manipulation of the secrets of life itself to achieve various objectives. The question is whether biotechnological inventions or discoveries in the form of genetically engineered new life forms, genetic materials, products of biotechnological processes, including various organisms, qualify as, or should be, the subject of private property rights. By property rights, we are not referring to questions of the patentability of biotechnological inventions and discoveries and the ensuing protection generally accorded patents. Our inquiry is of a much more fundamental nature, as it raises the issue of whether there is an independent basis for treating ideas as property. Property rights created by the state under a patent statute are not necessarily conclusive of the proprietary character of the ideas involved, nor of the power of the state to create those rights. Since biotechnology is concerned with life itself, certain ideas might be beyond the scope of property and legislation.

Moreover, unlike other forms of property, or property based on other inventions such as machines or equipment, biotechnological discoveries involve the very essence of living organisms, including that of human beings. The ownership of a chair, or the technology for manufacturing a combustion engine, does not exclude another person from owning a different chair or a different combustion engine technology. In the case of biotechnological inventions, the ownership of genetic discoveries and inventions does not necessarily leave open the possibility of ownership by others. Biotechnological inventions are ideas based on basic scientific knowledge. There might be only one pathway within a genetic discovery, or invention, and the ownership of such a pathway might foreclose ownership by others and limit access to ideas.
The successful cloning of Dolly, the sheep, and other animals only raises the question of whether the cloning of human beings might not come sooner than one might have foreseen. Moreover, since the scientific investigation in biotechnology goes to the essence of life itself, it is quite possible that someone will uncover the secret of creating human life de novo, and the question of conferring property rights on that person will carry with it horrendous theological, social, political, and ethical implications. If property rights are granted to the creator, the property regime would then have helped us create a human "demi-god" in the inventor. The history of the world has amply demonstrated that the acquisition of power, short of that of God, has often been abused by human beings. One therefore ought to be concerned

6. Recently, Professor Liam Donaldson, Chief Medical Officer of the United Kingdom, and the Donaldson Committee issued a report which recommended that stem cells research and therapeutic cloning be allowed because of the importance of embryonic stem cells in the search for the treatment of certain diseases, such as Parkinson's disease and Alzheimer's disease. The Donaldson report touched off a debate in the U.K. about the question of cloning human life forms. For newspaper discussion of the report, see Rosemary Bennett, Embryo Research Law to be Relaxed, FIN. TIMES, Aug. 11, 2000 (announcing the recommendation of the Donaldson Committee that the law should be amended to allow research in stem cell to be harvested from early stage embryos); Clive Cooks, UK Moves Closer to Human Embryo Cloning, FIN. TIMES, Aug. 16, 2000 (explaining that the ban on reproductive cloning will stay in place but the UK government will ask Parliament to vote on whether research in stem cell and therapeutic cloning should be legal); Editorial Comment, Say Yes to Cloning Research, FIN. TIMES, Aug. 16, 2000 (in support of the Donaldson report, the Editorial offers explanations of the potential benefits from allowing research in embryonic stem cell research and therapeutic cloning); BBC News, MPS Divided on Cloning, BBC NEWS, Aug. 16, 2000 (discussing the ethical concerns over cloning and the division among members of Parliament). Cloning Report Prompts Ethical Debate, BBC NEWS, Aug. 16, 2000 (discussing the various ethical positions taken within the medical community and in Parliament over the issue of stem cell research and therapeutic cloning); Cloning to Beat Genetic Diseases, BBC NEWS, Aug. 16, 2000 (explaining the techniques of stem cell research as not exactly cloning); and Clive Cooks on, The Birth of Regenerative Medicine, FIN. TIMES, Aug. 18, 2000 (discussing the importance of therapeutic cloning and the lack of uniform national policies or action on this issue in the EU and raising questions about the use of adult stem cells as opposed to embryonic cells). But there appears to be some competition on the issue. Just when the Donaldson report and its recommendations were released, there was a change in the rules in the U.S. rules on embryonic stem cell research. See Nicholas Wade, New Rules on Use of Human Embryos in Cell Research, N.Y. TIMES, Aug. 24, 2000, at 1 (discussing the announcement by the National Institute of Health that federally financed funds would now be made available for research in human embryonic stem cell research. Previously, such research, while not prohibited, could not be federally funded. President Clinton explained the change in position as based on the staggering benefits that could be derived from the new rules. As might be expected, the announced rules drew fire from pro-life and anti-abortion advocates, who believe that human embryo stem cell research is illegal, immoral and unnecessary.). The seriousness of the potential for cloning humans is manifested by a patent which was perhaps "inadvertently issued" by the European Patent Office for cloning life forms, including human life forms. The problem came in the description of the patent, which was not limited to non-human cloning. It is expected that the European Patent Office will modify the patent. See Deborah Hargreaves, Cloning Patent to be Modified, FIN. TIMES, June 26, 2000.
7. The idea of creating life de novo is not far fetched. Scientific research currently underway is investigating how life might be created from scratch by shifting through the genes of bacteria to find the elements absolutely necessary to life. See Ronald Kotulak & Jeremy Manier, Scientists Trying to Sort Genes to Create New Life: Fears Over Ethics, Weapons Put Firm's Research on Hold, CHI. TRIB., Dec. 10, 1999, at 1; Zone: N Life, Fears Over Ethics, Weapons Put Firm's Research on Hold, CHI. TRIB., Dec. 10, 1999, at 1; ZONE: N (discussing the research in creating life de novo and raising questions about what life is and whether within the context of religion human beings should play God).
about the implications of creating a human "demi-god," substantially driven by the property regime.

It is reported by scientists that about 98% of human DNA is shared by other animals used in various forms of scientific experimentation and genetic manipulation. With transgenic genetic engineering, further policy considerations are raised about the desirability of creating property rights in biotechnological inventions. Should we draw a distinction between human biotechnological advances and those of their close cousins, and, if so, what would be the rational scientific basis for the distinction? Moreover, biotechnological inventions involve many issues that further complicate the policy considerations in conferring property rights on them. Biotechnological discoveries involve knowledge, information, data, ideas, and the process of scientific-tinkering and manipulation of various genetic materials. Scientific knowledge, information and data are generally not considered to be property, and their non-proprietary characteristic serves an important function of facilitating the advancement of knowledge in society.

Because of the significant implications of conferring property rights on biotechnological inventions and discoveries, it might be beneficial to return to the origins of the concept of property. Such a journey back should inform, but not necessarily dictate, the policy considerations and choices to be made on this important issue today. The search for guidance in history might be most fruitful if the inquiry is focused on three areas. The first area of investigation is the concept of property itself. Over centuries of evolution, the concept of property has acquired certain settled and traditional characteristics. Any new claims and accretions to the attributes of property should appropriately be measured against the traditional conception of property, not because tradition should be controlling, but rather because we need some objective measuring standard. The second subject on which history could shed light and useful insight is the classification of property. The question to be examined is how biotechnological discoveries and inventions would have been classified by ancient civilizations, such as Rome, that influenced the modern concepts of property. Finally, it would also be instructive to return to the policy justifications or philosophical rationale for the creation of property rights. The literature on the policy and philosophical justifications for property rights is both old and extensive. It might then be argued that there is nothing such an inquiry could uncover or add to the existing state of knowledge. However, the objective in this exercise is to draw attention to the fact that, even after centuries of debate, there continues to be disagreement over the general justifications for the existence of property. Perhaps even more important to us is what Becker has termed the question of specific justification; "namely, what sorts of people should own what sorts of

things and under what conditions.” Any guidance or illumination one can get on the issue of the assignment of property rights is particularly important when the rights involved concern life itself.

In summary, the goal of this article is therefore to confront the fundamental first principle issues relative to property rights in biotechnological inventions. We are aware of the differences in the biotechnology industry and that a single monolithic policy might not be appropriate for all situations. We are also conscious of the differential impact of different discoveries on society and the ecological balance. Such differences might justify a much more sensitive and discriminating policy approach. However, the goal of this article is to begin a generalized inquiry about the appropriate property regime for biotechnological inventions. Is there a general case for treating biotechnological inventions as *sui generis* deserving its own property regime, and, if so, what type? Given the results of the generalized inquiry it might be fruitful to consider the appropriate property treatment for specific categories of biotechnological inventions.

This article is divided into eight parts. Following the introduction in Part I, Part II is devoted to an overview of the biotechnology industry with the aim of creating the necessary background for the discussions that follow. In Part III, we address the historical and conceptual basis of property. First, we provide an analysis of the concept and attributes of property in order to determine the degree to which the concept of property is applicable to ideas in general and to biotechnological inventions in particular. Second, we address the classification of property under Roman law with the goal of determining whether certain things were excluded from the private property regime and why. The goal of such an inquiry is to determine whether, in general, biotechnological inventions fall into the category of things that should not be owned, since that might influence patent policy. Part IV addresses the policy justifications for the existence of property and the extent to which such justifications are applicable to biotechnological inventions. In that context, we first investigate the First Occupancy Doctrine of property. Next we examine the justification for property under Judeo-Christian doctrines. Then we explore the nature, operating premises, and scope of Locke’s labor theory of property and see how it applies to biotechnology. Finally, we discuss traditional and economic utilitarian theories of property. In Part V we seek to develop a hierarchy of norms for patent policy and legislation. Parts VI and VII extend the policy discussion by providing additional policy considerations for developing a patent system. In this regard, Part VI focuses on the appropriate policy for the incentive to invent whereas Part VII addresses the adoption of the concept of the *usufruct* to ensure better and greater access to biotechnological inventions and ideas. Part VIII is devoted to some concluding remarks.

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II. BACKGROUND OF THE BIOTECHNOLOGY INDUSTRY

Almost half a century ago, in 1956, two brash and perhaps arrogant young scientists, Francis Crick and James Watson, announced in the Eagle pub in Cambridge, England, that they had discovered the secret of life in the form of deoxyribonucleic acid (DNA), the genetic material stored in the nucleus of every living cell. That a bold declaration of a scientific discovery of such momentous import was made in a tavern was greeted with understandable skepticism by the scientific community. However, the claim proved to be more than an empty exercise of boastful youthful exuberance. For, after decades of scientific investigation and advances in DNA technology, the assertion by Crick and Watson that they had found the secret of life appears, in retrospect, to have been an understatement.

Significant scientific advances in DNA technology have demonstrated that not only does DNA explain the very essence of every living cell but also that it holds a promise hitherto unfathomable. The discovery of the nature, intimate structures, and functioning of all living organisms has ushered in a new era. In this new era, knowledge itself is not as important as the possibilities it presents. Knowledge of the genetic structure of different life forms has now made it possible to push the limits of life sciences through tinkering or manipulation of intra-species or transgenic genetic structures. With an understanding of the essence of life, it is now possible for the genetic structure of any living cell to be decoded with little effort. Using DNA technology, scientists can now identify with a high degree of particularity specific genetic traits and characteristics responsible for certain diseases, intelligence, athletic ability, or even leadership potential in human beings. In the case of plants and other life forms, the DNA technology permits


11. Prominent among the advances scientists have made is the mapping of the entire three billion letters of the book of life (human genome), which has been greeted with unusual superlatives. See David Pilling et al., The Human Blueprint Unveiled, FIN. TIMES, June 26, 2000 (noting that scientists and statesmen hailed the mapping of the entire human genome as a historic event comparable to the invention of the wheel); Clive Cooks, Genetic Map Hailed as Scientific Revolution, FIN. TIMES, June 26, 2000 (mentioning that knowledge of the three billion chemical letters of the book of life will transform health care and many aspects of life in the next century).

12. There are several reports of transgenic cloning whereby the genes of one species are inserted into another species to produce various proteins for medical uses. See Christopher Bowe, Biotech Companies Plan to Milk Herds of Cloned Cows for Human Drug Needs, FIN. TIMES, Oct. 13, 1999, at 6 (describing how advances in biotechnology have made it easier to clone large numbers of transgenic cows to produce certain pharmaceutical protein in their milk); Shreeve, supra note 10, at 44-45 (discussing cloned pigs used to produce a protein known as factor VIII, a clotting agent needed by type A hemophiliacs).

13. Discovery of what appear to be smart genes have raised questions about how that knowledge might be used by gene doctors. For a discussion of the discovery of the smart gene, see Michael D. Lemonick, Smart Genes?, TIME, Sept. 13, 1999, at 54 (describing the genetically engineered smart mouse at Princeton University and the potential benefits to human beings); Nancy Gibbs, If We Have It, Do We Use It?, TIME, Sept. 13, 1999, at 59 (raising questions and concerns about the use of smart genes for designer babies).
scientists to alter or confer specific traits and structures that affect the way these life forms function or respond to their environments.

Advances in DNA science suggest that DNA holds the potential for much good or much evil. For example, decoding the genetic traits of living organisms could lead to the elimination of certain diseases through genetic intervention at the cellular level or through the treatment of defective genes. DNA science could also be used to identify and classify various genetic traits most susceptible to serious diseases, such as diabetes or cancer. Medical treatments and pharmaceutical products could then be designed for a target genetic pool.

However, the same scientific knowledge could be used to create the ultimate class structure by genetically controlling the characteristics of people, how long people live, where they live, and even what they eat. It holds the risk of creating a world in which the human endowment at birth is not based on the probabilities of natural genetic selection but rather based upon preselection and genetic engineering. Inequality could then be the result of predetermined social engineering achieved through genetic manipulation. As our knowledge of DNA technology deepens, the potential beneficent or maleficent use of such technology increases correspondingly. Whoever controls the sources of knowledge in DNA science will hold virtually immeasurable power.

Initially, the immense potential of the DNA discovery aroused the intellectual curiosity of universities, governments, research institutions, and scientists interested in the expansion of scientific knowledge and the propagation of ideas for the benefit of humanity. However, it soon became obvious to those engaged in research, venture capitalists, and to the business community in general that DNA technology held the promise of significant financial rewards, if the science could be converted into products or services. The realization of the potential for great financial rewards, in part, led to the emergence of the modern biotechnology industry of today. Universities and research scientists once committed to the credo of total openness were no longer merely interested in scientific discoveries in biology, biochemistry or the life sciences simply for the advancement of knowledge. They were now also interested in scientific discoveries that could be appropriated, protected within an intellectual property regime, and eventually transformed into products or services in the market place. Openness and sharing of knowledge and ideas which used to be

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15. The ethical issues raised by biotechnology are serious and controversial. For a general discussion of the ethical issues raised by biotechnology see Daniel J. Kevles, Social and Ethical Issues in the Human Genome Project, 18 PHI KAPPA PHI J. 18-20 (1993) (discussing how: (1) eugenics might be used to determine which children live or are aborted; (2) genetic engineering might affect health care; (3) life and health insurance might be determined by genetic traits; (4) employment prospects such as in the United States Air Force might be controlled by genetics); UNESCO, Report of Subcommittee on Bioethics and Population Genetics of the UNESCO International Bioethics Committee, Final Version, Nov. 15, 1995 (discussing various interdisciplinary and ethical implications of biotechnology, including racism, population genetics, health, insurance and eugenics).

16. The problem of genetic discrimination has been alluded to by ethicists. See Kevles, supra note 15, at 21.
one of the distinctive and characteristic attributes of scientific investigation was replaced by acquisitiveness and exclusivity. Thus, the focus of scientific investigation in DNA research shifted from pure science to applied science, with the market determining, to some extent, the direction of the effort. Biotechnology attracted the positive attention of financiers and venture capitalists looking for that single breakthrough invention or discovery that could instantly and forever transform their financial fortunes.

The emergence and explosion in the biotechnology industry was fueled by two waves of significant investments. The first wave, which came in the 1980s, was a period characterized by investments of a speculative character. Investors were willing to commit large sums of capital based on the promise held out by the industry rather than on a rational analysis of a specific product-driven business plan. However, after a decade of research and development, the potentialities of biotechnology became less speculative and a second wave of investments began in the 1990s. Although the typical capitalization of a biotechnology company is in the hundreds of millions of dollars, using various investment strategies to minimize risk, venture capitalists, large global pharmaceutical companies, agricultural multinational enterprises and others interested in the biological or life sciences have been willing to organize and commit large sums of financial resources to particular companies, with high expectations of financially rewarding discoveries.

Investor optimism is not misplaced. Reports of recent discoveries in various fields of biotechnology have heightened investor enthusiasm and touched off global competition among companies and between countries vying for dominance in the biotechnology industry.

The success stories of the biotechnology research effort can be divided into two broad categories: healthcare and pharmaceutical products; and other agriculture and food products. In the case of healthcare and pharmaceutical products, biotechnology companies have evolved two interrelated strategies. The first and overarching strategy is to seize, alter, and control the gates to healthcare in the next millennium.

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18. The size of the investments in biotechnology only suggests the hopes entrepreneurs have in making significant returns on investments. See Lawrence M. Fisher, The Race to Cash In on the Genetic Code, N.Y. TIMES, Aug. 29, 1999, Business, at 1 (discussing the size of the market capitalization in the industry and the revenue generated).

19. Id. at 12.

20. Id.


22. See David Pilling, Drug Groups Wrestle with Seismic Shifts in Business Practices, FIN. TIMES SURVEY, LIFE SCIENCES & PHARMACEUTICALS, Apr. 6, 2000, at 1 (discussing mergers of U.S. and international biotech firms in an effort to improve their position on the brink of new discoveries in the industry.); see also David Pilling, Biotech Success a Geographical game of Chance, FIN. TIMES SURVEY, LIFE SCIENCES, Oct. 28, 1999, at 1 (pointing out that there is an increase in interest in biotech industries in the U.S. as well as abroad, due to recent developments of new products and the prospects of new products in the not-so-distant future).
by controlling all the critical genetic pathways to disease and the remedial medical services and pharmaceutical products. The current competition between biotechnology companies to map out the entire human genome sequence is, in large measure, motivated by the desire to acquire exclusive “gatekeeper rights.” Such control over a potential market of over six billion people will permit the gatekeeper to exact whatever fees and terms it wants from those seeking admission. The gatekeeper strategy does not necessarily require the actual development of pharmaceutical products or services; that task can be assigned to others admitted into the realm of the gatekeeper.

The second strategy involves the production of pharmaceutical or biomedical goods and services. The focus of this strategy is twofold: (1) to exploit scientific advances for the development of specific genetically engineered pharmaceutical products; and (2) to apply gene therapy to treat diseases traceable to certain gene deficiencies. Unlike genetically engineered pharmaceutical products that will be used to treat diseases, gene therapy will permit doctors to correct dysfunctional genes at the source by actually inserting and manipulating genes within a cell in order to prevent a genetic disorder. Advances in DNA technology have made it possible for scientists to engage in transgenic cloning, whereby human genes are inserted within animals of other species such as cows, sheep, goats and pigs, to produce human proteins, antibodies, or tissue for the treatment of various diseases.

Genetic engineering is not limited to biomedical and pharmaceutical activities. A similar process is underway in agriculture and agribusiness. After years of research and development, giant agricultural enterprises have now introduced genetically engineered, value-enhanced seeds, vegetables, fruits, and other plants. Examples of genetically modified agricultural products include better tasting and longer lasting tomatoes, herbicide-ready seeds, Roundup Ready® soybean—engineered to contain a bacterial gene conferring tolerance to the herbicide glyphosate or Roundup®, insect resistant corn (Bt-corn), and many others.

23. Fisher, supra note 18, at 1.
24. Id. at 12. Companies such as Incyte Pharmaceuticals Inc. are not interested in producing drugs but in supplying information and data to drug producers, at a price.
26. See generally Bowe, supra note 12.
27. The U.S. Department of Agriculture has issued a statement in which it explained the nature and benefits of value-enhanced crops produced through genetic engineering. See Value Enhanced Crops: Biotechnology’s Next Stage, ECONOMIC RES. SERVICE/USDA AGRIC. OUTLOOK, Mar. 1999, at 18-19 (explaining the improvements in soybeans (high protein and amino acid soybeans), high lauric canola, high-oil corn, and others). For a discussion of some of the positive attributes of genetic engineering in crops, see Frankenste Le Plant? 1 GLOBAL ISSUES AGRICULTURAL RESEARCH, Nov. 15, 1998 [hereinafter Frankenste Plant?].
28. See THE ECON. AND POL. OF GENETICALLY MODIFIED ORGANISMS IN AGRIC. IMPLICATIONS FOR WTO 2000 (Bulletin 809, November 1999) at 1-8 [hereinafter Genetically Modified Organisms] (discussing the traits of genetically modified organisms including Bt Corn and glyphosate-resistant or Roundup Ready soybean); Michela Wrong, GM MAY be a Matter of Seduction, FIN. TIMES (Life Sciences) Oct. 28, 1999, at 4 (explaining the benefits of GM products such as Astra Zeneca tomatoes that have better flavor, longer life, etc.).
The controversy over what has been termed the "Terminator Seed" seems to capture the strategy and direction of the research effort in bio-agriculture. The Terminator Seed originates from a patented technology that can engineer crops to kill their own seeds in the second generation. In other words, the Terminator Seed will produce sterile seeds and for that reason has been dubbed the "suicide seeds—genetically engineered seeds that beget sterile progeny." The controversy and the implications of the Terminator Seed will be discussed later in section IV.D.2(ii).

For the moment, suffice it to note that the development of the Terminator Seed technology only reinforces the central strategic vision of biotechnology companies. It is not so much control over specific products or services that is sought, but rather ownership and control over the molecules or DNA sequences along the pathways to the products or the processes of genetic engineering. Ultimately, controlling the pathways of genetic engineering would lead to an effective control over the end product itself. For instance, Astra Zeneca, a mere exclusive licensee of one of many genes used by outside scientists in the genetic engineering of a new type of rice that contains Vitamin A nutrients was able to control and dictate how the new invention might be used.

The unprecedented advances made in biotechnology have touched off a storm of controversy and concern over the implications and impact of genetic engineering on society at large. Critics are particularly concerned because genetic engineering appears to be moving into unchartered waters at an ever increasing pace. Prevailing scientific knowledge, which is still inadequate, suggests that the current natural

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29. See Frankenstein Plant?, supra note 27 (explaining how the Terminator technology works); Hope Shand, Terminator Seeds: Monsanto Moves to Tighten its Grip on Global Agriculture, MULTINATIONAL MONITOR MAG., November, 1998 (discussing the potential impact of the Terminator Seed technology); Martha L. Crouch, How the Terminator Terminates, OCCASIONAL PAPER OF THE EDMONDS INSTITUTE, 1998 (offering a detailed scientific explanation of the Terminator Seed technology including the realities and misconceptions of the risks and dangers it may pose).
30. Shand, supra note 29.
32. Madeleine Nash, Grains of Hope, TIME, July 31, 2000 at 39, 43 (Time magazine published a Cover Story on the importance of genetically modified foods in fighting world hunger and also addressed the problems faced by scientists motivated by humanitarian goals when their corporate sponsors have commercial interests).
33. Public outcry against genetically modified products is worldwide and the concerns are wide-ranging. See Food for Thought, THE ECONOMIST, June 19, 1999 (discussing the differences in European and U.S. public perceptions and protests against genetically modified products; offering different reasons for resistance to those products, such as this "they are unnatural, foods produced from them are dangerous, or they are bad for the environment). See also Genetically Modified Organisms, supra note 28 (discussing the economic and political implications of genetically modified organisms). The concerns over the impact of genetically modified organisms has led to a demand for Congressional action in the U.S.; see Adriel Bettelheim, Reluctant Congress Drafted into Bioengineering Battle, CONG. WKLY., Apr. 22, 2000, at 938 (discussing the policy choices faced by Congress in addressing the public reactions to genetically modified products, taking into account the interests of consumers and the biotechnology industry).
order of things took millions of years to evolve. Tinkering with nature at the molecular level makes some critics nervous. It is feared that genetic engineering may contain hidden dangers to the current ecological, health, or bio-diversity balance and may expose humanity to risk of serious irreparable harm.

While concerns over the impact on the environment, health, and bio-diversity are important, they are nevertheless speculative in nature and appear to be induced by fear. However, concerns of perhaps equal importance and of a less speculative nature relate to questions of ownership and control over biotechnology discoveries, inventions and innovations.

34. Environmental organizations such as Greenpeace have spearheaded the assault on the genetic engineering particularly as it relates to food. It is reported that Prince Charles made the following comment about genetic engineering that may be representative of the concerns of many: "I happen to believe that this kind of genetic modification takes mankind into realms that belong to God and God alone." See Michael Specter, *The Pharmageddon Riddle*, THE NEW YORKER, Apr. 10, 2000, at 58. According to Specter, unlike genetic engineering in medicine "playing with the molecular foundations of the food supply has seemed to many people like the agricultural equivalent of cloning a lamb—it crosses some unacceptable boundary." Id. at 61.

35. See id. (explaining the fears of opposition groups to genetic engineering). One of the main concerns is the impact of genetic engineering on the environment. See Carol Kaesuk Yoon, *Altered Corn May Imperil Butterfly, Researchers Say*, N.Y. TIMES, May 20, 1999, at A25 (explaining how genetically modified Bt corn pollen carries a toxin deadly to monarch butterflies); *Frankenstein's Plant?, supra note 27*, at 5-6 (discussing the environmental issues and concerns over super viruses, stubborn weeds and the impact on insects); *Food for Thought, supra note 33* (discussing the grassroots nature of the coalitions formed against the genetically modified organisms); Michela Wrong, *Americans Get Wise to Agricultural Revolution*, FIN. TIMES, Dec. 16, 1999, at 11 (explaining that having lost its steam in the United Kingdom after government action, the debate and public outcry over genetically modified organisms gained momentum in the U.S. resulting in Food and Drug Administration hearings); Michiyo Nakamoto, *Japan's Food Labels Decision May Fuel Trade Friction*, FIN. TIMES, Sept. 16, 1999, at 8 (indicating that the concerns over genetically modified foods have reached Japan, resulting in the demand for the labeling of such products from foreign sources). The diversity in corn in Mexico is claimed to be threatened by the importation of genetically modified corn seeds which could contaminate native species. See Henry Tricks and Andrea Mandel-Campbell, *Mexico's Farming Habits Under Pressure From Transgenics*, FIN. TIMES, Oct. 12, 1999, at 8 (discussing the threat posed by the importation of transgenics to 24,000 varieties of corn in Mexico).

36. The fear and public hysteria that has been generated by opponents of genetic engineering is not always well-founded. Some scientists have felt obliged to step outside their laboratories to defend genetic engineering. See, Conrad Paul Lichtenstein, *This Other Eden*, FIN. TIMES, WEEKEND, Apr.1/Apr. 2, 2000, at 10, (arguing that there is nothing unnatural about genetic engineering or genetically modified organisms). "Indeed, those of us who still smoke inhale the combustion products of a natural GM event where foreign DNA entered tobacco millions of years ago somewhere in the Andes. Genes are handed on from parents to their offspring by 'vertical transmission.' As the hereditary genetic information replicates, natural errors—'mutations'—occur at random generating genetic variation." The cumulative effect of the natural selection process produces new species. Id. See also Lila Guterman, *Scientists Leave the Lab to Defend Bioengineered Food*, THE CHRON. OF HIGHER EDUC., Apr. 14, 2000, at A29 (describing the efforts of scientists trying to educate the population about the risks and benefits of genetic engineering based on the massive information available, rather than on fear). These scientists are also concerned about the impact of uninformed rejection of the biotechnology on the funding of research, not only in the United States, but also in the European Union. See Burton Bollag, *Public Pressure Puts a Damper on Biotechnology Research in Europe*, THE CHRON. OF HIGHER EDUC., Apr. 14, 2000, at A74 (discussing the decline in funding of genetically modified organisms in Europe). Some argue that genetically modified products are of high quality, but companies have not been able to market them properly and focus on their positive attributes. For an article addressing this point, see Ben Rogers, *Superior Tomato Puree is Not Enough*, FIN. TIMES, WEEKEND Oct. 2/Oct. 3, at III.
III. HISTORICAL AND CONCEPTUAL BASIS OF PROPERTY

A. The Attributes of Property

If, as discussed above, the mission of biotechnology is to unravel the mysteries of nature about life and living organisms, the question is raised whether such effort should be rewarded with the grant of property rights. The idea that biotechnological inventions and discoveries may be the exclusive and private domain of individuals presents several significant and fundamental policy concerns to be addressed. The concern is not just about the appropriateness of subjecting certain fundamental ideas about the cellular structure and functioning of all living organisms to the property regime. It is also about the impact of private ownership of discoveries and inventions which have the potential for a revolutionary and unpredictable transformation of human social and political organization. It is unclear whether such power should be left in the hands of private owners or should be made available to humanity at large. Moreover, what is sought to be owned generally involves ideas about the functioning of organisms at the cellular level or the processes and pathways in nature. Questions are further raised whether such ideas are part of the general human patrimony, not the appropriate subject of private ownership. These questions cannot properly be addressed without a return to the concept of property and its application to biotechnological inventions and discoveries.

Certain basic characteristics seem to lie at the core of western philosophical and jurisprudential notions of property. Property is often described in terms of dominion over a thing reinforced by the power of exclusion. This view of property is best exemplified in Blackstone’s Commentaries on the Laws of England. Blackstone presented a generalized power theory of property which was absolute, characteristically excessive, and logically driven. According to Blackstone, a property right is “that sole and despotic dominion which one man claims and exercises over the external things of the world in total exclusion of the right of any

37. See WILLIAM BLACKSTONE, COMMENTARIES ON THE LAWS OF ENGLAND (William Carey Jones, ed., Bancroft-Whitney Co. 1916) (1765). The argument might be made that any discussion of application of western property concepts to ideas must address the work of philosophers such as Kant and Hegel. However, because of space and time considerations the work of Kant and Hegel will not be discussed in this article. The interested reader might explore the following sources for the work of Kant and Hegel: GEORG WILHELM FRIEDRECK HEGEL, THE PHILOSOPHY OF RIGHT, (T.M. Knox Translation) (GREAT BOOKS OF THE WESTERN WORLD, Robert Maynard Hutchins Ed. 1952). The discussion of property starts at paragraph 41 and Hegel makes some comments about ideas or intellectual property in relation to physical property in paragraph 43. For a discussion of Hegel’s concept of property as applied to intellectual property see, Justin Hughes, The Philosophy of Intellectual Property, 77 GEO. L.J. 287, 330-39 (1988) (examining in detail the general tenets of Hegel’s philosophy, his concept of property and its application to intellectual property). The protection of some forms of intellectual property rights such as copyright also caught the attention of Kant who argued for the protection of literary works. See IMMANUEL KANT, THE SCIENCE OF RIGHT (Translated by W. Hastie) GREAT BOOKS OF THE WESTERN WORLD, Robert Maynard Hutchins Ed. 1952). At page 425, Kant poses the question “What is a Book?” and sought to explain why protection should be given to the publisher of books.
other individual in the universe." A few comments are worth making about Blackstone's theory of property.

One has to be cautious about what implications to draw from Blackstone's views on this journey back into history. Because Blackstone sought to construct a system of property rights that was logically coherent, he felt compelled to fill any gaps with deductive reasoning and various legal fictions. Whatever lessons we might learn from Blackstone, we must remember Holmes' assertion that "the life of the law has not been logic: it has been experience." One might say that, under the common law, the case preceded the rule as legal principles were created to solve specific problems as they emerged. Indeed, the evolution of the common law might more appropriately be likened to an elephant being constructed by four blind persons. The elephant is likely to take on lumpy and incongruent shapes at various stages of construction and, if the job is ever completed, it would probably lack symmetry. All of these counsel caution in seeking guidance from the common law past on this important question of property rights in biotechnological inventions.

Second, it should be noted that Blackstone's characterization of property limited property rights only to external things or physical objects (res quae tangi possunt), also referred to by Grotius as 'the irrational and inanimate part of the creation'. In attributing only physical characteristics to property, Blackstone was merely reiterating limited views held by ancient Roman jurists. However, the notion that property rights conferred on the owner absolute and despotic powers over the thing owned seemed excessive and extraordinary in the suggestion that no qualifications to property rights could exist either under Roman law or the common law. The power theory of property seemed to have been derived from the Roman law term dominion (dominium), often associated with the right to use, enjoy and misuse (usus fructus abusus) and, inferentially, power over the thing. Dominium in its absolute

38. BLACKSTONE, supra note 37, Bk. II at *2.
39. See OLIVER WENDELL HOLMES JR., THE COMMON LAW 1 (1881). The quoted sentence was part of a series of lectures delivered by Holmes on the Common Law. The idea that the common law is based on experience, not logic, is fully captured in the following passage:

The felt necessities of the time, the prevalent moral and political theories, institutions of public policy, avowed or unconscious, even the prejudices which judges share with their fellow-men, have had a good deal more to do than the syllogism in determining the rules by which men should be governed. The law embodies the story of a nation's development through many centuries, and it cannot be dealt with as if it contained only the axioms and corollaries of a book of mathematics. In order to know what it is, we must know what it has been, and what it tends to become.

Id.

40. The association of property with physical objects is old. It has been described as the physicalist conception of property which links property to things touchable. See Kenneth J. Vandevelde, The New Property of the Nineteenth Century: The Development of the Modern Concept of Property, 29 BUFF. L. REV. 325,331 (1980) (discussing the physicalist conception of property and attributing this concept to Blackstone).
41. Hugo Grotius, War and Peace, READINGS IN JURISPRUDENCE AND LEGAL PHILOSOPHY 7 (MORRIS R. COHEN & FELIX S. COHEN 1951) [hereinafter READINGS IN JURISPRUDENCE].
42. MAX RADIN, HANDBOOK OF ROMAN LAW 335-337 (1927) [hereinafter ROMAN LAW] (discussing the nature and scope of the concept of dominium under Roman law).
form consisted of the following privileges and rights: *jus untendi*—the right to use a thing while keeping its corpus intact; *jus fruendi*—the right to use a thing by diminishing its outgrowth; and *jus abutendi*—the right to completely consume a thing and therefore end its effective existence. It is doubtful whether one can infer from these rights absolute and despotic power over the thing owned.

Equally extraordinary was Blackstone's view that the right to exclude others was not only total, but also was held against the universe. If by universe Blackstone meant the world at large, property rights would have no territorial limits, nor could they be modified or qualified for socially beneficial purposes. On the other hand, if the term universe merely referred to English property, then rights would have territorial limits, with their absolute character remaining intact.

An absolute view of property enjoys little or no support in history. Nonetheless, the power to exclude interference by others has been extensively relied on to define property. According to Justice Holmes, the power to exclude others gives property its legal character. The power of exclusion was put in much more common language by Cohen when he asserted that property is that thing which has the label "Keep off unless you have my permission."

Other conceptualizations of property relied less on power theories and more on analytical jurisprudence, expectations, and value. Thus, Bentham called property a legally protected expectation. To others, property is anything that has an exchange value. Following the framework of analytical jurisprudence, Hohfeld described property rights as a bundle of many *paucital* (in personam) and *multital* (in rem) rights, actual or potential, and falling within a spectrum of two polar extremes: dominion and exclusivity at one end, and the absence of dominion and exclusivity at the other. Under this regime, property rights do not cease to exist merely because the owner does not possess absolute and despotic dominion over a thing because power and dominion are not essential attributes of all property rights. The bundle of property rights is divisible into different categories of control not limited to complete dominion and consistent with the type of property involved.

The Hohfeldian approach is much more sophisticated than the power theory of property and has been adopted by legal scholars and used to explain the modern liberal theory of property. For instance, Honore has argued that modern liberal property rights embody a bundle of at least eleven rights, prominent among which

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43. *Id.* at 336.
44. BLACKSTONE, *supra* note 37, Book II at *2.
49. *Id.* at 94-101 (discussing the range and multiplicity of property rights).
50. PROPERTY RIGHTS, *supra* note 9, at 18.
are the right to possess, use, manage, and the right to the income and capital.\textsuperscript{51} Becker describes the right to capital as perhaps the most important in defining ownership, because it includes "the power to alienate the thing, and to consume, waste, modify or destroy it."\textsuperscript{52} A person may own all the rights in a property except the right to capital, but the one who holds the right to alienate, consume, or destroy is considered by Becker as the owner. The argument is not that property rights that fall short of the right of alienation cease to be such, but rather that a person may hold certain property rights in that which is owned by others. The significance of the Hohfedian approach is that property does not just denote dominion over a material object, but concerns a multiplicity of rights in relation to it with respect to others. These rights are capable of residing in different people at the same time. For instance, the right to alienate, or otherwise dispose of, property might reside in one person, while the right to use, whether exclusive or not, might be held by another.

The preceding brief discussion of the concept of property has significant implications for biotechnological products, inventions, and discoveries. However, a discussion of these implications requires an understanding of the basic characteristics of biotechnological materials. Biotechnological materials can be divided into three categories: (1) the physical output, including biotechnological products, goods, materials, and related services; (2) biotechnological materials which are sub-cellular and invisible to the naked eye, yet whose physical existence is not in doubt;\textsuperscript{53} and (3) biotechnological inventions, discoveries, developments, and control of the pathways to the physical output or services.

To the extent that one of the characteristic attributes of property rights is dominion or power and control over tangible things (\textit{res quae tangi possunt}), the physical output of biotechnological processes would fall within that definition of property. Accordingly, Dolly the sheep and various transgenic cows, pigs, and mice, and genetically engineered seeds and plants, could be owned. If we exclude them from the regime of private property, it cannot be because they cannot be controlled or be subject to the dominion of a person. The exclusion from the regime of property must be based on some other policy rationale or justification. However, the mere fact that cloned sheep or transgenic cows and pigs \textit{can be privately owned} does not mean that \textit{the process or the pathways} to cloning them, as well as other forms of genetic engineering, should be \textit{privately owned}.

Sub-cellular materials not visible to the naked eye, micro-organisms, and enzymes have a physical presence and, for that reason, could be treated as private property similar to the products described above. Even though they share some characteristics with intangible assets, they are subject to certain types of control as tangible things. However, control over a thing is not determinative of property rights over it. A bailee, a robber, or a gunman may have control over a thing he does not

\textsuperscript{52} \textit{PROPERTY RIGHTS}, supra note 9, at 7.
\textsuperscript{53} These materials may be classified under the physical category of things.
own. Ownership presupposes some legally recognized relationship of a person to a thing. But the determination of such legal relationship is a policy matter not necessarily dependent on control or the capacity to control a thing. A policy of conferring property rights on sub-cellular materials does not mean that the process of creating such materials should also be owned. That is to say, knowledge, information, and ideas concerning the process may be in the public domain as res communes, but the specific results of their use may be privately owned. The reasons for conferring property rights on the results of the use of res communes is not based on dominion or power, but on a policy rationale.

However, since such sub-cellular materials may involve life itself, including human genetic materials, it is not entirely clear whether all sub-cellular materials, micro-organisms and their enzymes and, in particular, those of human origin should be privately owned. Notwithstanding the fact that such materials can be controlled in the same manner as the seats in a Roman stadium, there might be policy justifications for excluding them from the regime of private property.

Biotechnological inventions, discoveries, and the process of genetic engineering raise different considerations. First, because they are intangible assets that involve information, data, knowledge, and ideas, they are not, by their nature, easily susceptible to control by inventors and researchers. It could be argued that because they are derived from knowledge, ideas, and information, they are not dissimilar to air, light, and other intangible things excluded from the private property regime under Roman law. However, the question of power or control over a thing is not necessarily determined by its physical attributes, but rather by the prevailing technological capability. Technological limitations of today may make certain things uncontrollable, but future advances in technology may change that situation. Advances in technology may bring more things within human control and dominion than was previously possible. For instance, due to advances in satellite technology, telecommunications, star wars hardware, and sophisticated computer hardware and software, it is now easier to control access to and the use of large portions of the high seas than was possible during the Roman era, or even a century ago. 54 Thus, the inability to control intangible assets because of their incorporeal nature cannot be determinative of the issue of ownership. Whether private property rights should be created for biotechnological inventions is therefore a significant public policy issue to be resolved in the future.

Moreover, control over a thing can be achieved through means other than physical force or restraint. A regime of secrecy backed by an enforcement mechanism can be effectively utilized to maintain control over biotechnological inventions, ideas or information. A regime of secrecy supported by the law of contract allows inventors and researchers to extract a binding agreement to maintain

54. Current military hardware and the attempt to development a missile defense system are examples of the nature of control that can be exercised over any part of the globe from the air. See Todd Halverson, Ability to Detect Missiles Tested, GANNET NEWS SERVICE, May 23, 1993.
secrecy from those having access to research results or inventions. The current legal regime for the protection of trade secrets is substantially contract based. The issue is therefore not whether biotechnological discoveries or inventions can be controlled under a regime of secrecy, but rather whether they should be the subject of private ownership. If they cannot be privately owned, then it is further doubtful whether they can be excluded from the public domain through private secrecy agreements. In other words, that which is in the public domain cannot be the subject of an enforceable secrecy agreement. Thus, private parties cannot by agreement between them confer rights in contravention of a deliberate policy of exclusion of a thing from private ownership. Such a position might be justifiable particularly when we are dealing with inventions, ideas and information of critical importance to existence itself. The reason for excluding biotechnological discoveries and inventions from the protective umbrella of the property regime would then be policy-based rather than based upon the lack of capacity to control.

The significant social, economic, and political implications of the advances made in biotechnology compel a more careful inquiry into whether they should be privately owned, and, if so, by whom and for how long. Biotechnological inventions, similar to such things as air, light, the beach, and seats in a Roman stadium, have the characteristics of a public good. Inventions originate from ideas, basic knowledge, and general information which have a public good character. These inventions also maintain their public good character, in that they cannot be depleted by multiple use by people other than the inventor. The issue of whether they should be excluded from general access and use cannot be based on concerns that the inventor will be deprived of his asset through depletion from multiple use. Rather, the real concern is how the cost of the invention should be handled and how inventive activities can be encouraged. How these concerns are addressed is a question of policy rather than the attributes of intangible assets.

Biotechnological advances, whether they come in the form of inventions or discoveries, require the investment of significant amounts of financial and other resources. The question is whether the cost of these inventions justifies granting property rights to the inventors in order to encourage inventive activities. The

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55. The earliest reported trade secrets case in the United Kingdom in which judicial protection of trade secrets was sought is said to be Newbury v. Jones, 2 mer. 445, 35 Eng. Rep. 1011 (1817) (request for injunctive relief based on a trade secret agreement denied). See also Smith v. Dickenson, 3 Bos & Pul. 630, 127 Eng. Rep. 339 (1804) (successful action for breach of secrecy agreement). For the United States, the first reported case is said to be Peabody v. Norfolk, 98 Mass., 452 (1869) (recognizing property rights in trade secrets). In a more recent decision of the U.S. Court, the protection of trade secrets is based on the common law of the states. See Kewanee Oil Co. v. ICION Corp., 416 U.S. 470, 481-486 (1973) (discussing the definition and policy rationale behind trade secret protection).


57. Fisher, supra note 18.
incentive to invent argument is a complex one not easily susceptible to falsification through theories of causation. This argument is examined below under the policy justification for creating property rights in biotechnology.

On the other hand, the consequences of granting private ownership rights might be so undesirable that an alternative technique of handling the cost should be explored. For example, public funding of biotechnology research and inventions is the most appropriate policy choice if the public good and res communes character of such inventions should be maintained. However, public funding is only one of several policy choices.

Finally, one of the most important questions to be resolved is the scope of property rights that might be granted. Relying on the Roman law term *jus utendi fruendi abutendi*, modern property theories, following Blackstone's characterization, seem to suggest that the holder of a property right holds the absolute right to use, enjoy, misuse, or destroy his property. However, *usus, fructus* and *abusus* did not connote the absoluteness of rights thereafter asserted by subsequent jurists such as Blackstone. The Roman law origins of the claim of absolute and despotic rights are questionable. According to Richard Theodore Ely, the contention that property rights included the absolute right to destroy or misuse property was due to bad translation of the word *abutendi* in the Roman law phrase "dominium est jus utendi et abutendi re." As explained in the section on Roman classifications, the word *abutendi* connoted using a thing until it was depleted and consequently ceased to exist. This meaning of *abutendi* does not easily fit the concept of destroying one's property, which implies wantonly to lay waste to the thing owned. As further explained by Ely, the property rights embodied in that phrase were further qualified by the clause "*quatenus juris ratio patitur*" in so far as the reason of law permits. However, the holder of a property right might misuse it as in *abusus* but such use might only relate to power or capacity, which does not require any legal sanction. Besides, the term *abusus* (misuse) is both a normative and an ideological concept, because it connotes putting something to a use unapproved by societal norms; it is the negative side of the term *usus* (use). Whether a particular use of property is a positive or negative use or whether it benefits or harms society depends on some normative standard which may say nothing about the necessity or beneficial nature of the particular use.

It is, however, possible that the old Roman concept of *jus quiritium* or quitarian ownership might have given rise to the notion that property rights were absolute.
Jus quiritium consisted of peculiar property rights strictly preserved for Roman citizens who could exercise certain rights with respect to res mancipi without legal let or hindrance. Rights in res mancipi, which included lands located in Italy, slaves, cattle, horses, mules and asses, could only be created after an elaborate ceremony transferring legal title or ownership. While quitarian ownership conferred certain powers upon Roman citizens, it seems inaccurate to equate those rights with absolute and despotic power. Roman citizens holding quitarian rights were limited by law as to whom those rights could be sold. For example, aliens were prohibited from purchasing or otherwise acquiring those rights. Such limitations, even if they were directed at aliens, nevertheless operated as restrictions on Roman citizens and would tend to undermine the notion of absolute or despotic rights. Moreover, dominion under Roman law did not denote absolute or despotic power over a thing even if it had significant economic implications to the owner. The owners of slaves under Roman law could not maltreat or kill them. The rights of slave owners did not rise to the level of complete dominion, which included destruction through killing. Similar limitations and constraints were imposed on landowners. The rights of land owners were significantly qualified by the existence of neighboring land holdings, particularly public highways.

B. Roman Law Classification of Property

While the concept of property offers some guidance on how biotechnological inventions and discoveries might be treated under the property regime, further guidance may be obtained from the examining the classification of property. In a sense, the concept of property implicates the issue of classification of things as proprietary and non-proprietary. What distinguishes property from non-property is not just a question of definition but also a question of classificatory policy. Biotechnological inventions and discoveries can be classified a property or non-property based on policy choices. Where the line should be drawn is not a simple one and a journey back into history might provide some assistance on the choices to be made. The most appropriate historical excursion is into Roman law because the origins of western property concepts are traceable to Roman law.

63. Id.
64. WILLIAM L. BURDICK, THE PRINCIPLES OF ROMAN LAW 312-13 (Wm. W. Grant & Sons, Inc. 2d ed. 1989) [hereinafter PRINCIPLES OF ROMAN LAW] (describing the nature of res mancipi and res nec mancipi).
65. Id. at 314.
66. ROMAN LAW, supra note 42, at 337.
67. Id.
68. The influence of Roman law on many modern western legal systems cannot be doubted. That influence is best captured in the first paragraph of Burdick’s book, PRINCIPLES OF ROMAN LAW, where he stated:

The Roman Empire as a political organization passed away centuries ago, but Roman jurisprudence through its influence still remains a world power. In its modernized form Roman law has become the law of more than three-fourths of the civilized globe, and Gibbons words written in the eighteenth century “the laws of Justinian still command the respect or obedience of the independent nations,” are
Early Roman jurists were practical men who did not delve into the philosophical foundations or justifications of property.\textsuperscript{69} This does not mean that policy justifications for the existence of property rights did not exist. Such policy rationales might have existed but remained unarticulated. While later jurists and codifiers rooted the existence of property in natural law, or \textit{jus gentium}, earlier jurists were first interested in the classification of things (\textit{res}).\textsuperscript{70} The classification of property proceeded from the general to the specific. At the top were two general categories: things that could be the subject of private ownership or dominion (\textit{res in nostro patrimonio}); and those that could not be the subject of private ownership (\textit{res extra nostrum patrimonium}). The things that were excluded from private property were further divided into four categories.

First were \textit{res communes} or common property which belonged to all human beings in common. \textit{Res communes} included air, running water, the sea and the shore of the sea.\textsuperscript{71} \textit{Res communes} was, however, distinguishable from the second category, \textit{res publica}, or public property that did not belong to humanity at large, but rather belonged only to all people within the state or the general public. \textit{Res publica} included harbors, rivers, and public roads in which the public had only the right of use and enjoyment.\textsuperscript{72} The third category of property, called \textit{res universitatis}, or property of a corporate entity, had a narrower group of ownership. It belonged to all members constituting the corporation as a group, but not in their individual capacity.\textsuperscript{73} Included in this category was property of municipalities such as \textit{theaters} and \textit{studia}.\textsuperscript{74} The right to use and enjoy such property was however held by the members. Thus, citizens of Rome were entitled to enter and use vacant seats in the amphitheater which could not be privately owned. The last category of things not subject to private ownership was \textit{res divini juris}, or property governed by divine law.\textsuperscript{75} This category of things included the following: sacred property (\textit{res sacrae}), religious property (\textit{res religiosae}), and holy things (\textit{res sanctae}).

Finally, it should be noted that not all things that could be the subject of private ownership were actually owned. \textit{Res nullius}, referred to things belonging to no owner. \textit{Res nullius} was further divided into two sub-categories: things not susceptible to private ownership, such as things governed by divine law, and those,

\textsuperscript{69} See generally id. at Chap. IV., ROMAN LAW, supra note 42, at Chap. 2.
\textsuperscript{71} See PRINCIPLES OF ROMAN LAW, supra note 64, at 307; PH. J. THOMAS, INTRODUCTION TO ROMAN LAW 34 (1986) [hereinafter INTRODUCTION TO ROMAN LAW]; 2 JUSTINIAN, THE CIVILIAN LAW 33 (S.P. Scott, 1973 ed.).
\textsuperscript{72} See PRINCIPLES OF ROMAN LAW, supra note 64, at 307; INTRODUCTION TO ROMAN LAW, supra note 71, at 34.
\textsuperscript{73} PRINCIPLES OF ROMAN LAW, supra note 64, at 308.
\textsuperscript{74} Id.
\textsuperscript{75} Id. at 310.
while susceptible to private ownership, were not presently owned. This last category would include *ferae naturae*, or wild animals, birds, fish and unappropriated pebbles or gems on the beach.76

What was it about *res extra nostrum patrimonium* that excluded them from being the subject of private ownership? They did not all share the same physical characteristics, nor serve the same social purposes. Some of them were tangible and visible; others, such as air, were intangible and invisible. While some classical scholars and the codifiers explained the classification in terms of natural law,77 that justification does not fully explain why certain things could not be privately owned. Natural law was such a variable and contradictory concept throughout the history of Roman law79 that it could not offer a singular policy rationale behind the classification. Moreover, as noted above, Roman jurists were practical men who were concerned not so much with the essence of things as with their practical utility. One must then seek additional policy justifications from other sources.

The starting point for an alternative policy justification might be an examination of the basic characteristics of things excluded from the subject of private ownership. A careful review of the list will show the following. First, some of the things were central to life and living. Running water, rivers and the air were critical to living beings and must not then be appropriated by an individual, the state or any other corporate entity even if they could. It is unclear whether, under Roman law, the state could lawfully create private property rights in those things falling into the category of things that must not be owned such as *res communes*.80 If the exclusion of certain things from the property regime was dictated by natural law, however defined, the

76. *Id.* at 341. *Res nullius* include the following: (1) animals *ferae naturae*, (2) new things that come into existence by natural causes, (3) property of an enemy (*hostis*), (4) things abandoned by their owners (*res derelictae*), and (5) treasure trove (*thesaurus*) i.e. things hidden or concealed in the earth.

77. *Id.* at 308.

78. BRIAN TIERNEY, THE IDEAS OF NATURAL RIGHTS 136 (1997) (discussing the use of natural law by Roman jurists such as Gaius).

79. *Id.* at 137-48 (examining the different uses of the concept of natural law by different jurists at different times).

80. The location and exercise of legislative powers in Rome differed depending the time of history involved: early days of Rome, the Republic era, and the era of emperors. Irrespective of the era, the nature of legislative powers is unclear. There is little evidence of whether the legislature could exercise any or all powers in legislating on various subjects. Even during the post republican era when the legislative powers were in the hands of the emperor, it is unclear whether that power was not limited in law or in fact by civil or natural law. See WILLIAM A. HUNTER, A SYSTEMATIC AND HISTORICAL EXPOSITION OF ROMAN LAW XLVIII (Wm. W. Grant & Sons, Inc. 2d ed. 1994) (pointing out that the legislative powers of the emperor were defined by specific statutes thereby raising the question of whether such powers might have been limited). For further discussion of the legislative process in Rome see E. P. BURKE, HISTORICAL ESSAY ON THE LAWS AND THE GOVERNMENT OF ROME 230-37 (Wm. W. Grant & Sons, Inc. 1994) (1827) (explaining that in the post Republican era there was absolute monarchy in which the prerogative of legislative powers was solely vested and as legislator the emperor had no opposition, no fear, no dilatory forms of proceedings that could slow down the process and execution of laws). It is still not clear what this meant if the legislative powers of the emperor were based on specific statutes. See generally ALAN WATSON, THE LAW OF THE ANCIENT ROMANS 10-16 (1970) (discussing the legislation, the law of the Kings and the Twelve Tables).
state might have lacked the power to interfere with the dictates of such law. While it might be argued that the list of things excluded from private ownership were mostly things that could not easily be controlled, it was not so much the impossibility of controlling them as it was their importance to human existence that accounted for the result. For example, running water and the seashore could be controlled, but were nevertheless excluded from private ownership. The reason must have been because of some other policy justification and not because they could not be controlled.

The seas and rivers were important to the Romans and humanity for navigation, transportation and commerce. It is conceivable that the protection of such societal interests led to a policy of recognizing ownership of the land around a river but not the river itself or the running water. Private ownership of the shores would impede the ingress and egress of ships, which would not be beneficial to a sea-faring nation.

Some of the things excluded from private ownership had the character of a "public good" in that they could be used over and over again by different people without being easily depleted. The beach, harbors, public roads and seats in a stadium fall into this category. While beaches and shores were naturally occurring, harbors, public roads, and stadia had to be built and maintained at some considerable expense. Such costs nevertheless did not deprive them of their beneficial character. Navigation, transportation, and entertainment were so important to the Romans that they appeared unwilling to privatize access to them.

Some other things, like the air and the sea, could not easily be controlled. However, it is doubtful whether their indomitable character explained their exclusion from private ownership. Rather, it appeared that their importance in nature and to existence, was the reason for their exclusion from private property.

Some things of a spiritual character were also excluded from private ownership. This category included things that generally could be privately owned yet because of the use to which they could be dedicated, a policy was adopted to exclude them from the category of appropriable things.

What lessons might one learn from the ancient classification system? How would biotechnological inventions and discoveries fit into the system? It should be noted that the classification system included a category for corporeal things and incorporeal things. Incorporeal things were abstract conceptions which were protected by law but could not be the subject of ownership. Thus, a distinction was made between legal protection in general and legal protection through ownership. It is important to note that biotechnological inventions and discoveries would largely

81. See ARROW, supra note 56, at 151 (discussing the indivisibility nature of information); see also CASSON, supra note 56 at 36-38 (1979) (discussing the diffusability of information); Yelpaala, supra note 56 at 208, 220 (1986).

82. See ARROW, supra note 56; CASSON, supra note 56; Yelpaala, supra note 56.

83. INTRODUCTION TO ROMAN LAW, supra note 71; JUSTINIAN, supra note 71, at 43; PRINCIPLES OF ROMAN LAW, supra note 64, at 303, 312-13.
fall into the category of incorporeal things and, ab initio, should be incapable of private ownership under this reasoning.

However, our inquiry about the policy considerations in biotechnological innovations might benefit from the discussion of the classification of things in general. Because biotechnological inventions concern life itself, they have significant implications similar to those surrounding air, running water, rivers and other things excluded from the possibility of private ownership under Roman law. Thus, quite apart from the incorporeal argument for exclusion, it might be useful, in the modern context, to examine whether there are sound arguments for excluding biotechnological inventions, discoveries and innovations from the regime of private ownership. If we follow the Roman classification model, can we conclude that some biotechnological inventions and discoveries are in the public domain and must not be interfered with through legislation? Moreover, biotechnological inventions and discoveries share the characteristics of a public good. As discussed above, inventions, ideas and concepts are diffusible and inexhaustible with multiple and simultaneous uses. The classical jurist saw no policy justification for denying access to things with a public good character. The reason for allowing access seemed magnified when the public good had significant implications for life and living, as do biotechnology discoveries. But policy considerations based on the public good characteristics must take into account the cost of inventions. Because biotechnology research involves billions of dollars, the funding of such activities might have to be reconsidered if the results of the research and development are to be treated as a public good.

Finally, one of the relevant policy issues raised by classification system is the question of control. It appeared that some of the things not susceptible to private ownership were also not easily susceptible to human control. In the same vane, biotechnological inventions originate from and form part of knowledge, ideas, and concepts not easily controlled once disclosed. However, it has been argued that the inability to control is not in and of itself the reason for exclusion from ownership. Knowledge, ideas, and concepts are essential for human civilization and for that reason have always belonged to the category of things that “cannot” and “should not” be controlled through private ownership even if the control became technologically feasible. Such a position is not controlled by the nature or the essence of the thing, but rather by some fundamental policy justification.

It would therefore appear that a study of the ancient classification of things under Roman law could be beneficial to modern policy issues concerning the treatment of biotechnological inventions and discoveries. The specifics of how the classificatory system might influence the treatment of complex modern scientific advances would be based on the study of the basic issues of life, its sustenance, the

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84. It is undisputable that the concept of property rights in ideas is of very recent origins. See supra note 4 and accompanying text.
propagation of knowledge, the advancement of humanity and other competing issues.

C. Summary

It is apparent from this brief historical survey of the nature of property that any debate over how to treat biotechnological inventions and discoveries might benefit from the lessons of history. History has taught us that the classification and assignment of property rights was often guided either explicitly or implicitly by some larger social objective. Certain things and objects considered important or central to life or to the fundamental tenets of society were excluded from the regime of private property. In part, the goal was to make such things available to all citizens and in some cases to humanity at large. Equally important is the lesson that property consists of a bundle of rights capable of being held and exercised by different people at the same time. The Hohfeldian bundle of rights theory minimizes the importance often assigned to the right of exclusion as a defining element of property. Finally, history has also taught us that property rights are often the subject of limitations and restrictions imposed to achieve certain societal objectives. Power theories of property that grant property holders absolute and despotic rights cannot easily and legitimately be supported by the history of Roman law.

All of these lessons are particularly important to our discussion concerning the treatment of biotechnological inventions. The question is whether any attempts to design a regime for property rights in biotechnological inventions should not draw on some of the important lessons of history. For instance, should biotechnological inventions be excluded from the regime of private property or at least be subject to restrictions. Certain specific limitations and constraints may become particularly important given the significant socio-economic, ethical, environmental, cultural, political and a whole host of other implications of biotechnology.

It is apparent from the preceding sections that any discussion of the nature and classification of property inevitably raises fundamental policy choices. A classificatory system for property that distinguishes between things that can be owned and those that cannot, or between different categories of property, presupposes some explicit or implicit policy choices. That the distinction between property and non-property is one based on policy is much more apparent when the classificatory system treats two things that share the same physical characteristics or distinctive attributes differently under the same property regime. One may be included and the other excluded from things that can be owned. Moreover, Roman law traditions only manifested the contradictions and ambiguities inherent in legal systems. For it was the same legal system that excluded certain things from the regime of private property because of their importance to humanity and life itself, but recognized property rights in human beings even as it insisted all people are born free. What inferences can be drawn from these contradictions and ambiguities? Would the Roman jurists have recognized property rights of slave masters in the
essential and constituent biological elements of slaves if they were confronted with
the continuing advances made in biotechnological inventions of this era? Because
of the inherent contradictions in the ordering of human social organizations, the
answers to these questions are not obvious. It would therefore appear that the central
issues concerning how biotechnological inventions and discoveries might be treated
are more a question of fundamental policy than the essence of things.

IV. POLICY JUSTIFICATIONS FOR PROPERTY RIGHTS

A. The First Occupancy Doctrine

One of the earliest justifications for private property was advanced by Roman
jurists who asserted that the first occupation or acquisition of res nullius (things that
belong to no one) conferred property rights on a person.\textsuperscript{85} If a thing belonged to no
one there could be no objections to its acquisition by someone. But first acquisition
per se was not sufficient to confer property rights. As a precondition, the thing
acquired must have belonged to the category of things that could be owned and
would not have been already owned. These two conditions would ordinarily be
satisfied with the concept of res nullius. But why would the first acquisition of res
nullius justify conferring property rights on the acquirer? Did the justification arise
from the nature of the acquiring act, the nature of the thing acquired, or some other
policy justification? To Roman jurists the answer lay not so much in the act or
object of the acquisition as it did in natural reason taught to humanity by jus
gentium.\textsuperscript{86} Gaius, for example, maintained that it was only natural and rational that
"what belongs to no one is conceded to the occupier."\textsuperscript{87} By relying on jus gentium,
the Roman jurists saw the first occupancy doctrine as a universal justification for the
existence of property since jus gentium was applicable to humanity at large.
Apparently, the Romans could not conceive of a society of rational human beings
who, on the basis of natural reason, would reject the first occupancy justification for
property.

While the universality of the first occupancy doctrine may be debatable, it is
doubtful whether within its own terms it could be used as a justification for granting
property rights in biotechnology inventions and discoveries. Such an attempt would
immediately be met with certain difficulties. At the outset, it must be determined
whether biotechnological inventions satisfy the first condition for private property—
whether they fall into the categories of things that can be owned. We have already
argued above that biotechnological inventions and discoveries—like ideas, know-
how, processes, knowledge, additions to knowledge including inventions—did not

\textsuperscript{85} Tierney, supra note 78, at 136, Principles of Roman Law, supra note 64, at 333-34; Roman Law,
\textsuperscript{86} Principles of Roman Law, supra note 42, at 341.
\textsuperscript{87} Tierney, supra note 78, at 136.
fall into the categories of things that could be the subject of private property. Ancient societies appear to have placed significant value on the propagation of knowledge and ideas because they are essential to the formation of coherent human social, economic, and political organization. They chose to leave ideas, techniques, methods, know-how and basic knowledge unprotected as property no matter how important they might have been. Thus, they did not create private property rights even in historically significant inventions such as the wheel or gun powder.

History has taught us that ancient civilizations—such as the Egyptians, the Greeks, the Romans, the Persians, and the Chinese—borrowed ideas, processes, and know-how from one another and passed them on to other societies and eventually into modern societies. For the Roman jurists, the issue would not have been whether or not biotechnology inventions are valuable, but whether creating property rights in them would have undermined the basis of societal progress, i.e., the development of the arts, civil engineering, manufacturing techniques, ship building, and the general economic well being of society. It bears stressing that the importance of biotechnological inventions lie not so much in the products derived from them as it does in the pathways to those products. The Romans would probably have opted to leave such pathways open and uncluttered with private property rights in order to provide benefit and use to humanity. The arguments advanced so far would also be applicable to biotechnological inventions that have a physical or tangible character. Such inventions also derive their importance from their pathways and because they concern life itself, raise serious questions about whether such materials should be owned on the basis of first acquisition through discovery or invention.

B. Judeo-Christian Property Concepts

The problems confronted by the Roman law concept of first occupancy principle seem to pale in comparison to those created by a reformulation of the first occupancy doctrine advanced by subsequent philosophers and jurists of the Judeo-Christian tradition. With the arrival of Christianity and the infiltration of Christian theology into the intellectual discourse of the medieval era, the approach to the origins of property experienced a decided and significant shift from the somewhat secular Roman approach.

The influence of Christian theology on the concept of property came as a result of certain developments in Europe during and after the medieval era. Medieval
Europe is often described as steeped in darkness and unenlightenment. Yet, even during the dark days of medievalism, certain pockets of enlightenment thrived and acted as a spark plug for subsequent revisionist theories of property to emerge. Medieval schoolmen, scholars, and teachers in the universities devoted their entire lives to the study, analysis and debate over the fine points of Roman law.91 Pawing through ancient texts and commentaries with the keen eyes of an eagle, these scholars kept the otherwise dead subject of Roman law alive, refined, and accessible as a well of knowledge. From this well, the Church, secular princes and various factions with conflicting interests could draw on the concept of property to serve their needs.92 Thus, when the great Franciscan debate erupted in the Thirteenth Century, the disputants drew on the Roman law of property that had evolved to that point.93

The central issue in the Franciscan debate was consistency of the acquisition and ownership of property with Christianity.94 With a denunciation of acquisitiveness or property and the embracing of poverty, the Franciscans believed that they had seized the higher moral ground of true Christian morality. They argued that property and its central significations of complete dominion, exclusivity, and the concomitant right to deny access were inconsistent with the teachings of the Holy Scriptures.95 It took the intervention of the Vicar of Rome to resolve the debate. In answer to the Franciscans and their sympathizers, Pope John XII traced the concept of property to Divine law, arguing that the Grant by God to humanity included the permission to appropriate from the commons as private property.96 By elevating property to the status of Divine law, the logical inconsistency between private property and Christian morality was removed. What was sanctioned by God could not clash with Christian morality.

While the intense theological and intellectual debates of the time produced various justifications for property (divine law, res nullius, natural law, human law),97 the supernatural emerged as a dominant theme in the debate over property. Indeed, it can be said that the single most important event that influenced the shift from the

91. Bouckaert, supra note 2, at 785 (discussing the role of medieval universities in maintaining the study of Roman law which was in practice dead).
92. Id. at 785-86.
93. Id. at 786.
94. Id.; see also TIERNEY, supra note 78 (discussing the theological disputations on the question of property and in particular the Franciscan debate).
95. The Franciscans were faced with a peculiar dilemma. Even as they denounced property they had accumulated significant amounts of wealth from providing various services. They were in a better position to appreciate the potential impact of the right to exclude others from using property even when the owner had more than was necessary for his survival. They had more than they needed. Bouckaert, supra note 2, at 786.
96. Id. at 787; see also TIERNEY, supra note 78, at 154-56 (quoting Pope John XXII answering his critics on the question of the creation of private property from common property saying, "Dominion of temporal things was not introduced by primeval natural law understood as the law common to all animals . . . nor by the law of nations, nor by the law of kings or emperors, but by God who was and is the Lord of those things.").
97. See TIERNEY, supra note 78, at 144 (discussing a scattered collection of scholarship on the subject of the Decretum).
secular reasoning of the Romans to some supernatural or divine intervention was the
arrival of Christianity with the Holy Bible in hand. Christian doctrine assigned a
central and controlling role in the explanation of property to the Holy Bible. But
the imprint of Christian thinking on the origins of property had to wait until the
Seventeenth Century to be fully assembled, developed and advanced by a learned
Dutch jurist, Hugo Grotius. Drawing heavily from the Holy Bible, Grotius, in his
famous masterwork, De Jure Belli et Pacis (On the Law of War and Peace), asserted
that private property was but a subset of a larger sample of all things and creatures
God gave to mankind to hold in common and as inheritors of one general
patrimony. Other philosophers and jurists of that era also found justification for
property in the Holy Bible. For instance, relying on the Holy Bible as a historical
document, Blackstone made the following observations about the first property
rights:

In the beginning of the world, we are informed by holy writ, the all-
bountiful Creator gave to man “dominion over all the earth; and over the
fish of the sea, and over the fowl of the air, and over every living thing that
moveth upon the earth.” This is the only true and solid foundation of man’s
dominion over external things, whatever airy metaphysical notions may
have been started by fanciful writers upon this subject. The earth, therefore,
and all things therein, are the general property of all mankind, exclusive of
other beings, from the immediate gift of the Creator. And, while the earth
continued bare of inhabitants, it is reasonable to suppose, that all was in
common among them, and that everyone took from the public stock to his
own use such things as his immediate necessities required.

This account of the grant to humanity was common among historians and
philosophers in the post medieval era. John Locke in his Two Treatises of
Government asserted that God gave the world to Adam and his posterity in
common. Quoting the Psalms of King David, Locke stated that “tis very clear,
that God ... has given the earth to the children of men, given it to mankind in
common.” From these accounts of the origins of property, it can at least be

98. Id. at 145.
99. Id. at ch. 13 (discussing the influence of Grotius on the evolution of the law of nature); Bouckaert, supra
note 2, at 787-88.
100. See READINGS IN JURISPRUDENCE, supra note 41, at 55-56. The debate over nature and origins of
property did not end with the Papal intervention; it continued to be of interest to continental Christian theologians
particularly in Spain in the sixteenth century.
101. BLACKSTONE, supra note 37, Book II at *2-*3.
102. JOHN LOCKE, TWO TREATISES OF GOVERNMENT, SECOND TREATISE ¶ 25 (Peter Laslett ed., Cambridge
103. Id.
argued that the first property rights in western philosophy were not only communal or public but also rooted in Christian doctrine.

The shift in the operating premise of the first occupancy principle raised two categories of problems. The first related to confronting the problem of creating private property from common property rights. The second concerned the impact of interjecting the supernatural or the divine into the concept of property. With respect to the first, explaining the transition from communal to private property became a task that would occupy the attention of philosophers and jurists. The idea that the assertion, "I was here first; I was the first to discover or invent this," would be sufficient to deprive society of its original claim to common ownership did not seem to flow naturally from the concept of common ownership. In that regard, Grotius found justification for the creation of property not in occupation \textit{per se} but in many other supporting arguments.\textsuperscript{104}

His first argument was necessity, induced by population explosion and scarcity.\textsuperscript{105} But why would necessity or scarcity justify private property? Would the interest of society not be better served to deny the conversion of common property into private ownership in such difficult times? What would be the rational response of society to conditions of scarcity or necessity with respect to common property? Would society allow acquisitiveness, dominion, and exclusivity over common property? It is not obvious that the rational response of society to difficult conditions of scarcity would necessarily be to sanction the "law of claw and fang or survival of the fittest."\textsuperscript{106}

The second argument advanced by Grotius is based on some expressed or implied consent of humanity that occupation would confer property rights on the occupant.\textsuperscript{107} The starting premise of the first occupancy doctrine does not easily permit the consent theory of property. For it appears almost impossible to procure the consent of all humanity with respect to any particular act of acquisition. It is not surprising that Grotius did not advance an argument for actual consent but rather for the supposition of consent.

His last argument was that it would be unjust to deny ownership to the occupant.\textsuperscript{108} However, justice to the individual is a community concept that may not be sustainable in all cases of first occupancy. These arguments are of a utilitarian nature, and similar to those advanced by Blackstone.

According to Blackstone the first notions of private property were usufructuary, based on, and lasting with, possession and use. These rights were transitory in nature. Thus, the property returned to the common stock after use. However, as the

\begin{footnotesize}
104. \textit{READINGS IN JURISPRUDENCE, supra} note 41, at 57.
105. \textit{Id.}
106. \textit{Id.} (emphasis added). Grotius' argument seems to fit the roman law concept of \textit{res nullius} better than it does common property. In the case of \textit{res nullius} anyone may seize or occupy that which is not owned and insist on excluding other much more easily than if the thing seized or occupied is the common property of all humanity.
107. \textit{READINGS IN JURISPRUDENCE, supra} note 41, at 58.
108. \textit{Id.}
\end{footnotesize}
social and political organization of mankind increased in complexity, it became necessary to recognize permanent property rights on efficiency grounds. He argued that continued recognition of the transitory and purely usufructuary rights in property would have significantly discouraged the evolution of a more convenient, commodius, and agreeable lifestyle. Similarly, John Locke found justification not in the occupation itself but in a theory discussed below.

The difficulties presented by the first occupancy theory to modern property theorists have been explored by property scholars such as Becker. Given joint property interest, the creation of private property had to overcome objections from common or joint owners and a host of other problems. As noted above, for first occupation or acquisition to create property rights, the thing taken should not have been previously owned, but that premise could not be satisfied since all things were already jointly owned. Moreover, other justifications and arguments met with similar difficulties and Becker concluded that, at bottom, the first occupancy theory is empty and could only be supported if based on some utilitarian or other justification.

While the introduction of the supernatural in the debate does not necessarily negate the existence of property, it nevertheless complicates the justifications for property. If God gave all things and creatures to humanity as common property, it might be instructive to examine the nature and scope of such a grant to determine whether there are divine law constraints on any private property regime that might be created. Common property might have been granted by God to achieve some divine objective such as ensuring the survival and propagation of the human species. If so, would God oppose a private property regime that seriously threatens the original divine objectives inherent in the initial grant? Assuming, however, that private property was contemplated by God as argued by Pope John XII, might there nevertheless be a category of things in the common stock so essential to the survival and propagation of the species that it must never be the subject of private ownership? These questions seem to be the same as those confronted by Roman jurists in a much more pragmatic secular arena. The difficulty presented here is that any justifications or limitations on property rights require some support from Christian theology and the interpretation of the Bible. However, the centrality and dominance of the Bible over other ancient religious texts is highly controversial.

To the extent that the divine or the supernatural plays some role in the creation of

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110. See generally Property Rights, supra note 9, ch. 3 (discussing the first occupation theory of property).
111. Id. at 30-31.
112. It should be noted that non-Christians may look to other Spiritual text such as the Koran for guidance on the question of the origins of property. Within each text there might be much controversy as demonstrated by the Franciscan debate over acquisitiveness and Christian morality. Eastern religions such as Buddhism may have an entirely different approach to the question of property and its application to ideas. Since this inquiry is limited to western legal systems and in particular, the United States, we shall not examine other philosophical approaches.
property rights, the determination of the nature and scope of those rights might be better left to theologians, ethicists, and philosophers of different faiths.

Perhaps, the shift from the secular to the divine has its most significant and direct implications on how biotechnological inventions and discoveries might be treated. It may be recalled that the function of biotechnological inventions, genetic engineering and the entire industry is the decoding, manipulation, and tinkering with life itself. The goal might be to create new life forms, clone existing life, or extend life through genetic manipulation or by halting the aging process. Whatever the objective might be, the created (scientists) appear to have pretensions to being the Creator. From the theological perspectives it is doubtful whether God would tolerate such aspirations or even curiosity. For, we are reminded of the Old Testament story of the Tower of Babel erected on the plains of Shinar in Babylonia in an attempt to reach heaven. It is recorded in the Bible that the very presumption of reaching heaven through the tower angered God and He created confusion by introducing many languages immediately thereby ending the endeavor. What the story of the Tower of Babel means is unclear and is a knot for biblical scholars and theologians to untie. However, others may consider the fundamental objectives of the modern biotechnology industry as following perilously close to the same foot paths as the descendants of Noah. The idea of human beings discovering and decoding the source of life and even creating life might be seen as presumptuous and being nothing short of pretensions of being God. Under such circumstances, the entire enterprise and its results might face condemnation.

On the other hand, even if the endeavors to create, sustain, extend, and manipulate life are not to be condemned, arguably God would demand that whoever is successful in this task be as generous as God Himself was. Such generosity would be best demonstrated by returning all inventions and discoveries to the common stock. Whether or not this argument can be supported is a question to be resolved by theologians, ethicists and philosophers. Indeed, it is apparent from our

113. Supra notes 5-9 and accompanying text.
115. The ethical issues in biotechnological inventions is a subject that has occupied the attention of many religious leaders. For an example of concerns expressed about genetic engineering and medicine, see Pope John Paul II, Dangers of Genetic Manipulation, Address to the World Medical Association, October 29, 1983. He called for an unwavering respect for and protection of the integrity of human being in its totality and asserted that God alone is the master of human life and of its integrity. He argued that genetic intervention beyond the limits of therapeutic conduct is morally unacceptable. He said that genetic intervention must not infringe on the origin of life, that is procreation linked to the union, not only biological but also spiritual, of the parents, united by the bond of marriage. It must, consequently, respect the fundamental dignity of men and the common biological nature which is at the base of liberty, avoiding manipulations that tend to modify genetic inheritance and to create groups of different men at the risk of causing new cases of marginalization in society. Id. Some see in biotechnological patents the seeds of greed and evil. See Joy Thompson, A Spiritual Case Against Patenting Life Forms, KNIGHT-RIDDER NEWS SERVICE, May 19, 1995 (expressing concern that patenting life forms is like playing God and scientists do not qualify for that title); Larry B. Stammer & Robert Lee Hotz, Faiths Unite to Oppose Patents on Life Forms, L.A. TIMES, May 18, 1995, at A1 (explaining that religious leaders are not
discussion so far that the issues raised by the developments in the biotechnology industry are complex and challenge many fundamental views.

The complexity of these issues is further increased by the interjection of the divine and the supernatural into the discussion of property. How these issues may be resolved would require serious and informed policy choices based on a vigorous and open debate of the relevant issues by interested parties.

C. Locke's Labor Theory of Property

One of the most hotly debated justifications for the creation of property rights is the labor theory of property, expounded by John Locke. In trying to determine the applicability of the labor theory to the protection of biotechnological inventions as property, a series of arguments needs to be made. First, there is a question as to the validity of the labor theory as a general theory of property. The issue of the general validity of Locke's labor theory has been the sport of philosophers, legal scholars, and students of government for centuries so it need not be repeated here. We are only interested in those aspects of the age-old debate which shed some light on the treatment of biotechnological inventions. Second, there is the issue of whether a labor theory of property that is applicable to tangible objects is equally applicable to ideas and the product of ideas. Last, assuming that the labor theory is applicable to ideas in general, should its application to biotechnological inventions be different, and, if so, why? The answers to these questions can best be tackled by examining the operating premises and substantive content of Locke's labor theory.

opposed to patenting biotechnological inventions except those involving human and human genes themselves); Mark Sagoff, *Patented Genes: An Ethical Appraisal*, ISSUES IN SCIENCE AND TECHNOLOGY, Spring 1998, at 37-41 (expressing the opposition of religious leaders to biotechnological patents in genes noting that religious leaders believe that human and animals are creations of God not humans and should not be patented; also explaining the position of religious leaders that patent policy should draw distinction between discovery and inventions and between what is in nature and the product of human ingenuity.); Sabra Chartrand, *A Human Gene is Patented as a Potential Tool Against AIDS, But Ethical Questions Remain*, N.Y. TIMES, Mar. 6, 2000, at C9 (describing the position of religious leaders, medical ethicists and scientist that the Human Genome belongs to the public). But see Editorial, *Patenting the Human Genome*, THE LANCET, Oct. 2, 1999 (arguing that it is too late to be concerned about the patenting of genes and the like because patents have already been granted for various life forms and that issues of access should be handled by the market.) The issue of ethics is not in the exclusive domain of religious leaders; see NOVARTIS Foundation for Sustainable Development, *Ethical and Ecological Aspects of Industrial Property Rights in the Context of Genetic Engineering and Biotechnology*, (visited Sept. 10, 1998) <http://www.foundation.novartis.com/genetic_engineering_biotecnology.htm> (copy on file with the McGeorge Law Review) (adopting the ethical and ecological analysis of Professor Dr. Klaus M. Leisinger that the ethical issues in intellectual property rights are too complex and multi-cultural to handled by basic generalizations). For an academic discussion of the different types of ethics and their relationship to a pluralistic world community of scientists and researchers particularly on issues of the genetics, see David J. Roy et al., *Ethics for Complexity, in Human DNA: Law and Policy* 189 (Bartha Maria Knoppers, ed., 1997).
In his famous work, *Two Treatises of Government*, John Locke offered an explanation of how private property came into existence—in language the full import of which can only be captured from two extensive quotations. First, Locke wrote:

> God, who hath given the World to Men in common, hath also given them reason to make use of it to the best advantage of Life, and convenience. The Earth, and all that is therein, is given to Men for the Support and Comfort of their being. And though all the Fruits it naturally produces, and Beasts it feeds, belong to Mankind in common, as they are produced by the spontaneous hand of Nature; and no body has originally a private Dominion, exclusive of the rest of Mankind, in any of them, as they are thus in their natural state: yet being given for the use of Men, there must of necessity be a means to appropriate them some way or other before they can be of any use, or at all beneficial to any particular Man.

In the quoted passage, Locke was merely restating in his own terms long established views about the common grant of the world by God to humanity. What was unique was his explanation of how private property could be derived from common property. It may be recalled that in the Franciscan debates, Pope John XII maintained that God contemplated acquisition of private property in His common grant. Centuries later, Grotius conditioned the creation of private property on the express or implied consent of society. But making private property contingent on the consent of others meant that no property rights could be created in the face of an objection. Therefore, Locke sought to free the concept of private property from the grip of the consent requirement. Indeed, he argued that the product of labor was the property of the laborer without the assignation of consent from anybody. Notwithstanding all the abundance of nature and the common stock, humanity would have nevertheless starved if consent were required.

The remedy was to be found in his labor theory of property that is captured in the following passage:

> Though the Earth, and all inferior Creatures be common to all Men, yet every Man has a Property in his own Person. This no Body has any Right to but himself. The Labour of his Body, and the Work of his Hands, we may say, are properly his. Whatever then he removes out of the State of that Nature hath provided, and left it in, he hath mixed his Labour with it, and

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116. Locke *supra*, note 102, at ¶ 25.
117. *Id.*
118. TIERNEY, *supra* note 78, at 154-56.
119. READINGS IN JURISPRUDENCE, *supra* note 41, at 58.
120. LOCKE, *supra* note 102, at ¶ 26.
joyned to it something that is his own, and thereby makes it his Property. It being by him removed from the common state Nature placed it in, it hath by this Labour something annexed to it, that excludes the common right of other Men. For this Labour being the unquestionable Property of the Labourer, no Man but he can have a right to what is once joyned to, at least where there is enough, and as good left in common for others.\textsuperscript{121}

It is apparent from the quoted passage that Locke's labor theory of property was built on a series of arguments, suppositions, and assumptions. While the substance of Locke's arguments continues to be the subject of ongoing intellectual discourse, his suppositions and assumptions seem to command less attention.\textsuperscript{122} Yet, the strength and weaknesses in Locke's theory might be inextricably linked to the operating premises of his theory. Because the mission of this Article is to invite a serious revisionist inquiry into the applicability of the concept of property to biotechnological inventions and discoveries, it seems appropriate to start this section with a discussion of Locke's operating premises.

1. Locke's Assumptions and Operating Premises

At the outset, it should be noted that Locke appears to attribute some \textit{divine utilitarian} or \textit{instrumentalist} motive to God in the common grant to humanity. The grant of the Earth and all in it was to serve three purposes: to facilitate sustenance or support, convenience or comfort, and to bring enjoyment to humanity.\textsuperscript{123} Nature and its spontaneous production are but the \textit{instruments} of God in the achievement of His divine utilitarian objectives since God made them available to humanity for the declared purposes.\textsuperscript{124} However, God gave human beings reason to make the best use of the common grant, consistent with the divine utilitarian objectives. Thus, the exercise of human rationality in the acquisition and use of common property was to be guided by this external, qualitative normative standard. In other words, Locke seems to suggest that any regime of private property must be guided by and conform with the ultimate objectives of God in making the common grant. An acquisitive appetite that is motivated by greed, power, wealth for the sake of it, or some other similar human motive might trigger disapproval from the perspective of divine utilitarianism.

The notion of divine utilitarianism also suggests some internal limits on individual appropriation of common property. The terms \textit{sustenance, convenience, and enjoyment} suggest limits on the human need to appropriate things. Any

\textsuperscript{121} \textit{Id.} at ¶ 27.

\textsuperscript{122} Locke's assumptions have been commented upon by Becker. \textit{See generally} \textit{PROPERTY RIGHTS, supra} note 9.

\textsuperscript{123} \textit{LOCKE, supra} note 102, at ¶ 25

\textsuperscript{124} \textit{Id.}
acquisition of property should not exceed what is naturally necessary for one's sustenance, convenience, or enjoyment. Each individual is expected to know these limits and to adhere to them. Locke also imposed an internal check on acquisitiveness by demanding a focus on the needs of others when he argued that labor might create property "where there is enough, and as good left in common for others."125

The internal limitations seem to be consistent with Locke's other assumptions and operating premises. For, Locke assumed that Nature imposes a limit on the scope and the product of human labor. He further assumed that there is a natural limit to human enjoyment of the fruits of labor. From these two limitations he concluded that the acquisition of private property through labor can never be total, nor would it ever encroach upon the rights of others. There will always be something left for the rest of society.126 It is quite apparent that Locke could not conceive of a case where the acquisition of property rights could lead to a monopoly. Not only did he have a dim view of the technological capacity and potential of humanity, he was also overly impressed by the immenseness of the endowments of nature.

While such views might have been characteristic of the times, they were falsely predictive of human ingenuity and the capacity of nature to sustain the needs of an ever growing human population. Modern advances in science and technology have expanded the acquisitive capacity of humanity beyond what Locke could have imagined. It is now possible for a single individual to appropriate all, or substantially all, of a thing in certain discrete fields crucial to human survival. The advances in biotechnology, particularly those in genetics, make it possible for a single scientist to discover, manipulate, and appropriate the only pathway to a single cell constituting the only source of existence, to a critical pharmaceutical drug, or to some other human need.127 The competition among scientists to map the entire human genome is not just a struggle for bragging rights, but perhaps more importantly for the ensuing property rights.128 The fierceness of the competition

125. Id. at ¶ 27.
126. Id. at ¶ 35.
127. Davis, supra note 31.
128. While the international human genome project has made its findings available to the general public, Celera Corporation of Rockville, Maryland which was involved in the competition for mapping the entire human genome is reported to have filed thousands of provisional patents covering between 100 to 300 medically relevant genes. Reports indicate that Celera also plans to license genetic information to pharmaceutical companies for the development of products. See Editorial, The Patent Problem, ST. LOUIS POST-DISPATCH, Mar. 16, 2000, at B6 (discussing the issue and the statement of President Clinton and Prime Minister, Tony Blair of the United Kingdom that the findings of the human genome research should be made public and available to all). Note, however, that some have argued that issues of access to any information generated by the human genome project should be handled by the market under existing patent regime. See Editorial, Patenting the Human Genome, THE LANCET, Oct. 2, 1999, at 1135 (arguing that it is too late to deny patent protection to the findings of the human genome project since patents have already been granted for natural genome sequences of a nematode, two birds, one rabbit, a guineapig and a fish. No exception can be made for the human DNA by high minded politicians); Arthur Caplan & David Magnus, Clinton-Blair Stand is Not End of Debate on Genome Patents, THE INQUIRER, Mar. 20, 2000. The
confirms that the capacity and the desire exist for monopolistic acquisitive conduct or gaining gatekeeper rights in a field that concerns the very existence of life itself. No industry captures the fears of such monopolistic acquisitiveness better than biotechnology.

In addition to the anti-monopoly restrictions, Locke imposed a non-waste requirement on his labor theory of property. Locke considered it a punishable offense against Nature for a person to acquire property and waste it. According to Locke, a person is not entitled to more than he can use. But what does this condition actually mean? Does the laborer have property rights until the point of waste, or do the property rights exist only for those which can be used? Who determines the scope of such use? Furthermore, the examples used by Locke relate to perishable goods and one wonders how the non-waste condition might apply in the case of ideas in general and biotechnological inventions in particular. It should be noted that the term “waste” suggests a loss to both the laborer and society of the value of the property lost. In this connection, it is doubtful whether the non-waste condition is applicable to inventions and ideas which have a diffusible and non-depletable character. The fact that an invention is not used does not necessarily implicate a loss of its intrinsic value to its owner and society. It is therefore doubtful whether an invention is wasted if it is not used by its owner. On the other hand, the non-waste condition might demand greater access to ideas and inventions that are not being exploited by their owners. The waste lies in the denial of a valuable contribution to the needs of society possible in the exploitation of unused inventions.

The final condition imposed by Locke, of interest to us here, is the notion that labor should produce something of value. This condition is particularly interesting in the case of biotechnology. While there is no doubt that many biotechnological advances have tremendous positive value to the inventors and society at large, there are questions about the long term impact of certain inventions. The genetic manipulation of seeds and recent advances in the creation of herbicide ready seeds and the so-called Terminator Seed raise questions about the impact of such

authors discussed the unfavorable market reaction to the statement by President Clinton and Prime Minister Tony Blair that the information of the human genome project should be put in the public domain. They also raised questions about the dangers and utility of denying patent protection based on the concerns over the abuse of patents. They claim that the real goal of the Clinton/Blair statement is to encourage cooperation between the private and public research groups. Chandler Burr, Patenting Genes is Bad Medicine, NAT’L POST, Mar. 21, 2000, Commentary, (explaining that the rush to map the human genome by companies such as Incyte and Celera is not about bragging rights but the amount of money that could be made. “If you get the patent for my version of that gene and then figure out how to deliver that good version to Gary’s cells, where it then could do its gene job—making good enzymes—you’ll be rolling in money . . . Right now it’s a land rush, staking as many unsurveyed acres as you can, figuring that at least in some of them you’ll find gold.”) (emphasis added). Such is the argument of the author.

129. Burr, supra note 128.
130. LOCKE, supra note 102, at ¶ 37.
131. Id. at ¶ 40.
inventions on the ecological balance and long term health implications. The idea that value should be created raises the question, “From whose perspective? From that of the inventor or society?” If we return to the instrumentalist and divine utilitarian views discussed earlier, one might question the existence of property rights if such rights would present a threat to nature, its ecological balance and diversity, and to the health and safety of humans. The inventions may undermine God’s plans for humanity and the world. But the mere fact of a threat to society, the ecological balance in nature, the environment, or to specific categories of human beings is not necessarily dispositive of the issue of property rights. The nature, size, and depth of the danger presented may have a lot do with whether or not the rights should exist at all, and if so, only in a regulated form.

However, the question to be addressed is whether the assumed limitations are central to the viability of Locke’s labor theory. If Locke’s assumptions and operating premises are fundamental to the labor theory and they prove to be inaccurate or even of questionable validity, it becomes imperative to question the viability of the labor theory within the backdrop of the limitations. For instance, given the constantly expanding human capacity in science and technology, should certain subjects be excluded from the regime of private property because of a certain risk of monopolistic appropriation? Or would the divine utilitarian goals of providing every human being with free access to the means of sustenance, comfort, and enjoyment be served with a regulated monopoly over the sources of survival? Would human ingenuity and creativity vanish in the fields excluded from the property regime? These and other relevant questions are particularly important when we recall that the current fight over appropriable rents in biotechnological inventions is not about controlling products but the pathways to products. Monopoly over the pathways are much more repressive and intrusive than monopoly over products. The restrictions in monopoly over products are only product specific, whereas monopoly over ideas relating to the pathways to products imposes a broad ban on all from using their mental faculties in a specific way, even if the resulting products could be different.

2. Substance of Labor Theory

Given the assumptions and conditions discussed above, Locke advanced a derivative theory of property based on the root idea that “every man has property in his own person [and] “[t]his nobody has any right to but himself.” Proceeding from this root idea, Locke argued that the labor of a person’s body and the work of

132. See Nash, supra note 32, at 45 (discussing the yet unknown risk of genetic pollution, carriage of allergies and other risks from seed manipulation).
134. LOCKE, supra note 102, at § 27.
his hands are properly his own. But how does ownership of oneself and one’s labor lead to the ownership of a thing? Locke answered that question with the argument that the mixing, joining, or annexing of one’s labor with common property in its natural and raw state converts it into private property. The property loses its communal character or ceases to be part of the common grant, and the owner can, therefore, exclude all the commoners from it. But it does not follow that the accretion of value from labor should not go to the commoners. As has been argued, why does the laborer not lose his labor rather than the commoners lose their property?

Locke offered a series of arguments in response to this question. First, he argued that labor was commanded by God who rewarded the obedient and the industrious with property rights in the fruits of their labor. Second, he argued that labor accounts for the substantial change (99%) in the value of the thing. Essentially, he is arguing that ownership is based upon the fact that the increased value would not have existed without the exertion of effort, or the toils of labor. The commoners should not be entitled to that which neither existed nor would have existed prior to the mixing, or the annexing of labor with it. Finally, Locke asserted that it is just and fair for the product of labor to be appropriated by those who have toiled, or exerted themselves in creating the output.

At its superficial and popular level, Locke’s labor theory of property is powerful and easily appealing to those engaged in research and development in the biotechnology industry. The appeal of Locke’s labor theory is even greater considering the meaning of labor in that context. Although Locke did not define labor, examples of activities he considered labor suggest that he had set a very low threshold for conduct that would constitute labor. For him, the simple act of picking up acorns was sufficient labor to confer property rights over them. Measured by this standard, there is very little doubt that much of the research and development activities in the biotechnology industry would qualify as labor and the product of such labor would be privately owned. However, the simplicity of the labor theory tends to mask several difficulties in its application to ideas and their expression. To understand the complexity and difficulties of the labor theory of property one would have to start with an analysis of its root idea.

Notwithstanding its appeal, the labor theory of property presents certain difficulties of a fundamental nature that appear to undermine its central tenets. The argument advanced by the idea that every person has property in his own person cannot consistently be maintained with the idea that every person owns the product

135. Id.
137. LOCKE, supra note 102, at ¶ 32.
138. Id. at ¶ 40.
139. Id.
140. Id. at ¶ 27.
of his laboring. According to Becker, without some adjustment in either argument, the two contentions are irresolvably contradictory. The inconsistency in Locke's arguments might be illustrated with parents and children. According to the root idea, children have a property interest in themselves and nobody can own them. However, the labor theory also asserts that every person owns the product of his labor. Accordingly, parents must own their children as the product of their labor. However, children own themselves and nobody can own them. Also, children cannot own themselves not being the product of their own labor. These inconsistencies may be resolved by saying that not all products of labor can be the subject of property. If, therefore, in spite of the labor involved in the procreation and raising of children, parents do not own children as property, it must be that children fall into a category of the product of labor that cannot be owned. This conclusion is neither surprising nor inconsistent with the assumptions, conditions and presuppositions discussed above. That is, not all the products of labor are always appropriable.

While there is an obvious difference between children and other non-human products of labor, the question is whether the reasons for excluding children from the property regime can be extended to others. It has been suggested that Locke's idea of self-ownership was designed to guarantee individual liberty and freedom. If this was the purpose of Locke's root idea, then it is relevant to investigate the question of whether certain biotechnological inventions or discoveries that deal with existence itself or the roots and the sanctity of life are not better excluded from the property regime. Such inventions may affect the right to life and individual liberties directly, or may do so indirectly by affecting the human environment.

If the root idea and its derivative property rights face contradictions in the case of tangible property, the inconsistencies appear even more severe in the case of ideas. As mentioned above, Locke's root idea was designed as a guarantee for individual freedom and liberty. As part of such a guarantee, Locke maintained that self-ownership was inalienable. That is, a person could not voluntarily sell himself into slavery. It is, however, part of the exercise of liberty and freedom to think, to develop ideas, and to express them. The development of inventive ideas qualifies as labor and their expression as the product of labor. Palmer argues that granting property rights in ideas in the form of patents and copyright would result in contradictions similar to those found by Becker. For instance, if two persons independently develop an invention, they both cannot own it in the sense that neither

141. Labor Theory of Acquisition, supra note 136, at 657.
142. Id.
143. Id. at 657-58.
144. Id.
145. See Palmer, supra note 133; Palmer stated "In a great society, not all labor is rewarded; and not all of the rewards of labor are in the form of property." Id. at 834.
146. Id. at 832-33.
147. LOCKE, supra note 102, at 23. See also Palmer, supra note 133, at 833.
148. Palmer, supra note 133, at 834.
of them would have the right to exclude all others from dealing with the invention as property.\textsuperscript{149} Put differently, both of them would have the right to exclude each other and all others which would result in neither of them owning the invention. Moreover, if ownership is granted to them individually, one of them may make the invention available to all, while the other may prefer to exclude all others.\textsuperscript{150} The exercise of these contradictory rights would also effectively cancel the property rights of the owner who prefers to exclude all others. According to Palmer, these contradictions are irresolvable without some modification of one of Locke’s arguments.\textsuperscript{151} Modern patent statutes seem to have resolved the contradictions by granting patent protection only to the first to file. Thus, even though the two inventors would have both “labored” in producing the patentable invention, only one of them would be rewarded with protection and property rights. Under such circumstances, the grant of property rights cannot be based solely on labor but on some other social policy. Also, perhaps equally important is the inference from modern patent policy that not all products of labor are patentable or can be appropriated.

Besides, it has been suggested that the guarantee of individual liberty and freedom carries with it the right to develop and express one’s ideas in the form of patents, copyright, or in some other way.\textsuperscript{152} However, under the labor theory, conferring property rights on ideas would restrict the freedom of thought and expressions guaranteed by the root idea.\textsuperscript{153} The restrictive impact of property in ideas is likely to be much more severe than that of tangible property. In the case of tangible property, the right to exclude others from a specific item does not necessarily extend to other items of the same type. Therefore, the right to exclude others is not total and pervasive. However, with respect to ideas, the right to exclude all others from an idea may shut the door to the expansion of human knowledge which may be the source of specific inventions and innovations.\textsuperscript{154}

As property rights are granted to an increasing number of specific and discrete pathways in biotechnological discoveries and inventions, access to such pathways would become increasingly difficult. This phenomenon has been recently described by Michael A. Heller and Rebecca S. Eisenberg as the tragedy of the

\begin{itemize}
  \item \textsuperscript{149} \textit{Id.} at 830.
  \item \textsuperscript{150} \textit{Id.}
  \item \textsuperscript{151} \textit{Id.} at 834.
  \item \textsuperscript{152} \textit{Id.} at 828.
  \item \textsuperscript{153} \textit{Id.} at 831 (arguing that intellectual property rights restrict liberty).
  \item \textsuperscript{154} \textit{Id.}
\end{itemize}

Palmer argued:

\begin{quote}
My ownership claim over my computer restricts your access to that computer, but it is not a blanket restriction on your liberty to acquire a similar computer, or an abacus, or to count on your fingers or use a pencil and paper. In contrast, to claim a property right over a process is to claim a blanket right to control the actions of others.
\end{quote}

\textit{Id.} (emphasis added).
anticommons. The proliferation of rights might inhibit creativity and the development of root ideas and first principles without which specific inventions would be less likely. Again, applying the labor theory without any adjustments would lead to unresolvable contradictions (restrictions on freedom of thought and expression) and a negative impact on the free development of ideas. Humanity would be worse off with a property regime that could result in the ultimate control of the access to knowledge in general and particularly in a field as important as biotechnology.

The inconsistencies between the root idea and the derivative theory of property also have significant implications for the advances being made in human biological and biochemical sciences. The concept of self-ownership in Locke's root idea raises the questions whether each person has property in his body parts, organs, cells, DNA, and even bodily wastes. Does the idea of self-ownership translate into property rights in discrete parts of the body in the sense that they can be the subject of exclusion and transactions? In other words, can the human body as property be a commodity to be traded by its owner? The answer to these questions may depend on what Locke meant by the term “property” in the root idea. If the term “property” carried with it all the rights and incidents generally associated with ownership, then the human body, body parts, cells, and so on, could be the subject of commercial transactions. Scientific information and data derived or generated from the human body would also be proprietary. However, it is doubtful if Locke intended such use of the term “property.” For, would the commodification of the human body not undermine the very purpose of Locke's root idea of guaranteeing liberty, freedom and human dignity? Would it not also pose serious dangers “to the erosion of the sanctity of human life, . . . autonomy [and] privacy”?

One might argue the dangers referred to here need not materialize since a regulatory scheme might be established to eliminate or minimize them. Even so, a regulatory scheme no matter how rigorous may not be the most effective remedy to address those dangers.

On the other hand, the risk to human dignity and the sanctity of the human body might be significantly less if the term “property” meant something else. According to Becker, one could interpret the term “property” in Locke's root idea to be limited to the right to exclude others from interfering with or dealing in the human body. Such a limited use of the term “property” would appear consistent with Locke's objective of guaranteeing individual liberty and personal freedom. Recall that self-ownership did not permit an individual to subject himself voluntarily into slavery. If Locke had intended the term “property” to be used in its full-blown form, he would not have imposed such a limitation on self-ownership. It would therefore appear that a more restricted interpretation of the term “property” is plausible and might provide a solution to the dangers outlined above.

155. Heller & Eisenberg, supra note 1, at 700.
156. Litman, supra note 8 at 17, 21.
157. PROPERTY RIGHTS, supra note 9, at 37.
3. Labor Theory and Ownership of the Human Body

The ambiguity in the use of the term property in Locke's root idea further complicates the legal issues raised by advances made in the fields of biotechnology and biomedical research. It is well settled that the successful development of new cell lines, gene therapy, and other biomedical techniques or pharmaceutical products based on human materials can result in significant financial rewards to researchers, hospitals, and biotechnology companies. There is little doubt that the biotechnology industry is a billion dollar industry that attracts significant financial resources and human endeavor. Because the biotechnology industry is characterized by high risks and high returns, researchers, scientists, and their supporting institutions are clamoring for an expanded property regime to protect their investments. However, high returns have also attracted similar assertions of property rights in human donors of the raw materials used in the development of the new treatment techniques, inventions and pharmaceutical products.

At the heart of these competing claims is Locke's labor theory of property. As mentioned above, a restricted reading of Locke's root idea would lead to the conclusion that human donors, other than the right of exclusion, have no property rights in their persons or in their cells, tissues, body parts, and other human raw materials used in financially lucrative inventions. Ascribing such a limited meaning to the term property raises the question of whether the same limitations on the property concept should be imposed on claims of ownership of the inventions and innovations derived from human raw materials. If, on the other hand, we assigned to the term property its normal meaning the human supplier would have property rights in his own person and also in the human raw materials such as blood,
body fluids, cells, body parts, or even waste used in research. However, ownership in one's body and its cells or parts does not necessarily translate into ownership of the derivative products generated and developed from those human raw materials. Quite often the finished product, even though it could not have been developed without the specific human raw materials, is nevertheless significantly different from these raw materials. Would such a difference justify conferring property rights on the inventor rather than on the human donor of the raw materials? However, given that the inventor and the donor have both contributed something towards the end results might there be a sound policy basis for recognizing a joint property interest? These were some of the questions confronted by the California Supreme Court in the famous case of Moore v. Regents of the University of California (Moore).\textsuperscript{163}

The facts in Moore were simple and non-controversial but the conclusions of the Court have evoked a significant debate. Moore, the plaintiff, alleged, inter alia, the conversion of his possessory and ownership interest in his blood, bone marrow aspirate, and other bodily substances extracted by his physician during a treatment of his leukemia. Unknown to the plaintiff, tests had revealed that his blood had certain unique properties attractive for scientific and competitive commercial exploitation. His physician designed a treatment program that required the plaintiff to make several visits to the University of California, Los Angeles Medical Center where his bodily substances including his spleen were extracted, in part, to foster the research interests of the physician. Without his knowledge or consent, the plaintiff's bodily substances were used in research resulting in the development of a cell line patented by The Regents of the University of California.

In a weakly reasoned opinion, a majority of the California Supreme Court rejected Moore's claim of conversion offering several justifications which had little bearing on the essence of property. The Court started its analysis by noting that under the common law, the precondition to conversion is the existence of some property interest of the plaintiff in the subject matter of the conversion.\textsuperscript{164} Unfortunately for the plaintiff, the Court found that he did not have the requisite property interest in his excised bodily substances upon which the theory of conversion could be founded.\textsuperscript{165} However, a careful reading of the Court's reasoning suggests that the rejection of Moore's claim of conversion did not resolve the basic issue of ownership of one's body. The Court was very careful in the way it framed its conclusion. It said: "Since Moore clearly did not expect to retain possession of

\begin{footnotes}
\item[163.] 793 P.2d 479 (Cal. 1990).
\item[164.] \textit{Id.} at 487.
\item[165.] \textit{Id.} at 489. The Court offered three reasons for denying the conversion claim: no precedent; California statutes restrict continuing ownership interests; and the subject matter of the patent "cannot be Moore's property." \textit{Id.} Having so found, the Court concluded that Moore's claim "must frankly be recognized as a request to extend [conversion]." \textit{Id.} at 493. The Court denied the extension based on three reasons: policy considerations; area better suited for legislative action; and there are other means available for protecting the rights of patients. \textit{Id.}
\end{footnotes}
his cells following their removal, to sue for their conversion he must have retained an ownership interest in them."\textsuperscript{166}

The operative phrase in the quoted passage is "retained ownership interest." The implicit suggestion of the Court from using the term "retain" is that Moore had ownership and possessory interest in his body and its constituent parts prior to their removal. One may ask what the majority could have meant by the phrase possessory and ownership interest.\textsuperscript{167} The answer to this question, oddly enough might be found in the dissenting opinion of Justice Mosk when he expressed the policy considerations behind ownership of one’s own body in these words:

In any event, in my view whatever merit the majority’s single policy consideration may have is outweighed by two contrary considerations, i.e., policies that are promoted by recognizing that every individual has a legally protectible property interest in his own body and its products. First, our society acknowledges a profound ethical imperative to respect the human body as the physical and temporal expression of the unique human persona. One manifestation of that respect is our prohibition against direct abuse of the body by torture or other forms of cruel or unusual punishment. Another is our prohibition against indirect abuse of the body by its economic exploitation for the sole benefit of another person. The most abhorrent form of such exploitation, of course, was the institution of slavery. Lesser forms, such as indentured servitude or even debtor’s prison, have also disappeared. Yet their specter haunts the laboratories and boardrooms of today’s biotechnological research-industrial complex. It arises wherever scientists or industrialists claim, as defendants claim here, the right to appropriate and exploit a patient’s tissue for their sole economic benefit—the right, in other words, to freely mine or harvest valuable physical properties of the patient’s body: “Research with human cells that results in significant economic gain for the researcher and no gain for the patient offends the traditional mores of our society in a manner impossible to quantify. Such research tends to treat the human body as a commodity—a means to a profitable end. The dignity and sanctity with which we regard the human whole, body as well as mind and soul, are absent when we allow researchers to further their own interests without the patient’s participation by using a patient’s cells as the basis for a marketable product.”\textsuperscript{168}

The concern expressed by Justice Mosk is not that a person does not have property rights in his own body. For, he noted “every individual has a legally protectible

\textsuperscript{166} Id. at 488-89 (emphasis added).
\textsuperscript{167} Note that this is the phrase that the Court used in framing Moore’s claim of conversion. Id. at 487.
\textsuperscript{168} Id. at 515-16.
property interest in his own body and its products."  

His concern was, rather, that a person could be allowed to exploit the body of another for profit to the exclusion of that person. If, therefore, ownership carried with it all the usual implications of the term, then Moore had the right to determine the conditions of access to his bodily substances before and after their removal. His property rights would not have terminated merely because of their removal, but rather based upon the terms of removal. As it was maintained by the dissent, Moore would have had an interest in the commercial exploitation of his bodily substances just as much as his physician unless he deliberately gave up that interest. It is unclear from the majority’s opinion how Moore lost his property rights.

The majority relied on regulatory statutes that were not intended to have, nor had, direct application to the creation, qualification, or loss of property rights in human body parts. The Court also seemed to argue that Moore lost his rights because he consented to the removal of his bodily substances. However, consent is not dispositive of the issue of retention of ownership. Consent, obtained through misrepresentation or fraud to have bodily substances extracted does not necessarily transfer ownership to Moore’s physician even though he might have had possession. Possession and ownership are not always coincident. The remedy for Moore should include conversion and does not lie exclusively in action for breach of fiduciary duty, the duty to disclose (informed consent) or perhaps fraud as suggested by the majority. It is clear from the foregoing that the Court’s opinion is muddy at best and contradictory at worst. For, the idea that Moore did not retain ownership interest was unsupported by property theories and even contradictory to the notion of prior ownership.

The majority opinion also raises other significant policy questions about the ownership of patentable inventions and innovations derived from human bodily substances. Notwithstanding the serious policy ramifications of the case, the Court appeared willing to offer a bright line rule on the ownership of derivative patents and products rejecting any claims of ownership by Moore in the following words:

[The] subject matter of the Regents ‘patent—the patented cell line and the products derived from it—cannot be Moore’s property. This is because the patented cell line is both factually and legally distinct from the cells taken from Moore’s body. Federal law permits the patenting of organisms that

169. Id. at 515.
170. The interest of Moore in the commercial exploitation of his bodily parts can best be seen from the discussion of the Court of the financial benefits to be reaped from the Moore cell line. The profits were estimated to exceed $3 billion by 1990. And these profits would be shared by all in the industry excluding the human donor. Id. at 516.
171. The statutes that seemed to guide the Court were: Health and Safety Code (various sections), Uniform Anatomical Gift Act, and Government Code § 27491.46 (right of coroner to retain certain bodily parts during autopsy). Id. at 489.
172. Id. at 483.
represent the product of "human ingenuity," but not naturally occurring organisms. Human cell lines are patentable because "[l]ong-term adaptation and growth of human tissues and cells in culture is difficult—often considered an art . . .," and the probability of success is low. It is this inventive effort that patent law rewards, not the discovery of naturally occurring raw materials. Thus, Moore's allegations that he owns the cell line and the products derived from it are inconsistent with the patent, which constitutes an authoritative determination that the cell line is the product of invention. Since such allegations are nothing more than arguments or conclusions of law, they of course do not bind us.173

The categorical statement that Moore did not have property rights in the patented cell line and products derived from it together with the earlier conclusion that Moore lost ownership interest in his extracted bodily substances have significant policy ramifications. First, there is the obvious suggestion that the researcher who extracts bodily substances from a person has greater rights in those substances than the donor. Implicit in the Court's opinion is that it would have recognized the property rights of the UCLA medical center in those bodily substances—even if they had been stolen by someone, even if the thief was Moore himself. An analysis that denies Moore prior property rights in his bodily substances but nevertheless allows his physician to acquire such rights from Moore would be violative of the well established legal principle which states, "nemo dat quod non habet" (One cannot give that which he does not have).

Second, a policy that allows only the researcher to have post extraction property rights in the substances and all derivative inventions and products seems patently unfair. The inequities created by the majority's position was addressed by Justice Mosk in the following words: "[o]ur society values fundamental fairness in dealings between its members, and condemns the unjust enrichment of any member at the expense of another. This is particularly true when, as here, the parties are not of equal bargaining positions."174 The inequities and injustice seemed magnified in the specific case at hand where the invention derived from Moore's bodily substances yielded over $3 billion which was shared exclusively between the universities and the biotechnology industry.175 Recognizing legally protected property rights in the donor's body and its products would not necessarily deny the inventor property rights but would facilitate or even compel the sharing of such profits and eliminate the unjust enrichment inherent in the majority's position.176 The goal of most legal systems include the development of a system of rights built on an edifice of distributive equities to foster respect of the system and the internalization of its

173. Id. at 492-93 (emphasis added).
174. Id. at 516.
175. Id.
176. Id.
values by society at large. Such a goal is undermined by a judicially created legal principle that is, or appears to be, patently unjust.

Third, the Court treats the grant of a patent as conclusive of the transformation of the raw material and ownership in the inventor. However, the grant of a patent is neither conclusive of the transformation of the raw materials into patentable new materials nor conclusive of ownership. After all it was Moore’s physician and a colleague who invented the cell line but the patent was taken out by the Regents of the University of California. The actual inventor did not hold property rights thus it would not have been necessary for Moore to have been the inventor to hold property rights in the patented cell line. Moreover, suppose Moore had not consented to the extraction of his bodily substances used in the patentable invention, who would have owned the patent? Or suppose a thief had stolen those substances from the UCLA laboratories and had used them to invent the cell line, would the Court have been so certain about the ownership of the invention by the inventor thief? In the case at hand, Moore contributed something to the enterprise without which the finished product would not have been possible. As long as the Court was wedded to the notion of property rights, it appears fundamentally inequitable and immoral for it to have categorically excluded Moore from those rights without a complete analysis of the underlining property theories.

Finally, the Court expressed great concern about the impact on research and development and society if Moore were given property rights in his bodily substances and their derivative inventions and products. However, Justice Broussard found the majority public policy position seriously flawed. According to him the majority position did not square with the concerns it expressed about the interest of society in research and development and inventiveness. Given such concerns, the logical conclusion of the majority would have been to advocate putting the extracted bodily substances and the resulting inventions in the public domain

177. Id. at 493.

178. Id. at 481-82. Quite often an employment contract will assign all rights in any invention and discovery by an employee to the employer thereby making the employer owner of such invention or discovery. That appears to have been the case with Dr. Golde and the University of California Los Angeles Medical Center.

179. Justice Mosk in his dissent cited opinions of an ethicist who argued that “the person [who furnishes the tissue] should be justly compensated... If biotechnologists fail to make provision for a just sharing of profits with the person whose gift made it possible, the public’s sense of justice will be offended and no one will be the winner.” Id. at 516. He therefore concluded that failing to compensate the patient who provided the raw materials would be morally unacceptable, unfair and result in unjust enrichment. Id.

180. The Court listed a parade of problems that would befall the system should the theory of conversion be sustained. There would be (1) restrictions on access to raw materials, (2) scientific exchange would be compromised, (3) liability will be expanded, and (4) researchers would be purchasing a ticket in litigation lottery each time they obtain human raw materials. Id. at 484-96.
and not create a private exclusive domain for them. Justice Broussard expressed his concerns in the following words:

It is certainly arguable that, as a matter of policy or morality, it would be wiser to prohibit any private individual or entity from profiting from the fortuitous value that adheres in a part of a human body, and instead to require all valuable excised body parts to be deposited in a public repository which would make such materials freely available to all scientists for the betterment of society as a whole.\textsuperscript{181}

Justice Broussard's argument merely underlines the serious nature of the policy considerations facing the treatment of biotechnological inventions. Because biotechnology seeks to decode, manipulate, or create life itself, it raises issues of such a fundamental nature that cannot easily be addressed by simple linear policy analysis. The fundamental policy issues are magnified when the target of biotechnology is human existence. The human body and its components or constituent elements are not simply scientific facts, or raw materials for genetic engineering, transgenic manipulation, or gene-therapy. Human cells, plasma, and genetic materials constitute something larger than their scientific basis. They are living organisms and constituent parts of life which continue to be a mystery and part of a larger universe of theology and nature. How the human body and its constituent parts might be treated should therefore be guided by policies that display great depths of sensitivity to theology, moral philosophy, and ethics. A property regime with its focus on exclusivity, dominion, and alienability might be unsuitable for the human body, or body parts. The concept of property, like other legal concepts, is an instrument. We must pause and ask the role of property in relation to the human body. If we exclude the human body from the regime of property in the full sense of the term, it cannot be that the human body cannot be owned but rather that it should not be owned because of the sanctity of the human body. If, however, we made the policy choice to treat the human body as property then we must apply that concept fairly and consistently.

4. Summary

Of all the traditional property theories that could support property rights in biotechnological invention none appears as attractive as Locke’s labor theory of property. The idea that a person is entitled to the fruits of his labor is both simple in its conception and intuitively appealing to those engaged in Research and development in the biotechnology industry. The task of genetic engineering is neither simple nor cheap. The process of developing biotechnological inventions

\textsuperscript{181} Id. at 505.
which often require a complex set of sequences and involve time consuming and painstaking activities certainly qualify as labor. At the popular level, ownership of the results of such labor appears rational and fair. However, the issue is not whether the labor theory of property can be applied to biotechnological inventions but rather whether all products of labor must be protected as property. From the philosophical and technical level one cannot conclude that every product of labor including patentable inventions qualifies as property. As has been demonstrated in this section, the labor theory of property is built on assumptions, suppositions, and conditions not always fulfilled irrespective of the amount of labor involved. Thus, notwithstanding a significant amount of labor involved, property rights may fail because the preconditions fail to be met.

Moreover, even as a substantive matter, not all products of labor constitute property and not all property is the product of labor. For instance, children are not the property of their parents in spite of the labor involved the procreation and raising of children. And children do have property rights in themselves not as a result of any labor on their part. What therefore motivates the qualification of labor whereby certain products of labor are removed from the property regime? And why is it that property rights exist even without labor? Might certain biotechnological inventions be excluded from the property regime because of their fundamental importance to life, liberty, human dignity and the maintenance of an ecological balance? Advances in biotechnology invite a much more deliberate examination of the labor theory of property to determine its applicability to the products of labor in that industry.

D. Utilitarian Theories of Property in Biotechnology

One of the basic and fundamental justifications for property rights can be found in utilitarian philosophy. Utilitarian philosophers offer an instrumentalist explanation of property. To them the creation of property rights is not an end but a means to an end: the achievement of happiness or the minimization of transaction costs. Utilitarian justifications for property fall into two categories: (1) traditional utility and, (2) economic utility. Because these two variants of utilitarianism offer different approaches to and explanations for the existence of property their ramifications for biotechnology are likely to be different, thereby warranting separate analysis.

1. Traditional Utilitarianism

In concert with its instrumentalist objectives, traditional utilitarian justifications of property assert that the end of private property rights is happiness. The guarantee of security of possession, use, and consumption accorded to property

182. See Property Rights, supra note 9, at 57.
operates as incentives for human acquisition, possession, and use of a thing for the achievement of happiness. So basic are the tenets of traditional utility that Becker has argued that they lie at the core of any justification of property rights.183

Traditional utility based instrumentalist theory of property is constructed on three related arguments all aimed at the goal of achieving happiness. The first of the arguments is that security of possession, use, and enjoyment of a thing does not only lead to the attainment of happiness but also is a fundamental good. Such a fundamental good should not be undermined by insecurity of possession. The second argument is based on necessity. Essentially, property rights are seen as necessary for the achievement of happiness. A stronger version of the necessity justification might be that property rights are a sine qua non for happiness. But why is that? Arguably because human beings have such a persistent need for property rights, it would be unjustifiable to deny them such rights unless there is some compelling countervailing good. The last argument is based on a balancing of property rights against other societal interests. In other words, on the balance, it would be best for society, as a whole, to recognize property rights unless there are significant countervailing reasons not to do so.

2. Traditional Utilitarianism and Property Rights in Biotechnology

The philosophical utilitarian arguments for property rights summarized above while complex and interesting, shall not detain us here. Our interest is limited to the policy issues they raise within the context of biotechnological discoveries and inventions. As a policy matter, how might a society confronted with the advances made in biotechnology decide the issue of property rights based on the instrumentalist goal of happiness? Any reliance on happiness as a determinant of property rights will run into several difficulties. First, the concept of happiness is as elusive as it is insusceptible to easy definition and measurement. Happiness is a subjective phenomenon induced by a multiplicity of conditions not always the subject of objectification. Second, there is the question of whose happiness should be the focus of an instrumentalist theory of property. Should it be that of those involved in the tedious research and development work that results in new biotechnological products, or should happiness be measured by the general benefit to society at large? If we rely on the benefits to society, how might those be identified? For instance, in the case of genetically modified foods, there is a growing public disapproval of them almost bordering on uninformed hysteria. Should such public fear, even if there is no scientific basis for it, be indicative of "no happiness,"

183. Id. at 59.
184. Id. at 64-65.
185. Id. at 65.
186. Id. at 66.
187. Id.
thereby forming the basis of the denial of property rights? Finally, if happiness is to be promoted by the creation of property rights, who should hold such rights, of what quality, and for what duration? If we conclude that general societal welfare is the objective, would private ownership better serve that goal than communal ownership?

The seriousness and complexity of the policy considerations required in confronting the instrumentalist goals of traditional utilitarianism are not lessened with respect to the second and third arguments based on necessity and societal benefits respectively. The suggestion is made in the second argument that the desire for property rights are inherent in human nature. Absent some compelling reasons, society should not contravene such inherent human tendencies towards private property rights. However, we are not told what would qualify as justifiable reasons for denying property rights. Thus, would fear, uncertainty, or public disapproval of a biotechnological invention be sufficient reason to deny property rights in it? Or must there be a demonstrable danger or risk to human health and safety or to the environment? Suppose an invention is so important to society at large but the grant of property rights would create a monopoly, would that be sufficient justification for denying property protection? Moreover, would property rights be justified by the cost, level of difficulty, or significance of the invention involved? Similarly, the argument that, absent some countervailing good, society is better off recognizing specific property rights raises parallel policy questions; the answers to which require a much more deliberate and discriminating analysis of the biotechnology industry.

The biotechnology industry is not a monolithic entity to which a single comprehensive policy might apply with ease. Rather, it is a complex industry with different interests, different operations, and differentiated impact on society as a whole. As such, any policy design to assign private property rights in biotechnology must be sophisticated and take these differences into account. A starting point for understanding the complexity of the biotechnology industry is to classify the activities into their relevant categories. One might divide the biotechnology industry into five broad sectors. The first involves life sciences devoted to the study of, and innovations in, human genetic structures which can be used for medical and non-medical purposes. The second sector is also devoted to the study of non-human life sciences. Research and development in this field may be directed at changing the basic characteristics of certain animals by manipulating their hormones or altering their genetic structures at the cellular level for various purposes. For instance, the purpose might be to design genetically better tasting and tender beef, improve the milk production of cows, or to create a new species of exotic animal or flower. In the third sector, we have biomedical operations which are directed at using the innovations in human and non-human sciences to develop new medical

188. Id. at 64-65.
189. See supra note 6 and accompanying text.
190. See supra note 7 and accompanying text.
treatments such as gene therapy, transgenic cloning for the production of proteins or the development of organs for human transplantation. The fourth sector is devoted to the development of biotechnology-based pharmaceutical products. The fifth sector involves the use of biotechnological techniques such as seed and plant genetics for the development of new breeds or hybrid varieties of seeds and plants.

Whether property rights might be recognized in any of these areas would require separate analyses and policy justifications. For instance, in the case of innovations and inventions involving human life sciences, the issue of creating property rights raises serious political, ethical and economic implications already discussed above. The risk to human dignity and liberty might outweigh any benefits in the form of happiness that property rights might bring. Moreover, granting exclusive property rights over the pathways to cloning of human beings or even for the creation of human life de novo might reintroduce slavery, serfdom and other forms of human indignities now positively condemned by the Declaration of Human Rights. In the case of biomedical and pharmaceutical inventions, justifying property rights based on the welfare or happiness of inventors and their financiers also presents significant risks. The exploitation of medical and pharmaceutical advances might be dictated purely by profit motive and not by the medical necessity of the most needy segments of society. Thus, a medical culture favoring the affluent and the powerful would emerge, in which research expenditures would not necessarily be directed at the most difficult and needy medical areas. Considerations of class, race, ethnicity, and wealth would be the primary determinants of biomedical and pharmaceutical research and marketing efforts. We are already currently confronted with the situation in which proletariat diseases and those most prevalent in developing countries receive little or no attention from the major biomedical and pharmaceutical

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191. See supra note 7-9 and accompanying text.
192. See supra note 7-9, 24 and accompanying text.
193. See supra note 27-28 and accompanying text.
194. In particular, the following Articles of the International Declaration of Human Rights should be of interest to us in any discussion of the implications of the advances made in biotechnology: Article 3, Everyone has the right to life, liberty and the security of person. . . . and slave trade shall be prohibited in all their forms. . . . inhuman or degrading treatment or punishment. . . . a person before the law. INTERNATIONAL DECLARATION OF HUMAN RIGHTS, Adopted by United Nations General Assembly, Dec. 10, 1948, 3 U.N. GAOR, I, at 71, U.N. Doc A/810 (1948).
195. The pursuit of profit and the exploitation of the most lucrative biomedical advances would be the logical consequences of the privatization of research in these areas. The shareholders would demand that research and the exploitation of the results enhance the market value of their companies. And based on corporate law principles the board of directors of the companies would be expected to act in such a way as to improve the valuation of their companies. Indeed one commentator has suggested that pharmaceutical companies are not interested in finding the cure for cancer since that might lead to government intervention and less profits. See Lester C. Thurow, Poaching Patents, CAL. L. REV., Nov. 1999, at 24.
global enterprises. Current developments in the biotechnology industry appear to bring some of these issues to the forefront and invite the adoption of a revisionist property policy analysis.

**a. Monsanto and the Corporate Strategy for Dominance in Biotechnology**

As a general matter, recent advances in agrobiotechnology have attracted both positive and negative attention from many sectors of society and Monsanto has been in the eye of the hurricane. To some, genetic engineering of seeds, plants, fruits and other agricultural products provide the tools for eliminating the curse of hunger from the face of the earth. Biotechnology is not only touted as providing the technology

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196. Diseases that are prevalent mostly in developing countries have received very little attention from the research departments of drug companies. See Tim Vollmer, *Disease in Poor Countries Get Short Shrift from Drug Companies Focused on the West's More Lucrative Ailments*, S.F. CHRON. June 25, 2000, at 1. According to the author, pharmaceutical companies aim their research efforts at developing new drugs for affluent markets. For instance, 80% of pharmaceutical sales are made in North America, Europe, and Japan. Africa accounts for only 1%. Between 1975 and 1997 there were 1,233 new medicines patented. Of this number only 13 or 1% were for tropical diseases. Malaria is a tropical disease that affects between 300 to 500 million people each year yet the medicine for malaria is 40 years old and the disease has been able to mutate in response to medication. Yet no research effort is put into the development of a new drug. Sleeping sickness is another disease caused by the tsetse fly. The medicine for this disease which is comprised of antifreeze and arsenic was developed 70 years ago and no company appears willing to pump research funds and effort into developing a new treatment. See also *Millions for Viagra, Pennies for the Poor*, TRONTO STAR, Aug. 13, 1999. This is what this news paper wrote about the attention paid to diseases in poor countries: "One old, fat, bald, fungus-ridden rich man who can't get it up means more to the pharmaceutical industry than half a billion poor people vulnerable to malaria. . . . Malaria, tuberculosis, acute lower respiratory infections claimed 6.1 million lives in 1998. People died because the drugs to treat those illnesses are non-existent or are no longer effective. They died because it doesn't pay to keep them alive . . . on malaria alone, a recent survey of the 24 biggest drug companies found that not a single one maintains an in-house research program, and only two expressed even minimal interest in primary research on the disease."(emphasis added); Patrick Bishop, *Why Poor People are Worth less than Animals*, DAILY TELEGRAPH (LONDON), Mar. 24, 1999, at 24 (posing the question whether impotence or pneumonia that kills millions of people particularly children is the bigger problem, and also arguing that some of the very few medical patents for tropical diseases were spin-offs from research into animal rather than human diseases). The general issue of the lack of research effort in diseases of the poor was brought to the forefront by a controversial statement made by President Thabo Mbeki of South Africa at the 13th World Aids Conference on AIDs about the causes of AIDs and the availability of drugs to poor nations. For instance, see generally Alex Duval Smith, *AIDS SUMMIT: Drug Companies 'Inflicting Holocaust on the Poor': Anti-Capitalist Rhetoric Deflects the Spotlight from South African President's Mishandling of Crisis in his Disease-Ravaged Country*, THE INDEPENDENT (LONDON), July 10, 2000, at 11 (explaining the controversy raised by President Mbeki's comments.); Norman Kempster, *Clinton, Mbeki Focus on AIDs During Meeting*, L.A. TIMES, May 28, 2000, at 6 (discussing Mbeki's position on AIDs on a state visit to the White House with Clinton).

197. The promise of biotechnology was recognized by President Bill Clinton when he honored four Monsanto researchers with the National Medal of Technology in 1999. See David Stipp, *Is Monsanto's Biotech Worth Less Than a Hill of Beans?*, FORTUNE, Feb. 21, 2000, at 157. Time Magazine devoted a cover story to the potentialities of using genetically modified foods to eliminate world hunger. It provided charts showing the role of genetically modified foods in fighting hunger and the needs of overpopulated countries such as China and India. See J. Madeleine Nash, *supra* note 32, at 39-46. Biotechnology has also proved beneficial to farmers growing transgenic papayas, African sweet potatoes, fruits and vegetables that stay fresh for a long time. In Africa the promise of genetically modified organisms include reducing the need for weeding that keeps children from going to school. *Id.* at 46. One of the strongest supporters of genetically modified foods and plants is Gordon Conway, a British ecologist who believes that the technology can be directed at productive activities with clear benefits to human
for feeding the world but also as satisfying specific food needs. With the capacity to design seeds, plants and other agricultural produce with unique attributes or proteins, foods of specific qualities (low fat, high fibre, high protein) and quantities can be produced to meet the needs of society. For instances, through genetic engineering, scientists have developed a new type of rice (golden rice) that contains beta-carotene, the nutrient for Vitamin A.\textsuperscript{198} The golden rice is supposed to save the lives of millions of children particularly in developing countries who suffer from Vitamin A deficiency leading to death or blindness.\textsuperscript{199} Also, through genetic engineering scientists have been able to develop a new breed of longer lasting and better tasting frost-resistant tomatoes.\textsuperscript{200} The potential benefits of agrobiotechnology even extend to the environment. The development of insect- resistant plants and herbicide-ready seeds such as the Round-Up-Ready seeds were intended to reduce, and may be applauded as reducing, the need to use pesticide thereby minimizing the negative impact on the environment.\textsuperscript{201}

If agrobiotechnology holds such great promise for society why is there such an uproar over genetic engineering in agriculture? The answer to this might be explored through the experience of one of the major players in the industry, Monsanto. Monsanto is an interesting subject for a case study because it used a deliberate and elaborate corporate strategy to acquire and maintain a dominant position in the biotechnology industry seen by some as a threat to social welfare. Moreover, because of the controversy surrounding the conduct of Monsanto, there has been much commentary on its corporate policies and strategic objectives. These policies and strategic maneuvering have an impact on the concept of property, requiring the analysis that follows.

\textit{i. Monsanto and the Corporate Strategy}

Monsanto is a Saint Louis based U.S. global biotechnology enterprise that appears to have been caught up in the spins of its own clever strategic maneuvering in the agrobiotechnology sector. Monsanto is a major global player in the seed business. It has been listed among the top ten global agrochemical companies in

\textsuperscript{198} Nash, supra note 32, at 40-41.
\textsuperscript{199} \textit{Id.} at 39-41 (discussing the development of the golden rice and its importance to the health of children in developing countries. The genetic engineering involved here was deliberately engaged in to solve the vitamin A deficiency of children in developing countries).
\textsuperscript{200} \textit{Id.} at 46; \textit{see also} Michela Wrong, \textit{GM May Be a Matter of Seduction}, \textit{FIN. TIMES, LIFE SCIENCES}, Oct. 28, 1999, at 4 (using AstraZeneca’s genetically modified better tasting and longer lasting tomato as an example of benefits of genetic engineering).
\textsuperscript{201} \textit{See} Michael Specter, \textit{The Pharmageddon Riddle}, \textit{THE NEW YORKER}, Apr. 10, 2000, at 60 (discussing the corporate objectives of Monsanto to minimize the environmental impact in the use of genetically modified organisms).
1997 in terms of revenues generated. According to estimates of transgenic crops planted in the United States, Monsanto held a dominant market position with 88% of the market while the next two competitors, Aventis and Novartis, held 8% and 4% respectively. Monsanto appears to have adopted an aggressive corporate strategy which brought it both success and headaches. Monsanto is currently engulfed in a global public relations debacle over the infamous Terminator Seed and is also in a patent infringement dispute with a small Canadian farmer over what may be described as “the escaped seed.” The reasons these two incidents are indicative of the general problems faced by the biotechnology industry will become obvious later.

The corporate strategy that brought Monsanto to global prominence and, as some might say, “ill fame” has been the subject of much commentary. Indeed, according to one commentator, Monsanto seems to have become a “cauldron of evil” and, one might say, virtually synonymous with all that is bad with genetically modified organisms. One such recent commentary is by Toby E. Stuart of the University of Chicago Business School. According to Stuart, major scientific advances in biotechnology in the 1970s suggested revolutionary changes in the agriculture business. The top management of Monsanto, recognizing the promise of biotechnology, decided to become a major player in it. They selected an aggressive corporate strategy which ultimately transformed the company from a plastics and chemical entity to a biotechnology power house. The strategy involved the formation of over 50 overlapping biotechnology strategic alliances and many acquisitions of companies in the field of biotechnology. Monsanto’s strategic structure has been described by Stuart in Figure 1.

203. Id. at 7.
204. See infra Parts IV.D.2.c and IV.D.2.d (discussing the Terminator Seed and escaped seed disputes).
205. Virtually every article addressing the promise or evils of genetically modified organisms discusses the role of Monsanto in the industry. See generally supra notes 197 and 201. See also Jon R. Luoma, Pandora’s Pantry, MOTHER JONES, Jan./Feb. 2000, 53, 58 (explaining the types of strategic moves Monsanto made in the employment and appointment of former government officials as employees or members of the board of directors thereby creating a chemical bond between Monsanto and policy makers in government).
206. See Specter, supra note 201, at 62.
207. Not long after President Clinton awarded Monsanto’s scientists with the National Medal of Technology, the company came under heavy attack over genetically modified foods. See generally Stipp, supra note 197.
209. Id. at 6.
210. Id.
211. Id.
212. Id. at 4. It should be noted that Stuart’s article was written to demonstrate the power and the how-to of strategic alliances and collaborations in complex modern business operations. However, the strategy employed by Monsanto is particularly interesting to scholars of property since the strategy has serious implications on the issue of ownership and access to ideas.
As it is apparent from Figure 1, Monsanto employed a spider’s web strategy in the formation of its strategic alliances. The spider’s web strategy is one in which an enterprise, Monsanto, enters into many alliances with different other entities in the same or many fields of business activities. By so doing, it spins and weaves a wide web or network of collaborations and alliances bringing within its sphere of influence entities and resources outside its internalized domain. What is particularly interesting about Figure 1 is that Monsanto formed overlapping alliances with some of the leading players in biotechnology, seed research, and an assorted variety of

213. The term spider’s web was first used in the joint venture context by Steffan Gullander to describe the formation of multiple joint ventures by a single firm, typically a small company. See Steffan Gullander, Joint Ventures and Corporate Strategy, 11 COLUMBIA J. WORLD BUS. 104, 106 (1976). The term is adopted here to describe the phenomenon of multiple alliances to achieve various corporate objectives.
other areas including major research universities such as Harvard University and Washington University. These alliances provided Monsanto with many advantages: (1) direct access to new ideas and participation in cutting edge research activities; (2) peeping rights; that is, the right to look at the research activities and results of others through a peephole with a powerful telescope; (3) property rights in new inventions; (4) rights to exclusive or non-exclusive licenses; and (5) perhaps even more important, the right to sit at the bargaining table to determine how new biotechnological innovations might be exploited, by whom and under what circumstances. In other words, even though Monsanto might not have been the inventor of a new technology, it might nevertheless have a significant influence on the access to such an invention by others.

With the rights listed above, the spider has more power than its internal or physical resources would indicate. A wide network of alliances provided Monsanto with access to major new scientific ideas in the field and the direction of the biotechnology business. It could then engage in the most appropriate strategic response to emerging technologies. With acquisitions it could take over proven research and development entities such as Calgene, proven technologies such as the Terminator Seed, or acquire those that held the greatest promise. Overlapping alliances in a field allowed Monsanto to associate with, and obtain rights in, the first successful developments in that field; such that it could legally challenge subsequent developments as was the case in the Bt gene controversy with Mycogen. The right to sit at the bargaining table permits Monsanto to influence, if not control access to, and exploitation of, new biotechnology ideas even when it has no proprietary interest in such ideas. For instance, the inventors of the golden rice which contains the nutrients for Vitamin A had planned to put that invention in the public domain for the benefit of children worldwide suffering from Vitamin A deficiency.

215. Monsanto acquired a controlling interest in Calgene, a plant biotech company, also acquired Agracetus, in 1996, Delta and Pine Company, the joint developer of the Terminator Seed, and entered into many joint ventures with Cereon Genomics, Millium Pharmaceuticals, Synten, Ecogen, and others. See generally id. at 6.
216. Id. at 4. In 1996, the Environmental Protection Agency (EPA) approved insect-resistant corn for commercial use. Insect-resistant corn is genetically modified corn capable of producing Bacillus thuringiensis (Bt) pesticidal protein lethal to insects, particularly the European corn borer. Although the Bt toxin is naturally occurring its levels in plants had to be increased to be effective against insects. With the approval of the Bt corn, the market for genetically modified corn seeds increased steadily and it was estimated that by 1999 Bt corn cultivation would be 10 to 20 acres out of 80 acres of corn planted nationwide. With the projected expansion in demand Monsanto and Mycogene found themselves locked in a battle over patent rights in Bt corn. Mycogene brought a patent infringement suit against alleging that two of its Bt toxin patents had been infringed by Monsanto and some of Monsanto’s subsidiaries. Monsanto defended against the suit claiming that it had not infringed Mycogen patents and that those patents were invalid. For a full discussion of the dispute and the science of genetic engineering. See Mycogene Science Inc. v. Monsanto Company et al., 61 F. Supp 2d. 199 (1999) (holding inter alia that Mycogene patents were invalid); see also Monsanto Company v. Mycogene Plant Science Inc., 61 F. Supp. 2d 133 (1999) in which Monsanto claimed that Mycogene, Agrigenetics, and Novartis corporation had infringed another Monsanto Bt patent. However, the court held there was sufficient evidence for the jury to have found that the patent was invalid because prior invention.
However, that plan ran into stiff opposition from AstraZeneca, an exclusive licensee of one of the genes used by the inventors. A deal was struck giving AstraZeneca exclusive rights to the invention in developed markets in exchange for it being made available freely to developing countries.\textsuperscript{217} Thus, strategic alliances might be the source of market power beyond what could have been obtained through normal ownership of specific inventions.

The strategic posture of Monsanto was redirected in 1995 to give the corporation a gentler focus when Robert Shapiro became the Chief Executive Officer (CEO) of Monsanto. Mr. Shapiro is not only a lawyer but also a former professor of law and of urban affairs who saw his position as CEO as an opportunity "to make a difference in the world."\textsuperscript{218} According to Specter, the corporate goals of Monsanto were then channeled to help people "lead longer, healthier lives, at costs that they and their nations can afford and without continued environmental degradation."\textsuperscript{219} To achieve this goal, Monsanto shed its chemical operations and focused on the biotechnology arena where it developed Roundup-Ready seeds and insect resistant plants to increase yields in agricultural production while concurrently saving the environment.\textsuperscript{220} How then could such a noble goal produce such a ruckus

\textsuperscript{217} Madeleine Nash, \textit{Grains of Hope}, supra note 32, at 43 (discussing the goals of the inventors and the criticism the deal with AstraZeneca attracted).
\textsuperscript{218} Specter, \textit{supra} note 201, at 64.
\textsuperscript{219} \textit{Id.} at 60.
\textsuperscript{220} The shift in the corporate strategy seems to reflect the sensitivity of Mr. Shapiro, the CEO of Monsanto to social and environmental issues. This sensitivity was captured in the following conversation between Shapiro and Specter concerning the reality of the corporate game which Shapiro learnt as general counsel of G.D. Searle. Specter states:

He learned that [reality of the corporate game] in 1982, when he became the head of the NutraSweet operation at Searle. 'One of the moments in my evolution that I will always remember is after we had launched the product, and I was feeling really good because it seemed to be succeeding,' he said. 'It was the first business I'd ever been given a chance to try to create, and it was working well. So I was feeling proud of myself. But then I began getting letters from kids and from parents of kids, mostly diabetics, who had never before been able to have something like Kool-Aid or Jell-O. And I realized what was going on. \textit{We were doing something important for people. It wasn't just making a handheld calculator, as we had done in my previous incarnation. This thing actually mattered.}'

'That did it for me,' he continued. 'I mean, look, I am very well compensated and I like that. It's nice to have some of the perks that make life easier. It is even nice when you talk with people that they probably laugh at your jokes more than you deserve because of who you are. But the thing \textit{I never would have guessed about this job is that it gives you a chance to make a difference in the world.} When you go home at night and you talk to your family about what you're working on, it isn't like 'Gee, I designed a really cool paper clip today.' It's about the earth, it's about the environment, it's about food. It's about health and nutrition. Those are deep, ancient things for civilization, and they are for the people.'

At that point, Shapiro stopped talking, because he was fighting back tears. It was our first meeting, and I wondered if this reserved and powerful corporate leader was acting. After a few moments, he apologized. 'You asked me before how this makes me feel,' he said, referring to the very personal opposition that he and Monsanto face almost every day. 'There are two things that most of us feel. We feel hurt, and we feel angry.' Later, he added to that: 'We were really proud to get out front the way we
and such disastrous consequences for Monsanto? The simple answer may be that good thoughts do not always translate into good deeds. However, the answer to this question is necessarily much more complex and a full discussion of it is outside the scope of this Article. We shall, however, focus on those aspects of the answer that relate to the task at hand: the implications of Monsanto's strategic moves on ownership and access to ideas in biotechnology. In particular, we shall address below the implications of conferring property rights over the Terminator Seed technology and the property implications of the "escaped seed" dispute.

**ii. Monsanto and the Terminator Seed Controversy**

In 1998, the United States Patent and Trademark Office (U.S. PTO) granted a patent (Patent No. 5,723,765) to the United States Department of Agriculture Research Services and Delta and Pine Land Corporation (Delta), a Mississippi corporation and a major breeder of cotton and soybean. Although the patented invention was described by its developers as the "Technology Protection System," it was later dubbed by its critics as the "Terminator Seed." To critics the term "terminator" appeared appropriate because the invention involved a genetically modified seed that would produce sterile offspring. The seed sterilizing technology is guaranteed by its developers to work in cotton and tobacco and is also believed to work in wheat, rice and soybeans. A few months after the grant of the terminator patent, Monsanto acquired Delta and Pine Land Co. for about $1.9 billion and thereby obtained the patent rights in the terminator technology.

The public outcry against the Terminator Seed technology and all it stood for was first mounted against the USDA but was shifted to Monsanto after its
acquisition of Delta. What is it about the Terminator Seed that makes it so objectionable? Many of the objections to the terminator technology seem to surround the implications of private ownership of it. The Terminator Seed gives its owner automatic and extraordinary self-enforcing patent protection beyond that provided by any patent statute. Generally, a patent grants its owner, for a limited time only, the right to exclude others from making, using, and selling patented products without the consent of the owner. However, because of agency costs and post contractual opportunism by licensees, enforcing patent rights is not always guaranteed. The terminator technology is a brilliant commercial response to patent enforcement problems because it comes with a built-in biological patent enforcement mechanism. Indeed, the terminator technology creates its own biological patent system with the perfect and perpetual self-help enforcement of property rights. Because the Terminator Seed sterilizes its off-spring, the patent owner is assured that farmers and licensees who obtain seeds from the owner will not be able to cheat on the terms of the contract by breeding seeds without consent. But the biological self-enforcing protections are not limited in time as they are the case of patents. Thus, even after the patent protection has expired, the owner of the Terminator Seed can effectively and perpetually exclude farmers from improving the seeds. This type of potential negative impact has led some critics of the terminator technology to describe it as socially pathological.

For about 12,000 years, farmers all over the world have been developing non-proprietary techniques of producing, selecting, and retaining seeds. Seed breeding techniques were shared and passed down from generation to generation thereby facilitating the development of new seed varieties. The Terminator Seed is seen as a threat to this ancient know-how and tradition. As the Terminator Seed
technology gains acceptance in the farming community, seed breeding will be the exclusive domain of a highly concentrated group of seed companies and their scientists, who may affectionately be called *lab rats.* Farmers who use the Terminator Seed will be unable to develop and maintain independent seed breeding techniques of their own. Traditional seed breeding techniques accumulated over centuries might all but disappear. Biodiversity in seeds maintained, in part, through traditional low tech breeding techniques will also be threatened. Diversity in seed plasma and genetic material, so essential to seed development, would tend to suffer. One may ask, what societal benefits may be found in a technology which seeks to reduce, terminate, or eliminate the acquisition or expansion of knowledge in an activity so ancient and so vital to human existence? The terminator technology implicitly suggests that *lab rats* know best what is good for society and they alone should be allowed to control the development of seeds. One cannot doubt that scientists have certain specific knowledge that ordinary farmers do not have, but that cannot support a policy of denying the world of the contribution of millions of people in the development of new seed breeding ideas within different environmental conditions. A policy that puts a higher premium on modern high tech biotechnological ideas at the expense of traditional techniques might be unwise. 

*What then is the cost of the Terminator Seed?*

One of the concerns expressed by critics of the Terminator Seed is that seed production will fall into the hands of an ever decreasing number of global enterprises that might restrict output to enhance prices or select seeds for production based purely on their profitability and not the needs of society. This concern is reinforced by the fear that the terminator technology might be used as a platform for expanding its application in combination with other proprietary technologies such as Roundup-Ready, herbicide-tolerant, or insect-resistant genetically engineered techniques. For instance, the expansion of the application of the terminator technology to rice and wheat could have serious implications because they constitute about 75% of the staple of the world’s poor. Farmers would be eliminated from the ancient practice of seed breeding and would not even be able to retain part of their harvest for future use. They would have to depend on seed manufacturers for their annual or seasonal seed needs. Thus, the food needs of large segments of the world’s population will be controlled in the laboratories of a few de-personalized

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233. The problems of patenting genetically modified seeds have been the subject of commentary. See, e.g., Anthony DePalma, *The 'Slippery Slope' of Patenting Farmers' Crops,* N.Y. TIMES, May 24, 2000, at A4 (expressing concern over the potential impact of patenting plant genes held a select number of companies and universities on Mexican farmers. These farmers developed about 20,000 varieties of maize for hundreds of years but could now be excluded because they shared their traditional techniques with researchers); Henry Tricks and Andrea Mandel-Campbell, *Mexico’s Farming Habits under Pressure from Transgenics,* FIN. TIMES, Oct. 12, 1999, at 8 (explaining concern that genetically engineered seeds constitute genetic imperialism).

234. The suggestion of monopoly over seed production and sales is alluded in many of the reports on the Terminator Seed technology. See Kluger, *supra* note 222; Steinbrecher & Mooney, *supra* note 221.


236. Id.
global seed enterprises. With upstream supply side monopolies and downstream
demand side competitive markets, one can only image what pricing policies would
be adopted by global seed monopolies.

With the potential for cross-pollination, the expansion of the Terminator Seed
into other types of seed such as rice and wheat would create an even greater risk to
farmers using traditional farming techniques. An increasing number of seed
varieties would be exposed to and converted by the terminator technology. Such an
expansion of the Terminator Seed technology would tend to create monopoly
conditions for seed manufacturers. The risks presented by monopoly or oligopoly
in other areas of the economy might be distinguished from those in biotechnology.
As stated above, biotechnology is devoted to the fundamental issues of life and
living and an abuse of power in it is likely to have a much wider and deeper impact
on society than the concentration of power in other industries. Take the case of
staple seeds being controlled by a few global seed producers concerned about the
return to shareholders, earnings per share, and consequently the market price of
shares; what production decisions would be made if they completely dominate the
global seed market?

Obviously, if the goal of assigning property rights is happiness, the assignment
of property rights in biotechnology presents a serious threat to the achievement of
overall happiness of society. The attainment of happiness might require an
aggressive regulatory regime or demand circumscribing property rights in some
biotechnological inventions. In the case of the Terminator Seed, denying patent
protection might be insufficient to address the concerns of its negative impact if the
invention can nevertheless be used. With equal and free access to all, nothing
prevents the widespread use of the Terminator Seed technology by all seed breeders
in all seeds, patented and non-patented. Thus, denying patentability might have the
undesirable effect of magnifying the negative impact of the technology on society.
The solution might then lie in not only denying patent protection but also in making
the Terminator Seed technology illegal, or by prohibiting its use.

**iii. Monsanto and the Case of the Escaped Seed**

The full implications of private ownership of the terminator technology can be
fully appreciated by examining another seed dispute in which Monsanto is deeply
involved. Monsanto brought a patent infringement suit against a Canadian farmer,
Percy Schmeiser. While the facts of the case are still in dispute, Monsanto is

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237. The risk to cross pollination was admitted by a Terminator Seed scientist at Delta and Pine Land
Company. He also noted that the risk of genetic cross pollination in some plants is so high that the Terminator Seed
technology is recommended for them. See Nixon supra note 221.

238. There are several newspaper reports of the law suit by Monsanto against Percy Schmeiser. See generally
Karl A. Thiel, *Seeds in the Wind: For Monsanto, Patent Protection Stirs Controversy*, BIOSPACE (visited July 6,
2000) <http://www. biospace/articles/120699_print.cfm> (discussing the legal battle between Monsanto and
Schmeiser in Canadian court); Dave Margoshes, *Saskatchewan Farmer Battles Monsanto, Sues Them Back,*
claiming that a large proportion of the defendant's canola crop contains Monsanto's patented genetically engineered Roundup-Ready gene, found only in Monsanto's Roundup-Ready canola seed. The Roundup-Ready seed was designed to make canola plants resistant to Monsanto's Roundup herbicide. Generally, farmers buy their seeds from seed producers such as Monsanto. However, in the case of the Roundup-Ready canola seed, Monsanto chose to maintain control over the seed through a lease agreement in which Monsanto, at all times, retained ownership of the seed and its technology. Control was maintained through the following terms in the lease agreement: the farmers (1) must plant all seeds leased in the exact acreage agreed upon, (2) cannot hold back seeds for next year's needs nor engage in seed breeding, and (3) must lease from Monsanto each year's planting needs for the duration of the contract. The defendant, Schmeister, is not one of Monsanto's seed lessees so it must then be determined how the Roundup-Ready canola seeds found their way onto his farm.

Notwithstanding that the facts are still in dispute, the case presents several significant legal and policy questions to be resolved. Two of the policy issues raised relate to patent policy and the ownership of genetically engineered naturally self-replicating organisms. While these issues could be examined in the section addressing patent policy below, they will be discussed here because of their importance to the traditional concept of utility.

At the outset, it should be noted that Monsanto held the patent in the popular Roundup herbicide used by farmers and home gardeners to control weeds. Just as the Roundup patent was about to expire, Monsanto developed the genetically engineered Roundup-Ready seed which had embedded in it a gene that made plants resistant to Monsanto's Roundup herbicide. The new herbicide-tolerant seed gave the old expiring patent a new lease on life on a new platform with a new method of use. The new patent allows Monsanto to retain its competitive edge against potential producers of generic Roundup herbicide when the patent expires. While


239. See O'Malley, supra note 238.
240. See Thiel, supra note 238, at 1.
241. Leasing of seeds rather selling them, appears to be a common practice among seed producers. While there are reports of such leases it is difficult to determine the exact legal character of such lease agreements without an examination of those agreements. For a discussion of the lease agreements between Monsanto and the farmers, see Margoshes, supra note 238, at 2 (describing a contracting format whereby Monsanto "sells" the seed to farmers but retains rights to the DNA in the seed). According to another report, farmers using Monsanto's seed must agree to sell the seed back to Monsanto and buy seeds again in the following year. See About Percy Schmeiser v. Monsanto, GENTECH ARCHIVE (visited July 6, 2000) <http://www.gene.ch/gentech/1999/oct/msg00187.html at 2>. These agreements have properly been called leases. See Jeff Singer, David Countersues Goliath; Saskatchewan Farmer Percy Schmeiser Sues Monsanto Co., ALTERNATIVES JOURNAL, Jan. 1, 2000, at 2.
242. Control was maintained not only through the contract but also through a network of paid informants. See Margoshes, supra note 238, at 2-3.
243. Singer, supra note 241, at 2 (suggesting that Monsanto's patent on Roundup was about to expire).
theoretically the Roundup technology would be in the public domain, the new patent introduced a new and complementary method of use likely to create an entry barrier. Farmers may be reluctant to try generic Roundup herbicide if they associate the efficacy of the Roundup-Ready technology with Monsanto's brand of Roundup herbicide. The degree of complementarity of the old and new patents would invite tying agreements, actual or de facto. Indeed, there is no guarantee that Monsanto would not engineer technical complementarity between the Roundup-Ready seed and its brand of Roundup to maintain its edge in that technology.

Presumably, the Roundup-Ready seed technology has met all the technical requirements for patentability. However, the question may still be raised whether patent policy is advanced when a patentee is allowed to extend the life of the patent by new and improved methods of exploiting technology that has enjoyed a full term of patent protection and should now be in the public domain. With the potential for technical complementarity, extending the patent protection of the Roundup herbicide technology was another brilliant business strategy with questionable policy and social implications. The strategy gave Monsanto the opportunity to maintain a stranglehold on the Roundup technology beyond what was contemplated by the first patent. One may ask, how many bites at the apple are allowed?

The patent infringement claim of Monsanto raises equally significant questions about the nature and scope of patent rights in genetically modified organisms. In response to the patent infringement claim, the defendant has maintained that he neither planted nor authorized the plantation of the canola seeds on his farm. He however offered two theories of how the genetically modified seeds might have gotten onto his farm. First, he claimed that his canola crop was contaminated and polluted through cross pollination from neighboring Roundup-Ready canola farms. Based on this theory, the defendant countersued Monsanto for damages arising from the pollution of his farm. The defendant's second theory is also connected with some act of nature. According to him, the Roundup-Ready seeds were blown by the wind and spread either from neighboring farms or from the roads littered with spillover seeds during transportation. Whether the seeds arrived in the winds or through some other force of nature, the defendant insisted that he played no part in it and should not be found to have infringed upon the patent. Implicit in the defendant's argument is the notion that the word "infringe" is an

244. To obtain a utility patent, one must meet the requirements of novelty, nonobviousness, and utility. See 35 U.S.C.A. §§ 101 (West 2000) ("Whoever invents or discovers a new and useful process, art or method, and includes a new use of a known process, machine, manufacture, or composition of matter or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."); 102 (West 2000) (focusing on the requirement of nonobviousness).
245. See Thiel, supra note 238, at 1; Margoshes, supra note 238, at 1.
246. Thiel, supra note 238; Margoshes, supra note 238. The issue of cross pollination is not trivial as it reported that the Roundup Ready canola seed can indeed spread through cross pollination. See Singer, supra note 241, at 2.
247. Margoshes, supra note 238.
248. Id. at 3.
active verb which requires some volitional act on the part of the defendant. An act of nature is neither an act of the defendant nor an act attributable to him.

Suggesting what appears to be a strict liability approach, Monsanto has argued that patent infringement should be based upon the mere fact that Roundup resistant crops were found on the defendant’s farm. Should Monsanto’s position be maintained, it would have serious implications not only on the issue of patent infringement but also on the question of ownership of the alleged infringing crop. Unlike mechanical patents, genetically engineered seeds are self-replicating and can migrate and spread through cross-pollination. It is doubtful whether any patent policy would be advanced by finding infringement when the source of the infringement is a naturally occurring process. Besides, the defendant whose farm has been contaminated through cross-pollination is in a difficult position. He might not be able, nor should he be compelled, to stop the spread of the patented seed technology onto his farm.

Beyond the question of patent infringement is the larger issue of ownership of the alleged infringing crop before and after the harvest. According to the reported terms of the lease agreement between Monsanto and the farmers, Monsanto retained property rights in the seeds. The question is whether Monsanto retains ownership as the canola seeds were carried across fields into neighboring farms. If Monsanto owns the escaped seeds does it follow that Monsanto also owns the crops that grow from these seeds? It is reported that, as part of the infringement action, Monsanto is asserting property rights over the canola plants and the crop upon harvest. The answer to the question of ownership is neither obvious nor dictated by the logic of the initial ownership of the seeds. The implications of Monsanto’s claims can best be explained by the following hypothetical scenario suggested by the defendant: “What if a farmer has a scrub bull? . . . And his neighbour’s got a herd of purebred registered cows? Through negligence, the bull gets over the fence and impregnates his neighbour’s cows. Now the guy with the scrub bull says those calves are his. The cows too! Same thing eh?”

The defendant’s hypothetical raises the important question of the ownership of the calves contaminated by the scrub bull. The patented Roundup-Ready seed might be seen by some farmers as an inferior product similar to a scrub bull. Such a position might be held by organic farmers who hold genetically modified foods and crops in very low esteem. To them, cross pollination and contamination of their crop would be a total disaster with more widespread implications than the case of the scrub bull. In the case of the scrub bull, the contamination is of the calves, not the high quality cows. The next generation of calves can be controlled for quality by

249. Thiel, supra note 238, at 1.
250. Singer, supra note 241, at 2; Nixon, supra note 221, at 3.
251. Supra note 241.
253. Id.
selecting a high quality purebred bull. However, in the case of cross-pollination, the contamination affects the seed which is the source of future generation of seeds. The farmer cannot hold back any seeds for future use nor can he alter the quality of the seed during the next farming season short of abandoning the contaminated seed. If ownership of the contaminated crop is assigned to the patentee as suggested by Monsanto, that might be viewed as adding insult to injury in that the farmer, in addition to having his farm contaminated, would also lose his crop to the patent holder.

The case might be a lot more complicated if the bull were genetically engineered with very specific designer qualities and characteristics and through the negligence of its owner impregnated the neighbor’s cows thereby transferring the patented genetic qualities and characteristics to the calves. Suppose that there is no contamination as the calves are of higher quality and have a higher market value than ordinary calves. Who would own the calves, the owner of the bull or the owner of the cows? If ownership is denied to the owner of the bull, might the owner of the cows not be unjustly enriched for receiving the value added by the bull without incurring any associated cost? Or, might it not be argued that the calves are the product of cross breeding between the genetically engineered bull and ordinary cows in which case the resulting calves are a different species of calves not the subject of patent protection? One can provide other hypothetical circumstances that would further complicate the question of ownership under similar circumstances. However, that would be unnecessary since the complexities of assigning property rights to self-replicating genetically engineered living matter and organisms have been sufficiently demonstrated.

The discussion above suggests that measured against traditional utilitarian views, the issues raised in the dispute over the escaped seeds demand much more careful analysis of instrumentalist policy objectives. The assignment of any property rights must take into account the potential for the negative impact to be created by holders of such rights. The welfare of society might well demand a different approach to the treatment of the fruits of biotechnology than the urge towards privatizing rights in them.

However, in contradistinction to the case of the escaped seeds, cross-pollination introduces a different set of complex legal issues. Suppose, as the defendant claims, his farm was cross-pollinated by a Roundup-Ready crop. Does the genetic makeup of the defendant’s crop change after the cross-pollination or after the seeds have been formed? This is a scientific fact that can be determined through research. If cross-pollination changes the genetic makeup of the plants, does ownership change at that point or after the seed has been formed? Cross-pollination is a naturally occurring phenomenon and if the patented gene in the Roundup-Ready crop spreads naturally, as it ought to, should the patentee claim ownership of the affected crop? But if the gene can spread naturally, should the patent have been granted in the first place?
The issues of ownership become equally complicated in the case of interbreeding where the patented seeds spread naturally into other varieties without any human intervention. Granting ownership to the patentee would raise significant policy implications. In the first place, interbreeding might be seen as the natural production of something unique, new, unpatented, and therefore not owned by anyone. If the patented organism cannot be controlled or can escape and spread naturally through interbreeding the product should be viewed as part of the commons. Moreover, if ownership is granted to the patentee, a single genetically engineered seed could be used to acquire unprecedented widespread property rights in new breeds of seed neither earned nor clearly sanctioned by patent policy. Thus, a single genetically enhanced seed could be an instrument for the acquisition of monopoly power over all types of seeds including those used in subsistence farming in many parts of the world.

3. Summary

If the central tenet of traditional utilitarian philosophy is that property rights should be assigned in such a way as to promote happiness, that goal is not necessarily attainable in the case of biotechnological inventions. As demonstrated in this section, biotechnology is a complex, multifaceted discipline that generates a variety of significant fundamental ideas in science and technology. Many of the innovations in biotechnology stand to have a tremendous impact on life, living, the quality of life, the ecological balance, and on culture, politics and economics. Given the potential for such widespread impact, the assignment of property rights to promote happiness must then be sensitive to the multi-variate and differential social, political and economic impact. A monolithic policy of assigning property rights to private individuals in ideas that go to life itself threatens the goal of promoting general happiness because private decisions concerning the use, access, and exploitation of property rights in ideas may have objectives other than promoting happiness or general welfare.

Moreover, as demonstrated above, the central focus of biotechnology is not so much the end product as it is the control over the pathways to the end product. Privatizing the pathways to the products of life might not be the best way to promote happiness. Besides, in specific cases privatizing biotechnological inventions present a serious risk to social welfare and happiness. In particular, the assignment of property rights in biotechnological advances in seed breeding deserve special attention. Private ownership of genetically engineered technology for seeds such as the infamous Terminator Seed creates numerous risks to a human society still dependent on food for sustenance. Private ownership might depress and suppress the continued development of centuries of knowledge acquired through traditional seed breeding techniques, create intolerable dependency on a few global producers of seeds, and threaten biodiversity. It is seriously doubtful if a property regime that
presents these risks would, as a general rule, promote happiness and general welfare as envisioned by traditional utilitarian thought.

E. Economic Utilitarianism

Disappointed with the general looseness and measurement difficulties presented by traditional utilitarian theories of property, economists sought to offer a much more rigorous utility-based, instrumentalist conception of property. They argue that property rights are created to serve a variety of concrete societal objectives. In a broader sense, some argue that private ownership of productive resources provide the bedrock foundation upon which the edifice of capitalism is built. Accordingly, the object of private property is the nourishment of capitalism and its supporting ideology.

At a less general and comprehensive level, economic utilitarians view property as an instrument for achieving some concrete societal objectives. The primary function of property, arguably, is the creation of incentives for the efficient use and enjoyment of scarce resources. According to economists, common ownership of property generally imposes a cost on individuals and society with respect to the use and enjoyment of such property. Common ownership creates a disincentive for conservation and efficient use, encourages overaccumulation and hoarding, and leads ultimately to the depletion of common scarce resources; such a phenomenon has been described as "The Tragedy of the Commons." Private property is therefore seen as a solution to this tragedy since it creates an incentive for minimizing the cost and externalities associated with common ownership. Private property rights are also seen as an incentive for the efficient utilization of scarce productive resources. According to Posner, the efficient use of scarce productive resources requires exclusivity and transferability. He argued that if ownership connotes unqualified power to exclude others from a scarce resource that is freely transferable, property rights would maximize value. Value meant the maximum

254. PROPERTY RIGHTS, supra note 9, at 67.

255. It has been recently argued by Lester Thurow that capitalism will not work unless the assignment of property rights are clear. In particular, the protection of ideas lies at the center of the modern knowledge based economies. See BUILDING WEALTH, supra note 1, at 116-19.


257. The tragedy of the commons was first advanced by Garret Hardin to address the problems of over population and the management of scarce resources. Hardin associated common ownership with several ills: over use, waste, no incentive to conserve, and the eventual destruction of common property. For a discussion of the problems of common ownership, see Garret Hardin, The Tragedy of the Commons, 162 SCIENCE 1243 (1968). The problems of common ownership had been raised two years earlier by Demsetz using as an example, the fur trade in North America. Demsetz, supra note 256, at 350-53.

258. Demsetz, supra note 256, at 348; Hardin, supra note 258, at 1245.

259. POSNER, supra note 256, at 32.

260. Id.
price the resource would fetch in an open-market voluntary transaction.\textsuperscript{261} Thus, the ultimate goal of the assignment of such property rights would be the maximization of value. In more specific terms, economists argue that property rights would also encourage allocative efficiencies and distributive equities. The achievement of these goals are conditional on very strict technical conditions of Pareto optimality that will not be pursued here.\textsuperscript{262}

The general incentive justifications for the existence of property rights noted above have been extended to the protection of ideas. Accordingly, it is maintained that protecting ideas as property would create two distinct incentives: the incentive to discover or invent and the incentive to disclose inventions and new ideas.\textsuperscript{263} According to the incentive to invent theory, without some protection given to ideas as property, there would be no incentive to invent or discover new ideas, resulting in the discovery of too few ideas.\textsuperscript{264} To the extent that inventions are freely appropriable by any one not faced with the cost of inventing, competitors and free riders, would be able to copy new inventions and enter the market with underpriced products.\textsuperscript{265} The inventor would be unable to recover the cost of the investment and would certainly be discouraged from repeating that process with another invention. To remedy the situation, a regime of trade secrets would emerge and predominate, making new ideas less accessible and costly to discover.\textsuperscript{266} Moreover, because research and development activity is highly risky and expensive, there would be under investment in the creation of new ideas or investments would be biased towards ideas requiring lower preparatory investments.\textsuperscript{267} Besides, without some guarantee that free riders and competitors can be excluded from new inventions, there would be little incentive for inventions of great social value.\textsuperscript{268}

The incentive to invent justification is not free from controversy. According to critics, the incentive to invent might be undermined if granting property rights in inventions results in monopolies restricting access and new inventions. Moreover, the incentive to invent might distort the very economic efficiency it seeks to achieve by encouraging inefficient allocation of productive resources toward speedy inventions with little social value that would nevertheless facilitate the race to patent office. The potential distortions would include the financial burdens imposed on

\begin{itemize}
\item \textsuperscript{261} Property Rights, supra note 9, at 68; Posner, supra note 256, at 11, 31.
\item \textsuperscript{264} Id. at 115; Posner, supra note 256, at 36.
\item \textsuperscript{265} See Rebecca S. Eisenberg, Patents and the Progress of Science: Exclusive Rights and Experimental Use, 56 U. Ch. L. Rev. 1017, 1025 (1989); Posner, supra note 256, at 36.
\item \textsuperscript{266} Posner, supra note 256, at 36.
\item \textsuperscript{267} Id.
\item \textsuperscript{268} Eisenberg, supra note 265, at 1025.
\end{itemize}
new invention and attempts to invent around existing patents.\textsuperscript{269} These criticisms of the incentive to invent are certainly applicable to the biotechnology industry.

Posner raises a much more basic objection to the creation of property rights in ideas. According to Posner, ideas, unlike tangible objects, have no physical locus and suffer from identification problems. In time, they tend to be diffused, thereby making it difficult to identify the source of specific ideas embodied in products. Assigning rights to any particular individual as the source of an idea found in a product is therefore difficult.\textsuperscript{270} Apart from the illusiveness of ideas, there is some tension between open access to ideas for the advancement of humanity and the idea of exclusivity embodied in the concept of property. As pointed out by Kenneth Dam, that tension has to be resolved by balancing the needs of society against those of the inventor.\textsuperscript{271} A balance between exclusivity and access may require certain limitations and restrictions on property rights in ideas. How the balance is struck is particularly important in the case of biotechnology where the line between basic knowledge and inventions is often thin.

I. Economic Utilitarianism and Property in Biotechnology

As one might expect, economic utilitarian theories of property focus on efficiency as the object and purpose of property rights. However, given the nature, scope and the declared mission of the biotechnology industry, the extent to which economic efficiency should dominate the issue of creating property rights in biotechnological inventions and discoveries is in serious doubt. It may be recalled that the central and directed mission of the biotechnology industry is to decode, understand, and manipulate the basic building blocks of life which have remained unchanged throughout evolution.\textsuperscript{272} This mission raises significant issues of ethics, religion, morality, and policy considerations that go beyond the question of identifying ideas, private ownership, and economic efficiency. For instance, through mimicking nature, scientists have developed techniques of genetic engineering that have resulted in the cloning of animals, transgenic cloning of organs, and the mass production of proteins which play a critical role in the chemistry of life.\textsuperscript{273} Improvements in the science and technology of cloning might eventually lead to the science of cloning or creating human beings afresh. The possession of such technology raises questions beyond economic efficiency.

The implications of biotechnology also go beyond cloning. Genetic manipulation of living organisms at the cellular level provides various opportunities for altering the genetic makeup of any living organism including human beings.

\textsuperscript{269} Id. at 1025-30 (discussing various studies and arguments on the incentive to invent theory).
\textsuperscript{270} POSNER, supra note 256, at 37.
\textsuperscript{271} Dam, supra note 263, at 115.
\textsuperscript{272} Davis, supra note 31, at 314.
\textsuperscript{273} Id.
With this technology it would be possible to design babies with specific intellectual, physical, and other characteristics. The successful mapping of the Human Genome that provides the sequencing of the entire human genome opens another chapter in the study of human biology, medicine and other related subjects. If the past is any indication of the future, one would expect other breakthrough advances resulting from the Human Genome Project. Thus, the biological sciences and biomedical technology hold a great promise for the discovery of the cures to debilitating diseases such as cancer and Alzheimer’s.

The activities mentioned above require significant amounts of risky investment of large amounts of financial and human resources. Legitimate questions are raised about the returns of such investments, if they are to be continued. However, the question is not so much the size of investment nor the nature of the risk as it is a basic philosophical and moral question. The question is whether certain scientific advances might be so important to life, living, and human, social, economic, and political environment that they should be excluded from the regime of private property notwithstanding the significant private investment cost involved. The policy considerations required here are not new; they were confronted by the ancient Romans in their classification of property and continue to influence the choices made by modern societies even today. In that regard, might private ownership of some inventions be denied when such ownership would pose a threat to the social, political, and religious values of society? Consider the discovery of an anti-aging pill. How might the private owner of that technology exploit it and for what purposes? Imagine what the history of the world might have been if such a pill was available in Hitler’s Germany, Stalin’s Soviet Union, Mao’s China, or Titos’ Yugoslavia as private property based on a pharmaceutical invention. While the political and social problems are not solely those of private property rights, they nevertheless would be accentuated by private ownership. Furthermore, take the

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274. See generally Lemonick, supra note 13.  
275. Supra note 128 and accompanying text.  
277. See infra Part III.B.  
278. The race to develop an anti-aging pill seems to have reached a promising stage and the discussion has now shifted to the economic, social and political implications of such a pill. The impact of a successful development of anti aging pill has described as being equivalent to “Big bang explosion” as many things would flow from that. People will live longer, over population will be a real issue and the struggle to stay alive might lead to chaos, or the technology will be controlled by a few people at the expense of all the others. If the technology is not made generally available, it might be exploited to maximize profits that could mean only the affluent markets would be exploited. We already face a situation where proletariat diseases are often not the subject of research and development by pharmaceutical companies. That pattern could be repeated in the case of the marketing of an anti-aging pill. For a discussion of the potential impact of the anti-aging pill, see David Stipp, The Hunt for the Youth Pill, FORTUNE, Oct. 11, 1999, at 199-200.  
279. It is unclear whether the owner of an anti-aging technology would make it available to all nor is it whether governments would not influence its use for political purposes.
The goal of egalitarian access might be achieved through making all lifesaving technologies non-proprietary or acquiring those rights from their private owner under the eminent domain doctrine. Irrespective of the policy instrument used, the judgment would have been made that such technology better serves the interest of society by being non-proprietary.

Biotechnology also presents peculiar difficulties to the economic theories of property. If the goal of the assignment of property rights is to encourage the efficient utilization of scarce resources, the ownership of biotechnological discoveries and inventions might undermine that efficiency objective. As previously noted, the goal of biotechnological inventions is not so much the control over products as it is the control over the pathways to products. The number of pathways to be controlled is almost infinite and if each one is separately owned, certain problems would arise. Take for example the sand on the beach. *If every grain of sand is owned by a different person, the concept of the beach would be in serious jeopardy.* It would be difficult to organize transactions to assemble all the grains of sand to form the beach. Serious problems of hold-up and hold-out might frustrate that effort. To the extent that intransigence and total lack of cooperation serve the subjective needs of some owners, the concept of the beach would remain an abstraction not realizable in reality. Thus, the beach would never exist and whatever benefits the beach could bring to *beach bums* and the rest of society would be lost. Similarly, the ownership of every pathway, every new discovery, and every invention by an infinite number of individuals with the right to exclude all others would not only present serious problems aptly described as “The Tragedy of the Anticommons” but would also undermine the concept of property rights.

The proliferation of owners of an ever-increasing number of strands and pathways of biotechnological inventions can be found in patents granted for anonymous gene fragments, expressed sequence tags (ESTs) and new DNA sequences including gene fragments. The proliferation of property rights can also be found in patents for receptors used in screening potential pharmaceutical products at the preclinical stage. An increase in the number of Research Through Licence

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281. Heller & Eisenberg, *supra* note 1, at 698.
282. The proliferation of patents in gene fragments is alleged to have been instigated by the National Institute of Health when it filed a patent application for 347 gene fragments. Questions were raised about the wisdom of the application and the property rights implications. Currently pending before the U.S. Patent and Trademark Office are applications containing 18,500 sequences. See Dale B. McDonald, Who Owns Nature, FARM INDUSTRY NEWS, Mar. 1, 1999. For an excellent and thorough explanation of the nature, public policy analysis, and suggestions on how ESTs might be treated, see Molly A. Holman & Stephen R. Munzer, Intellectual Property Rights in Genes and Gene Fragments: A Registration Solution for Expressed Sequence Tags, 85 IOWA L. REV. 735 (2000).
Agreements (RTLAs) whereby inventors hold rights in downstream discoveries represent another manifestation of the anticommons phenomenon.\(^{283}\)

The heterogeneity of interests held by an ever-increasing number of inventors in different strands and gene fragments and sequences present the same type of transactional problems raised in the case of different owners of the grains of sand on the beach. Each isolated fragment or gene sequence may have no socially-useful property value, but assembling all necessary pieces would be a daunting bargaining task with significant transaction costs.\(^{284}\) The hold-up and hold-out problem would emerge again and any efficient gains that might have been contemplated by the grant of each individual patent would be frustrated. Thus, the phenomenon of the tragedy of the anticommons suggests that the proliferation of property rights in biotechnology might, in fact, undermine the concept of private ownership. Ironically, a return to common ownership might be more efficient than the private ownership suggested by Hardin in his article, "The Tragedy of the Commons."

The anticommons problem might be addressed with patent pooling and other arrangements designed to facilitate access and use of widely dispersed fragments of patents.\(^ {285}\) However, these techniques still require some voluntary cooperation of owners which cannot always be guaranteed because of the hold-up and other transaction cost problems discussed above.\(^{286}\) The tragedy of the anticommons appears to be a systemic problem and if it is, the solution might lie in an overhaul of the entire system rather than tinkering with it at the margins.

The proliferation of property rights in biotechnological inventions and discoveries poses other problems for society. The social and political institutions of humanity are built on knowledge and the free and unfettered access to ideas that are disseminated at home, in schools, in colleges and within other institutions. Free access to ideas fosters egalitarian principles and democratic values as knowledge tends to bridge the gap between people. Free and unencumbered access to basic ideas in science, literature, mathematics, and other disciplines also plays a significant role in the way in which any society raises, educates, and prepares its young to play the role of useful citizens. The proliferation of property rights in general, and in biotechnology in particular, threatens the attainment of these goals of society. The line between basic ideas that are in the public domain and those considered innovative enough to be owned as property is already very thin and is getting even thinner.\(^{287}\) As more and more marginal innovative ideas become

\(^{283}\) Heller & Eisenberg, supra note 1, at 699; DAM, supra note 17, at 8.

\(^{284}\) Heller & Eisenberg, supra note 1, at 699.

\(^{285}\) Id. at 700.

\(^{286}\) It has been argued by Dam that the anticommons problem is merely a serious possibility which does not warrant as much attention as the risk of insufficient patent protection. See DAM, supra note 17, at 10. However, it is apparent from the discussion in this Article that Hellen and Eisenberg have uncovered a serious problem, the depths of which seems to have been missed Dam's comment. Thus, the solutions (patent pooling, cross-licensing, etc.) suggested by Dam seem more optimistic than the problem might warrant. Id. at 11.

\(^{287}\) See DAM, supra note 17, at 6.
proprietary, an increasing number of ideas that should be in the public domain would be privately owned. With the multiplicity of pathways available in biotechnology, property rights in those pathways, their supporting research data and information would limit access and undermine the educational needs of society. The impact of such denial of access is likely to be severe on academic institutions that thrive on openness. For them, free and unencumbered access to research results, information, and data facilitates the development and deepening of fundamental concepts and the falsification and objectification of new ideas. A regime of property that denies access to such information and data to academic institutions will hamper the intellectual mission of such institutions.

Again, the question is whether the solution lies in a systems reconstruction or in mere tinkering with the system, such as an experimental use exception to patent protection. Dancing around the fire may contain it but does not extinguish it.

2. Summary

It is apparent from our discussion above that biotechnological inventions present significant difficulties in the application of traditional utilitarian theories of property. The idea that property rights might be assigned to achieve happiness is not susceptible to easy application in the case of biotechnological inventions. Even though biotechnological inventions hold incredible promise for the good of humankind, they also present new and unfathomable fears in many segments of society. There is concern that whatever benefits might arise from biotechnology inventions might eventually be destroyed by an irreversible negative impact, not just on humanity but also on the environment and the social and political structure of society. These fears seem to loom so large that one wonders whether the utilitarian goal of happiness is achievable through the assignment of property rights. The discussion above seems to suggest that privatizing the rights in biotechnological inventions should not be undertaken without a careful analysis of the potential negative impact on the goal of happiness.

V. TOWARD A HIERARCHY OF NORMS IN PATENT POLICY

A. Historical Overview of Patent Policy

In 1941, Professor Walton Hamilton of Yale University Law School submitted a monograph report entitled, Patents and Free Enterprise, to the Temporary Economic Committee created by Congress to investigate the concentration of

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288. See id. at 3.
289. Id.
290. See Heller & Eisenberg, supra note 1, at 1018.
economic power.\textsuperscript{291} After a thorough historical analysis of the subject, he concluded that the U.S. patent system had, by 1941, departed from its original mission directed by the Framers of the U.S. Constitution.\textsuperscript{292} Like other institutions burdened with the future in their instructed charge, the patent system necessarily had to adapt to changing circumstances to survive. No patent system could afford to be stuck in the past if it was to serve the evolving needs of the country. Therefore, as Professor Hamilton put it, the quarrel was not with the departure from the instructed path, but rather with the fact that the departure was not guided by any conscious policy.\textsuperscript{293} In response to the tumultuous development and growth of industry, the patent system, in practice, had deviated significantly from the text of the relevant statutes that had remained relatively unchanged over time.

Certain risks are generally associated with significant deviations between the law in practice and its underlining statutory scheme.\textsuperscript{294} The deviation might be indicative of a usurpation of the legislative powers of Congress being manifested in judicial activism. In a Constitutional framework, such as that of the United States, where the separation of powers is well entrenched, the usurpation of the powers of Congress by the judiciary might constitute a serious threat to the checks and balances enshrined in the Constitution by the Framers. The deviation might also suggest the mere employment of creative interpretative techniques designed to avoid absurd results. But creative interpretative techniques employed over a long period of time might suggest an abdication by Congress of its legislative responsibilities. At least, it might be argued that the unresponsiveness of Congress to the evolving needs of the patent system invites judicial activism. A third risk is the erosion of general public respect for statutes. When the law in practice deviates so significantly from the controlling statutory scheme, judges, lawyers, and ordinary people might conclude that statutes do not matter. In all of these cases, the risks created could be minimized if Congress intervened with necessary and timely reformative policies and statutes. Concerned about the impact of a drifting system, Professor Hamilton called for a conscious policy giving the patent system its appropriate place in the national economy.\textsuperscript{295}

Over half a century after the Hamilton report, the U.S. patent system may again be described as dislocated and being “out of sync” with the vibrant and explosive advances in science and technology, particularly in the biotechnology industry. The reasons for the dislocation and the degree of the misfit are both numerous and systemic. First, it appears that the patent system, designed over a century ago, has

\textsuperscript{291} PATENTS AND FREE ENTERPRISE, INVESTIGATION OF CONCENTRATION OF ECONOMIC POWER, TEMPORARY NATIONAL ECONOMIC COMMITTEE (Monograph No. 31 1941) [hereinafter PATENTS AND FREE ENTERPRISE].

\textsuperscript{292} Id. at 145.

\textsuperscript{293} Id.

\textsuperscript{294} See generally PATENTS AND FREE ENTERPRISE, supra note 291 (discussing the different problems that arise with a patent system that deviates from its statutory framework.).

\textsuperscript{295} Id.
been overtaken by the depth and complexity in human ingenuity. The incredible expansion and deepening of knowledge in modern science and technology, especially in biotechnology, has resulted in inventive activities of such variety and complexity that could not have been contemplated by the designers of the old patent system. In particular, the discovery of DNA and the resulting inventive advances in genetic engineering involving living organisms raise several moral, ethical, cultural, religious, and socio-economic issues beyond what could have been contemplated by the policymakers tens of decades earlier. The reasons for the inadequacy of the old patent system have been aptly described by Thurow in the following terms: "Designed more than a hundred years ago to meet the simpler needs of an economy based on natural resources and mechanical devices, our system of intellectual property rights are an undifferentiated one-size-fits-all system." 

Certainly, a system designed for mechanical devices would be most unsuited to the new era of inventions and discoveries involving new life forms, living organisms, gene sequences, intra-species, and transgenic cloning of living organisms including human beings. The fundamental policy issues raised by inventions and discoveries in the biotechnology industry are not only different, but also challenge the core premises of the patent system itself. One might say that trying to fit these new and complex scientific discoveries and inventions within the framework of the old monolithic patent policy is like putting new wine into old bottles. Little wonder then that there has been such an uproar over the patenting of genes, gene sequences, and other biotechnological inventions and discoveries. Besides, a system that was aimed at mechanical devices might still be inadequate even with respect to modern inventions of an inorganic nature. For instance, the nature and pace of advances in computer hardware and software seem to make the old patent system obsolete. The policy and legislative response to the dislocation in the patent system lies not in tinkering with it at the margins but in overhauling its basic framework.

296. Supra notes 21-24 and accompanying text.
297. Supra notes 15-16 and accompanying text.
298. Thurow, Poaching Patents, supra note 195, at 23.
299. Supra note 6 and accompanying text.
300. The objections to biotechnological patents have been broadly based. Some objections are made because biotechnological inventions permit humans to play God, others are centered round issues of human rights and the ban on slavery. For a general discussion of the objections in the U.S., Canada, and the E.U., see Eileen Morin, Of Mice and Men: The Ethics of Patenting Animals, 5 HEALTH L.J. 147 (1997) (providing different types of objections to the patenting of animals, humans, and other biotechnological inventions). Public outcry against biotechnological patents led to the holding of hearings by the U.S. Congress. See Patents and the Constitution: Transgenic Animals: Hearings Before the Sub-Committee on Courts, Civil Liberties and the Administration of Justice of the House Committee on the Judiciary, 100th Congress, 1st Sess. (1998); Sellers, Patenting Non-Natural Occurring Man-made Life: A Practical Look at the Economic, Environmental and Ethical Challenges Facing "Animal Patents", 47 ARK. L. REV. 269 (1994).
301. See generally O.P.M. Files for Bankruptcy Protection, 1981 Facts on File, Apr. 10, 1981 (discussing the inability of a computer leasing company to help keep its clients up to date with the latest computer technology); Stuart Cheifet, All Things Considered, NPR Radio Broadcast, Feb. 12, 1996 (complaining about the rate of obsolescence of computers and software).
A second and equally important reason for the misfit can be found in the policy issues raised by biotechnological inventions and discoveries. Unlike mechanical inventions, genetic engineering involves new life forms, living organisms, cloning, and existence itself and, for that matter, raises a wide range of fundamental questions including those of ethics, morality, theology, culture and economics, to mention a few. Indeed, as discussed in earlier sections of this Article, the existing patent system is terribly unsuited for addressing the new complex issues of patentability and ownership of inventions involving human life forms, intra-species and trans-genic cloning techniques. Neither the policy nor the statutory framework were designed to resolve the significant and fundamental moral, ethical and other concerns generated by biotechnological inventions. It is therefore doubtful whether the designers of the old patent framework ever intended that it be used to support the creation of rights in certain inventions that give inventors potentially awesome “God-like” powers.

Stating that the conditions in biotechnology are screaming for reform would not be an exaggeration—the question is whether Congress will respond. Most observers will agree that a patent system that lacks the structural flexibility necessary for adjustments and distinctions to be made between different categories of inventions is deficient. To remedy such deficiency, Congress might design a new patent system that is sensitive and responsive to the variety of complex and fundamental policy issues presented by the inventions in biotechnology.

Third, it should be noted that the systemic problem discussed so far is not in any way limited to biological life sciences; it also extends to other life sciences and living organisms other than mammals. The significance of the fundamental ethical, moral and other policy considerations discussed above are not lessened by the fact that the inventions concerned involve genetically modified seeds, foods, or plants. Such inventions not only hold an uncertain promise but also present certain risks to the concentration of economic power and to the destruction of the sources of knowledge and ideas developed and maintained for thousands of years. The interest of society in the development and maintenance of human knowledge might be undermined when the patent system permits or encourages the acquisition and maintenance of rights in ideas that would produce the risk of such drastic consequences.\textsuperscript{302} Thus, even in the case of genetically modified organisms, the patent system needs to be transformed to meet the needs of society outlined above.

Finally, other manifestations of the unresponsiveness of the patent system to the new and evolving inventive activities can be found in the imbalance between the right of exclusion and the access of the general public to new ideas. The proliferation of property rights in ideas described by Heller and Eisenberg as \textit{anticommons} pose significant problems for access to even basic ideas.\textsuperscript{303} We have

\textsuperscript{302} Supra notes 221-53 and accompanying text (discussing the potential impact of the Terminator Seed technology and Roundup Ready canola seed dispute between Monsanto and the Canadian farmer).

\textsuperscript{303} Heller & Eisenberg, \textit{supra} note 1, at 698.
referred to such a pattern of ownership as akin to private ownership of the grains of sand on the beach by countless individuals. A patent policy that permits such a result probably undermines more than it supports the concept of property in ideas. The reason for such a subversive outcome may lie, in part, in the reliance on an old and outmoded balancing of interests system.

Policies constructed for a world of mechanical devices and simple inventions do not raise the same issues of access as do inventions that are intertwined with basic knowledge or that implicate life, existence, and survival. As maintained by Dam, the line between basic research and applied research is thin.\textsuperscript{304} As an increasing number of basic ideas enter the private property regime, the domain of public property in ideas will continually shrink. It is generally maintained that there is some tension between the notion of access to ideas and the incentive to invent.\textsuperscript{305} Patent policies designed to strike a balance between these two competing interests decades ago would not necessarily fit the policy choices of today. The nature and impact of biotechnological inventions and discoveries are different from those relating to the invention of the combustion engine and other mechanical devices. To ensure that the effects of the anticommons phenomenon are minimized and to create a better balance between the incentive to invent and the public right to access ideas, a new patent policy is necessary.

\textbf{B. Survey of Current Patent Policy}

Any revision of the patent policy must start with the unimpeachable authority of Congress granted by the Constitution. Seldom is the delegation of powers to Congress by the Constitution so explicitly and briefly stated and the exercise of those powers so directly instructed as those relating to the promotion of science and the useful arts. In Article I of the U.S. Constitution, the Framers stated very briefly that “Congress shall have the power to promote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.”\textsuperscript{306} The exact contours of the delegated powers cannot easily be ascertained outside the words used by the Framers. For, all the critical terms and phrases were undefined, and any attempt to discover their meaning from supplementary sources and debates at the Constitutional Convention would be unrewarding. The clause was adopted without struggle, formal debate, or opposing pamphlets from which one could deduce the intent of the Framers.\textsuperscript{307}

Notwithstanding the absence of definitions, it is believed that the power granted to Congress to promote science and the useful arts was sufficiently explicit and

\textsuperscript{304} Dam, supra note 17.
\textsuperscript{305} POSNER, supra note 256, Eisenberg, supra note 265.
\textsuperscript{306} U.S. CONST. art. I, § 8, cl. 8.
\textsuperscript{307} PATENT AND FREE ENTERPRISE, supra note 291.
broad\textsuperscript{308} to meet the needs of an evolving society. The question therefore is how that power might be exercised in the case of biotechnology. First, it must be noted that the Framers did not command Congress to promote science or the useful arts; nor did they decree that Congress cannot discourage or prohibit specific scientific investigations or advances. The Framers merely empowered Congress to promote science if, in its infinite wisdom, Congress chose to do so. Second, in the event that Congress chose to exercise its powers under this clause it had to promote science and the useful arts in the manner prescribed by the Constitution for the ultimate benefit of society. Third, the grant of powers allows Congress to grant patent protection or to provide some other form of limited duration exclusive rights to inventors. However, it does not forbid Congress from decreeing a bounty, purchasing inventions, or contriving some other arrangement.\textsuperscript{309} The policy options available to Congress for addressing the complex issues raised by the biotechnology inventions are therefore many. How Congress exercises those choices would require a careful analysis of the issues raised in this Article.

However, the policy choices of Congress in dealing with the biotechnology explosion are further complicated by the specific instructions of the Framers to \textit{promote} science and the useful arts. The term "promote" suggests that the objectives of Congress, in a general sense, had to be directed at encouraging the advancement of science and the useful arts; but does it also demand that the results of scientific investigation encouraged be positive? Has Congress properly exercised its powers to promote science if the results would have a significant negative impact on society or the environment but the invention itself opens up new possibilities? Is it consistent with the Constitutional directive to promote science for the ultimate good of society if the patent system protects scientific discoveries that create monopolies in areas of vital importance to human existence, or pose a serious threat to the ecology or the human social, economic and political society as we know it? Should the advance in science take precedence over the survival of society and its value system? All of these questions are relevant in the determination of patentable subject matter in biotechnology.

One of the first policy considerations to be undertaken by Congress is the issue of the patentability of biotechnological inventions. As noted throughout this Article, biotechnology raises fundamental questions of morality, theology, politics and economics and on how human society is organized. Creating exclusive rights in discoveries and inventions involving the human body, in new life forms, and in the technology for cloning living organisms within or across species, raises innumerable questions of policy. Also, according property protection to ideas on the transgenic manipulation of life forms, seeds, and plants and, in particular, in the entire human

\textsuperscript{308} Diamond v. Chakrabarty, 447 U.S. 303, 307 (1980) (Court noted that grant of power to Congress by the Constitution to legislate was broad).

\textsuperscript{309} PATENTS AND FREE ENTERPRISE, supra note 291.
gene sequence recently successfully mapped, further raises issues that cannot be
adequately addressed by the existing general patent policy.

The need for a systemic transformation of the criteria for patentability was
raised before the U.S. Supreme Court in the case of Diamond v. Chakrabarty.\(^{310}\) In
Chakrabarty, the Court was asked to determine whether human-made genetically
engineered bacterium and micro-organisms were patentable under section 101 of the
U.S. patent statute. Many objections to the patent were raised and the Court
summarized them in these words:

To buttress his argument, the petitioner, with the support of amicus, points
to grave risks that may be generated by research endeavors such as
respondent's. The briefs present a gruesome parade of horribles. Scientists,
among them Nobel laureates, are quoted suggesting that genetic research
may pose a serious threat to the human race, or, at the very least, that the
dangers are far too substantial to permit such research to proceed apace at
this time. We are told that genetic research and related technological
developments may spread pollution and disease, that it may result in a loss
of genetic diversity, and that its practice may tend to depreciate the value
of human life. These arguments are forcefully, even passionately, presented;
they remind us that, at times, human ingenuity seems unable to control fully
the forces it creates—that with Hamlet, it is sometimes better "to bear those
ills we have than fly to others that we know not of."\(^{311}\)

Notwithstanding the gruesome parade of horribles, the Court limited itself to the
narrow task of constructing section 101 of the patent statute passed by Congress in
exercise of the powers granted it under the Constitution. Its interpretive exercise
was, however, to be guided not by the wisdom, or lack thereof, of the statute at
hand, but rather by what Congress meant by the words it used in section 101.\(^{312}\) The
Court found the language of section 101 to be broad enough to cover the
patentability of genetically engineered bacterium and micro-organisms.

In coming to the conclusion that micro-organisms and genetically engineered
bacteria were patentable, the Court was mindful of the concerns raised by the
opponents to the patent. It, however, saw the issue as one relating to the competence
of the Court to develop the criteria of patentability. It remarked:

What is more important is that we are without competence to entertain these
arguments—either to brush them aside as fantasies generated by fear of the
unknown, or to act on them. The choice we are urged to make is a matter of
high policy for resolution within the legislative process after the kind of

\(^{310}\) 447 U.S. 303 (1980).
\(^{311}\) Id. at 316.
\(^{312}\) Id. at 318.
investigation, examination, and study that legislative bodies can provide and courts cannot. That process involves the balancing of competing values and interests, which in our democratic system is the business of elected representatives. Whatever their validity, the contentions now pressed on us should be addressed to the political branches of the Government, the Congress and the Executive, and not to the courts.313

Given the Constitutional delegation of powers to the Congress on this matter, the Court was probably right in its conclusion that any change in the nature or scope of patentable subject matter lies within the province of the legislative branch of government and not the Court. How then might Congress approach its task of constructing a new patent regime for biotechnology?

C. Hierarchy of Norms for Patentability

Any attempt to construct a new regime for biotechnological inventions must proceed from the lessons taught to us from history about the nature, classification, and policy justifications for property. That history teaches that property rights have always been less than absolute, a bundle of different coexisting rights, and capable of accommodating various interests simultaneously. We also learn from history that certain things were excluded from the property regime not because they could not be subjected to the control and dominion of people, but because they played such a vital role to human life and the social, economic and political organization of society. History also teaches that the concept of property has always been driven by instrumentalist objectives. Property is an instrument for achieving certain goals of society. So what is included or excluded from the property regime is generally controlled by the goals of society at hand. In addition, any search for a new regime for biotechnology must take into account the application of the broader concept of property to ideas. It must also confront the fundamental issues of morality, ethics, religion, and other socio-economic and cultural considerations implicated by inventions involving life forms, living organisms, and the potential for creating human life de novo. To address all of the relevant issues, the following hierarchy of norms, as presented in Figure 2, presents a guide for developing a patent policy that is responsive to the complexities of the biotechnology industry.

313. Id. at 317 (emphasis added).
1. **Norm 1: That Which Cannot Be Owned Is Not Patentable**

The first norm presents the broadest and most inclusive patent policy that could be adopted because it defines the limits of patentable subject matter against the backdrop of the limits of property rights. It confronts the issue of whether certain ideas might be excluded from the property regime and must not be the subject of legislation to the contrary. Thus, even if the legislative powers of Congress are not so specifically limited by the Constitution, Congress might nevertheless refrain from putting specific categories of ideas inside the property regime. It may be recalled that the Constitution of the United States is not mandatory, but merely hortatory or permissive in the protection of ideas. In other words, Congress might adopt a policy that certain ideas, inventions, and discoveries are of such a nature that they cannot be the subject of private ownership and, on that account, are not patentable. Under this norm, the exclusion of an idea from the property regime has much more severe implications than is usually associated with non-patentability. Ideas, inventions and discoveries excluded from the property regime would also be excluded from the regime of trade secrets. In other words, *that which cannot be owned cannot be the subject of an enforceable secrecy agreement.* Thus, biotechnological inventions that cannot be the subject of property rights will always be in the public domain for the benefit of humanity.
Obviously, this norm puts a premium on total and unimpeded access to certain ideas in whatever form they come. One may then ask: what is it about these ideas that they must be excluded from the regime of private property? Such ideas or inventions may be critical to human existence, form part of the general patrimony of humanity, or are the source of basic knowledge for all societies. Congress may also consider such ideas as serving some fundamental societal interest that would be undermined by private ownership. To facilitate the adoption and implementation of this norm, Congress would develop a positive list of inventions and discoveries that can neither be owned nor patented. Such a list might include the discovery of certain basic ideas in science and mathematics including the functioning of nature and its genetic structure. Discoveries and inventions on the human body, including gene sequences, such as the human genome sequence would also fall into this category. In addition, inventions and discoveries that go to the very existence of humanity, human life forms, and living organisms would qualify for exclusion from the property regime and patentability. Furthermore, techniques for the cloning of life forms including human life and genetic manipulation of seeds and seed breeding would also be candidates for exclusion from ownership and patentability.

The primary focus of this norm is not the regulation of research and scientific investigation. Nonetheless, Congress might consider the possibility of creating a category of inventive activities that could be excluded from scientific investigation or experimentation. One such category might be the cloning of human beings or the creation of human life forms de novo. A policy that positively and deliberately restricts the acquisition of knowledge in any field is a serious limitation on the intellectual growth of humanity and therefore should not even be contemplated unless the actual threat to society is obvious and serious. Even when the conditions demand restrictive measures, those measures can only be adopted after a careful balancing of the risks and benefits. Congress might conclude that the risks associated with cloning or creating human beings, on balance, outweigh any benefits that can be generated. For instance, the inventor would acquire the attributes of “God” with awesome powers. Not only might such inventions and discoveries dislocate the entire human belief system, but it might also pose a threat to the very existence of human social, economic, and political organization. Perhaps human social and political organizations need transformation, but it is uncertain whether such a transformation can take place smoothly without some human belief system. Besides, one is not sure of how a human “Inventor God” might exercise the power that comes with the ability to create human life form.

In conclusion, because the policy and legislative agenda contemplated by this norm raises several significant issues and suggest new pathways, it demands national debate and Congressional hearings before implementation. A national

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314. The debate that has erupted regarding cloning suggests that it might be an example of the kind of activities that could be controlled.
discourse over the type and nature of ideas that must be excluded from the property regime and patent system would invite views from, and debate among, different interested groups. A Congressional hearing would present a forum where the full implications of the policy will be discussed. In such debates, or hearings, the views of experts and interest groups will inform the process and enrich the outcome. Should Congress adopt this approach, we might start to bring some coherence and clarity to policy and legislation on the issue of intellectual property.

2. **Norm 2: That Which Can Be Owned May Nevertheless Not Be Patentable**

The focus of the second norm is to define, in a broad sense, ideas that can be the subject matter of private property. The operating general premise of this is that an idea that can be owned may also be the subject matter of an enforceable secrecy agreement and patent protection. However, specific inventions and discoveries may be put in the public domain based on a deliberate policy to achieve certain objectives. Under this norm, inventive ideas and discoveries can be put into the public domain in one of two ways: (1) through specific exclusion, or (2) through patentability criteria. We shall examine these categories below.

a. **Specific Exclusion**

In the case of specific exclusion, certain inventions and discoveries might be specifically excluded from the patent regime for various reasons. The inventions in question may serve some positive societal objectives or that they pose a significant risk of negative impact on society. The inventions may also be excluded because they hold an incalculable and uncertain promise of social, economic, and cultural dislocation. Whether the impetus for the exclusion is the positive or negative impact of the invention in question, achieving different important policy objectives might be the goal.

The policy objective might be to make such inventive ideas available to all because of the importance of inventions or discoveries to society, or because Congress believes that exclusive rights in them might lead to undesirable monopolies. Any discovery of the cure to cancer and Alzheimer’s disease could be proprietary. However, the importance of such a discovery to human health and the goal of democratic societies to foster egalitarian access to the best cures for the worst diseases might lead to their exclusion from patentability. The development of new techniques in medical treatment including genetically engineered processes such as gene-therapy and the cloning of organs might also fall into this category.

315. THUROW, BUILDING WEALTH, supra note 1.

316. Cloning of organs is a controversial subject and may well be regulated by other legislative processes other than through the patent system.
The development of certain new seeds, plants, and animal varieties, to the extent they are not covered by Norm 1, might also be excluded from the patent regime based on a policy judgment that they would best serve society in the public domain rather than in the hands of private owners.

On the other hand, the use of the norm might be guided by the potential negative impact of an invention or discovery on society or the environment. Such a policy approach might be driven by fear and the parade of horribles alluded to by the U.S. Supreme Court in the Chakrabarty case. If an invention has a known or an uncertain negative impact on life, living, nature, or the ecological balance that has evolved over millions of years, Congress might take the view that it should not be actively encouraged with a reward of exclusive rights even if it is for a limited duration. Of course, the fears might be unwarranted after the fact, but policy makers might feel that an overly protective policy is better in the case of uncertainty because it is always better to be safe than to be sorry.

A policy of specific exclusion of certain inventions from the patent regime permits Congress to encourage controversial research while retaining ultimate control over the issue of access and use of the results. A research activity may have the potential of producing patentable results with multiple uses or applications. Some of these uses and applications may pose certain unacceptable risks and others may have beneficial impacts on society. Instead of prohibiting the scientific investigation as discussed under Norm 1, Congress might encourage the research activity but limit patentability to certain applications but not to others. Take the case of the technology for mass destruction; a policy could be adopted to outlaw its development. However, the policy choice might not be that clear in the case of the development of robotic fighting human machines with organic computer brain power similar to that of humans. The robots might have vision, the ability to communicate, take and give orders, and engage in tactical and strategic maneuvers. The technology itself may have other useful purposes. Intelligent robots might be used in space exploration, to manage and control nuclear accidents and waste cleanup, fight fires, engage deep sea exploration or rescue, or other activities too dangerous for human beings. However, the technology could also be used for other more controversial purposes. Its use to create a robotic fighting machine might lead to the creation of a robotic army with human characteristics, and that would be no laughing matter for any society. Because of the risks that might be posed by such a technology, Congress might choose to regulate its use rather than prohibit the investigation of the scientific basis for it.

Finally, there is the question of inventions currently protected by the patent regime which nevertheless would have qualified for exclusion from the patent regime under this norm either because they would better serve the interest of society in the public domain or because they, after the fact, pose some unacceptable risk to

society. With respect to inventions that prove to be not useful to society, the patents might be revoked under the utility doctrine or the patents be might subject to eminent domain or inverse condemnation.\(^{318}\) In the case of inventions that would better serve society in the public domain, the government could exercise its eminent domain powers to acquire such inventions and put in the public domain.\(^{319}\) However, there might be some inventions that would fall into the category of things that are not patentable because they could not be owned under Norm 1 above. For those inventions, in addition to the concepts of inverse condemnation or eminent domain, it might be useful to consider the use of the public trust doctrine to revoke any private ownership rights that the patent regime might have created.\(^{320}\)

\textit{b. Exclusion Through Patentability Criteria}

Patent regimes are generally governed by a system of patentability criteria which, to a large extent, control the subject matter of patents. Patentability criteria define the nature and scope of what is and what is not patentable. Where, however, the inventive activities are dynamic and constantly evolving, the patentability criteria may easily become obsolete and not responsive to new inventions. Such is the case of the biotechnology industry.

As mentioned above, the current U.S. patent regime was designed substantially for a simpler economy dominated by inventive activities dealing with mechanical and simpler devices.\(^{321}\) It was not designed to provide adequate guidance, if any, to discoveries and inventions dealing with living organisms, new life forms, genetic

\[^{318}\text{See generally KLK Inc. v. U.S. Dep't of the Interior, 35 F.3d 454 (1994) (stating that "Inverse Condemnation is a shorthand description of the manner in which a landowner recovers just compensation for a taking of his property when condemnation proceedings have not been instituted."); Grant, A Revolutionary Vie of the Seventh Amendment and the Just Compensation Clause, 91 Nw. U. L. REV. 144, 191-205 (1996).}\]

\[^{319}\text{See generally In re Ohio Turnpike Comm'n, 131 N.E. 2d 397 (1955) (defining eminent domain as the power of the sovereign to take without the owner's consent for public use); Wescott v. State Highway Comm'n, 138 S.E. 2d 133 (1964); Rose v. State, 123 P.2d 505 (1942) (claiming that the eminent domain power is a fundamental power of sovereigns founded on the law of necessity); Tomasek v. State, 248 P.2d 703 (1952); State ex rel. Eastvold v. Superior court of State, 269 P.2d 560; Grover Irrigation and Land Co. v. Lovell Ditch, 131 P.43; Joseph L. Sax, Takings and the Police Power, 74 YALE L.J. 36 (1964) (discussing federal takings jurisprudence).}\]

\[^{320}\text{The basic argument of this article is not based on the public trust doctrine nor is it developed on that principle. To do so would have required a thorough and careful analysis of the concept to determine its limits and degree of applicability. The argument of this article is differently and independently premised. However, the public trust doctrine might provide another instrument for addressing the power of the state to create property rights in biotechnological inventions. For a discussion of the public trust doctrine, see Virginia Matthews v. Stanley C. Van Ness, 471 A. 2d 355 (1984) (where the court described the concept of the public trust doctrine as imposing some limits on the power of the sovereign over certain types of property rights and derivatively creating rights for the general public over private property acquired from the sovereign. The court traced the origins of the concept to Roman law which put certain things out of the reach of private ownership based on natural law); for a seminal article discussing the nature, origins, and scope of the public trust doctrine as applied in the natural resource arena, see Joseph L. Sax, The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention, 63 MICH. L. REV. 471 (1970).}\]

\[^{321}\text{THUROW, supra note 1, at ch. 6.}\]
engineering, and all the other activities that the biotechnology industry has become so accustomed to lately. Subjecting the inventive activities of the new industry to the old rules of patentability is what we described above as putting new wine into old bottles. To the extent that the old patentability criteria do not contain sufficient built-in flexibility with checks and balances governing the range of ideas that should be included or excluded from the patent system, a reform is imperative. A manifestation of the need for reform and the degree of disconnect between the patentability criteria and the needs of the biotechnology industry may be gleaned from the U.S. Supreme Court decision in the Chakrabarty case. 322 The Court pointed out that there might well be cause for adopting new patentability criteria in the case of biotechnological inventions but concluded that it was the task for Congress. 323 And the facilitation of that task is what this section is aimed at.

There are several goals and objectives that Congress might seek to achieve in any redefinition of patentability criteria. First, there is a need to draw a brighter line between basic research and applied research. It is claimed that in biotechnology research, scientists are merely mimicking nature and not necessarily inventing anything new. 324 Accordingly, genetic engineering is seen as the mere application of what nature has taught to us. The goal of Congress would be to resolve this debate by adopting patentability criteria that are informed by the current state of scientific knowledge.

A second goal of Congress would be to address the questions raised about the desirability and practice of patenting information, data, and research results generated during biotechnological innovation. Redefining the criteria for patentability would also permit Congress to address the issue of access of the general public to basic scientific knowledge, ideas, information, and data. The adoption of new patentability also permits Congress to confront the problem of the proliferation of patents that, individually, are not socially useful but create the anticommons phenomenon. 325 Moreover, one of the major threats to scientific research in universities and other research institutions can be addressed in the new patentability criteria. As pointed out by Dam, the idea that research results, data, and information can be patented poses serious problems for academic institutions that rely on the free flow of information to carry out the mission of teaching, falsifying new ideas and expanding basic and fundamental ideas upon which inventors rely. While Eisenberg has argued for an experimental use exception, addressing the problem at the systemic level would provide a better solution. 326

Finally, it should be noted that redefining the criteria for patentability might not seem that radical, but it has the potential for a significant negative impact on the

323. Id. at 317.
324. Davis, supra note 31, at 308.
325. Heller & Eisenberg, supra note 1.
326. Eisenberg, supra note 265.
proliferation of new forms of patents that seem to threaten the ability of economic agents to act in a free enterprise system. The current patent system permits the patenting of various new information formats that results in a concrete tangible result. If this process continues, the proliferation of patents could cripple the very system it was designed to promote. New patentability criteria could set limits that remove the risk of anticommons or the phenomenon of every grain of sand on the beach being individually owned.

However, redefining the nature and scope of patentable subject matter might be an inadequate approach to the explosion and major advances in the biotechnology industry. Like the European Union, Congress might develop a new patent system uniquely tailored to the needs of the biotechnology industry. An industry specific policy would provide the basic essential structure consistent with the major advances in that industry and its peculiar needs. A biotechnology patent system would also facilitate the policy choices advocated above and permit Congress to avoid the problems associated with the current one-size-fits-all policy.

3. **Norm 3: That Which Is Patentable May Nevertheless Not Be Patented on the Grounds of Morality or Public Policy**

The policy framework set out above permits Congress to develop different legislative responses to many categories of the fundamental policy issues raised by biotechnological inventions. While many of those issues relate to ethics, morality, and fundamental public policy, the suggested choices presuppose some prior knowledge of the nature, scope, and potential impact of future biotechnological inventions on society. However, no legislature or policy maker can have full knowledge of the nature and potential impact of all future inventions. Therefore, notwithstanding all attempts to control the patenting of biotechnological inventions to minimize any negative effects on society, some future inventions might nevertheless pose substantial risk to basic morals, ethics, and fundamental public policy. Norm 3 is designed to give patent policy and legislation some flexibility and ultimate control over what is patented. Thus, even when such inventions might satisfy all the technical requirements of patentability, the patent could still be denied on the grounds of morality or public policy. A public policy exception to patents in general, and to biotechnological patents in particular, would allow the Patent and Trademark Office to reject patents for inventions that not only offend morality and public policy but also would undermine the policies behind any of the prohibited categories discussed above.

327. See State Street Bank & Trust Co. v. Signature Financial Group Inc., 149 F.3d 1368 (Fed Cir. 1998) (holding that data can be patentable subject matter as long as they can produce useful, concrete, and tangible results); AT&T Corp. v. Excel Communications, Inc. 172 F.3d 1352 (Fed Cir. 1999) (applying the State Street process claim rationale to mathematical algorithm to produce a useful, concrete and tangible results without preempting other uses).
a. Historical Overview of Public Policy

The public policy exception to patents is not a new phenomenon in the world. It is claimed to have existed in the Statute of Monopolies of 1623 in the United Kingdom. This seventeenth century policy appears to have found expression in many modern patent systems which explicitly provide for a morality or public policy exception to patents. An example of a modern patent system that contains the public policy exception is the European Patent Convention (EPC). Article 53(a) of the EPC does not permit the granting of a patent if the publication or exploitation of the invention would be contrary to “ordre public” or morality. Similarly, the United Kingdom Patent Act of 1977 provides that a patent shall not be granted if the publication or exploitation of the invention would be generally expected to encourage offensive, immoral, or antisocial behavior. The United Kingdom statute appears to have adopted language similar to that of the EPC so as to comply with and give effect to the EPC. The public policy exception is also captured in the European Directive on the Legal Protection of Biotechnological Inventions (Biotechnology Directive). Under Article 6 of the Biotechnology Directive, “[i]nventions shall be considered unpatentable where their commercial exploitation would be contrary to ordre public or morality.” It is obvious that there are similarities and differences in the language used in all three instruments. Both the EPC and the United Kingdom Patent Act seem to focus on the publication and exploitation as separate and distinct sources of offending conduct. As such, they seem to provide a broader public policy exception than does the Biotechnology Directive. The former takes the view that the mere publication of an invention might offend some moral code or public policy even if the invention is not exploited. The Biotechnology Directive, on the other hand, seems only concerned with the commercial exploitation as the source of offending conduct. Note however, that commercial exploitation is more limited than exploitation in general, since all exploitations need not be commercial. Combining this limitation with the exclusion

328. See Peter Drahos, Biotechnology Patents, Markets and Morality, 21 EUR. INTELL. PROP. REV. 441 (1999).
330. Id. Article 53 of the Convention states that European patents shall not be granted in respect of:
“(a) Inventions the publication or exploitation of which would be contrary to ‘ordre public’ or morality, provided that the exploitation shall not be deemed to be so contrary merely because it is prohibited by law or regulation in some or all the Contracting States;” (emphasis added).
331. Patents Act, 1977, ch. 37 § 1 (Eng.)
333. Id. Article 6 (1) of the Biotechnology Directive fully states: “Inventions shall be considered unpatentable where their commercial exploitation would be contrary to ordre public or morality; however, exploitations shall not be deemed to be so contrary merely because it is prohibited by law or regulation.” Id.
of the publication exception makes the Biotechnology Directive much more limited than the EPC and the United Kingdom Patent Act.

Arguably the Biotechnology Directive excluded publication because the drafters did not see any morality or public policy issues raised by the mere publication of biotechnological inventions. However, the difference in language between the Biotechnology Directive and the other instruments might have been induced by the desire of the European Union to comply with its obligations under the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs). As a general matter, what practical impact the differences in language would have on a patent system that must seek and maintain consistency between national patent regimes, the ECP, and the Biotechnological Directive is yet uncertain.

There is even a broader acceptance of the public policy exception to patents in the TRIPs Agreement adopted in 1994. Article 27 (2) of TRIPs permits member states to exclude an invention from patentability if doing so is “necessary to protect ordre public or morality.” Article 27(2) states as follows:

Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect ordre public or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law.

The acceptance of the public policy or morality exception under TRIPs by its member states signifies the endorsement of that principle by a large number of states albeit in a limited form. Since TRIPs is only enabling, any perceived limitations

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334. Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization Annex IC, LAW & PRACTICE OF THE WORLD TRADE ORGANIZATION 383 (Joseph F. Dennih, ed., 2000) [hereinafter TRIPs]. Since the Biotechnology Directive came after the entering force of TRIPs, it is only logical that the directive would have tried to comply with TRIPs. TRIPs does not compel the use of the public policy exception. It only requires that the exception be used in a certain way if a member decides to adopt it.

335. The problems that may arise from the differences in the language may be complicated further by the way in which various patent authorities interpret the public policy exception. See Amanda Warren, A Mouse in Sheep’s Clothing: The Challenge to the Patent Morality Criterion Posed by “Dolly”, 20 EUR. INTELL. PROP. REV., 445 (1998) (discussing the difficulties presented in achieving uniformity and consistency in the use of the public policy and morality exception when different tests are employed by patent authorities); see also Margaret Llewelyn, The Legal Protection of Biotechnological Inventions: An Alternative Approach, 19 EUR. INTELL. PROP. REV. 115, 121-23 (1997) (comparing the morality and public policy exception under the EPC and the Draft Biotechnological Directive); Sigrid Sterckx, Some Ethically Problematic Aspects of the Proposal for a Directive on the Legal Protection of Biotechnological Inventions, 20 EUR. INTELL. PROP. REV. 123 (1998) (commenting on the ethical issues raised in the first draft of the Biotechnological Directive with respect to the human body, genes, gene sequences, etc.).

336. TRIPs, supra note 334, at 398.

337. Id.
suggested by the use of the term *commercial exploitation* as opposed to *publication and exploitation* might be handled, in good faith, by signatory states through their domestic legislation. It is important to note, however, that Article 27(2) opens the door for the development of the public policy concept internationally.

*b. Public Policy in United States*

Unlike the United Kingdom or the European Union, the United States patent statute does not contain an explicit public policy exception. However, the public policy exception is not foreign to U.S. patent law. In the 1817 case of *Lowell v. Lewis*,338 Justice Story was called upon to decide whether a patent was invalid under the Patent Act of 1793 for not being a “useful invention.”339 In view of the fact that the statute contained no explicit public policy exception, the issue was raised in terms of the usefulness of the invention. Relying on the “utility” concept, Justice Story held that a patent would be invalid if it was “frivolous or injurious to the well-being, good policy, or sound morals of society.”340 In spite of the generality and seeming timelessness of the language used by Justice Story, it is doubtful whether a public policy exception extracted from a statute lacking specific statutory mandate over 150 years ago should control issues of patentability today.341 Certainly the moral compass of Eighteenth century United States has experienced significant shifts between the 1793 Patent Statute and the current 1952 Patent Act. Within that time period, the atom was split giving impetus to the development of the atomic bomb; the theory of relativity was discovered; the technology for transportation went from horse and buggy to jet airlines; and penicillin was discovered, just to mention a few. The moral and ethical issues raised by these monumental scientific and technological advances were certainly different from those that existed in the early days of the Republic. The moral and ethical issues have, since 1952, been further complicated by the discovery of DNA and the resulting explosion in the advances in biotechnological research. How then could Justice Story’s formulation be controlling today without some adjustment? The need for an explicit public policy exception is further demonstrated of the decision by the U.S. Supreme Court in *Diamond v. Chakrabarty*342 that genetically engineered bacteria and microorganisms are patentable343 and the proliferation of biotechnological patents that followed.

In 1998, the U.S. PTO sought to address the issue of the public policy exception in a press release. Allegedly, the PTO received a patent application for a technique

338. 15 F. Cas. 1018 (C.C. Mass. 1817) (No. 8, 568).
340. 15 F. Cas. at 1019.
341. THUROW, supra note 1, at 120.
343. Id. at 318.
that combines human and animal embryo to produce a single animal-human embryo or "chimera." Apparently, the patent was filed by a cellular biologist to instigate a public debate over the appropriateness of patenting genetically engineered biological life forms and genetic components. Confronted with the general public outcry against genetic engineering and the publicity generated by the animal-human embryo patent application, the PTO felt obliged to respond. It issued a press release in which it suggested that a patent might be denied on public policy grounds under the Lowell v. Lewis decision. To achieve its objectives, the PTO indicated that it would review patent applications with an eye toward seeking compliance with the strict patentability requirements contained in the patent statute, including the requirement that inventions have "utility."

Apparent from the actions of the PTO, there is a definite need for a much more deliberate and explicit policy for rejecting patent applications when inventions offend basic morality or fundamental public policy. The practice of extracting the public policy exception from the interpretation of the concept of "utility," while perhaps necessary, is an inadequate response to a major policy need. The concept of utility does not naturally or necessarily conjure up issues of morality or public policy in its use. Any reliance on it is likely to be strained, and can only provide a temporary solution to a serious and growing problem. It is therefore time for the U.S. Congress to address the need for the public policy exception with a new biotechnology patent regime that is sensitive to the interests and concerns discussed in this Article. Should Congress undertake to provide for an explicit public policy exception to patents, it could benefit from the experience of other countries that have addressed this issue in their domestic legislation. The difficulties and concerns emanating from the explosion of the biotechnology industry are not confined to single nations; they are of a universal character. National solutions and approaches to the public policy exception would be most effective if there is collaboration among nations on this issue.

c. Defining and Adopting the Public Policy Exception

However, adopting the public policy exception to patents is not without difficulties. As a concept, public policy is "vague, nebulous, intractable, and lacks meaningful and consistent contours that can guide its definition and application. Like a chameleon, it seems to be seriously influenced by its environment,

344. See Thomas A. Magnani, Biotechnology and Medical Devices: Patenting Lifeforms: Chimeras: The Patentability of Human Animal Chimeras, 14 BERKELEY TECH. L.J. 443 (1999) (describing the nature of chimera inventions, and the legal, moral, and policy concerns raised by such patents); see also Jehanne Henry, Biotech's Bad Boy, CALIFORNIA LAWYER, Nov. 1999, at 53 (discussing the work of an activists lawyer representing the interest of those opposed to biotechnological inventions and in this case confronting the patentability of the human-animal chimera and legal issues raised by Dr. Newman’s application).
346. Id.
surrounding circumstances, and the purposes for its use... It is like the ghost of Banquo which slips in when least expected.347 In short, public policy provides a standard that is not only variable with purpose, but also within time and culture.348 The experience of patent systems that have adopted the public policy exception suggests that determining the nature, content, and scope of the concept is both a difficult and universal task for all. Any attempt by Congress to adopt the public policy could benefit from a study of the experience of other patent systems and from the general use of the concept in the United States as well.

A useful place to start an examination of the nature and content of public policy as applied to patents is the European Patent Convention. Recall that Article 53(a) of the European Patent Convention provided a public policy exception with two prongs: morality or public policy.349 Starting from a strict interpretive posture, the European Patent Office argues in the Guidelines that the exceptions to patentability should be narrowly construed.350 Accordingly, the term ordre public is given its literal meaning, “public disorder” and only inventions that are “likely to induce riot or public disorder, or to lead to criminal or other generally offensive behaviour” would be excluded from patentability.351 The Guidelines offer as an example of an invention that might incite public disorder, the technology for a letter-bomb.352 Such a narrow and literal meaning ascribed to the term ordre public distinguishes it from the more inclusive concept of public policy. Note also that the Guidelines do not explicitly define morality nor do they distinguish morality from ordre public though there is language suggestive of the difference. For instance, the statement that the Article 53(a) exception might be applicable if “it is probable that the public in general would regard the invention as so abhorrent that the grant of patent rights would be inconceivable” seems more directed at morality than ordre public.353

The decided cases, on the other hand, seem to treat the two exceptions separately.354 In the Plant Genetic Systems case, the Board of Appeals drew a clear distinction between ordre public and morality.355 According to the Board, ordre public is generally understood as being applicable to inventions likely to threaten

349. Supra note 330 and accompanying text.
351. Id.
352. Id.
353. Id.
public security and the physical integrity of individuals as part of society. The concept would also apply to inventions the exploitation of which might induce the breach of public peace or social order such as acts of terrorism. Finally, the Board argued that the concept of *ordre public* is also generally understood as excluding from patentability inventions that pose a serious risk to the environment.\textsuperscript{356} It is apparent from the preceding discussion that not only does the concept of *ordre public* have multiple meanings but also that, in practice, it is applied to a wider range of circumstances than its literal translation might suggest.

Outside the patent system, public policy also has many meanings.\textsuperscript{357} In the famous case of English case of *Egerton v. Brownlow*, Justice Baron Parke ascribed an ordinary meaning to public policy and described it as political expediency or that which is good for the common good of the community.\textsuperscript{358} The nature of public policy has also been the subject of judicial commentary in the United States outside the patent system. According to Justice Story, “Public Policy means anything which tends to undermine that sense of security for individual rights, whether of personal liberty or private property.”\textsuperscript{359} In the case of *Loucks v. Standard Oil*, Judge Cardozo defined public policy as embodying, “some fundamental principle of justice, some prevalent conception of good morals, [or] some deeply rooted tradition of the common weal.”\textsuperscript{360}

The definitions outlined above appear to share some basic characteristics in that they all seem to address the basic and fundamental value system of society, some conception of the general good, or right and wrong. To the extent that this characterization is accurate, these definitions have something in common with Justice Story’s formulation of the public policy exception to patents in *Lowell v. Lewis*. He stated that to be patentable an invention must not be “frivolous or injurious to the well-being, good policy, or sound morals of society.”\textsuperscript{361} Like the other formulations of the public policy exception, the statement by Justice Story is necessarily general and not very helpful in specific situations without further guidance. To remedy that situation, Justice Story provided examples of inventions that would not be patentable on public policy grounds. According to him, “a new invention to poison people, or to promote debauchery, or to facilitate private assassinations, is not a patentable invention.”\textsuperscript{362} What might one learn from the

\textsuperscript{356} Id.; see also Harvard/Onco-mouse [1990] EPOR 501, 513 (where the Board of Appeals stated that in addition to the suffering of transgenic animals, considerations of the danger genetically manipulated animals might pose to the environment if released should be taken into account in determining patentability under Article 53(a) of the EPC).
\textsuperscript{357} Yelpaala, supra note 347, at 388-94 (discussing eight different ways of defining public policy within the context of conflict of laws).
\textsuperscript{358} 10 Eng. Rep. 359, 409, 4 H.L. Cas. 1 (1853).
\textsuperscript{359} Safeway Stores v. Retail Clerks Int’l Ass’n, 261 P. 2d 721, 726 (1953) (citing and adopting the definition of Story’s work).
\textsuperscript{360} 120 N.E. 198, 202 (1918).
\textsuperscript{361} 15 F. Cas. at 1019.
\textsuperscript{362} Id.
examples given by Justice Story? What types of biotechnological inventions would arise to the level of moral repugnance and condemnation intimated by these examples and must be excluded from the patent regime? Would the application for a patent of the "chimera" fall into the category condemned by Justice Story? These are some of the questions Congress would have to answer in its approach to the public policy exception to patents, even if it were minded to apply Story's formulation of public policy.

It should be noted that much of the discussion of the public policy exception is cast in the negative. Public policy is invoked to stop the patenting of an invention that is abhorrent, unacceptable, morally repugnant or offends our deeply rooted value system. However, public policy has a positive side, which may play an important role in the case of biotechnology. It might be invoked for some good to rid the world of hunger, to feed starving children of the world or to make a medical breakthrough available to all humanity. In any such case, the patent application may be rejected on public policy grounds, not because the invention poses a threat to society or has any moral or ethical negatives, but because it holds so much promise for so much good that its best use to humanity would be in the public domain. Many advances in seed genetics and biomedical research would easily fall into the category of inventions and discoveries to which the positive use of public policy would be appropriate.

For a public policy exception to be useful, it would need to remain open-ended, but at the same time be guided by concrete examples and suggestions of biotechnological inventions that might run afoul of this exception. Congress might invite the informed opinion of the scientific community, social scientists, and those considered to be guardians of the moral, philosophical, and religious values of society. The views of the latter group might be perceptual but they will provide a useful and essential balance against the more objective opinions of scientists and social scientists in developing the concrete examples. The subsequent use of the public policy exception would be guided by the type of moral condemnation inherent in those examples. Of course, this is the approach suggested by Justice Story in *Lowell v. Lewis*; but it has also been used by other patent systems. For instance, Article 6 (2) of the Biotechnology Directive provides the following examples of inventions that are not patentable under its public policy exception: "(a) processes for cloning human beings; (b) processes for modifying the germ line genetic identity of human beings; (c) uses of human embryos for industrial or commercial purposes; (d) and processes for modifying the genetic identity of animals which are likely to cause them suffering without any substantial medical benefit to man, animal, and also animal resulting from such processes."363

Congress might decide to take a different approach than that of the European Union or any other foreign patent system with the public policy exception. Whatever

approach Congress adopts, a well-articulated public policy concept supported by a representative array of examples would be indispensable if the U.S. patent system is to avoid problems confronting the EPC in the use of the public policy exception.364

d. The Public Policy Exception and the Terminator Seed

The absence of a deliberate and well-articulated public policy exception to biotechnological inventions poses certain risks to the application of that concept based on an implicit reading of the patent statute. A good example of an invention that raises serious public concerns of a very fundamental nature, apparently missed by the PTO under the implicit reading of the U.S. patent statute, is the Terminator Seed technology.365 Whether the PTO ever considered the public policy implications of the Terminator Seed technology when the application for the patent was made remains unclear. It is also unclear whether the PTO would revoke the patent under the public policy exception. What is clear, however, is that the validity of the Terminator Seed technology is doubtful under any reasonable definition of public policy. It is difficult to see how the PTO did not reject that patent on public policy grounds if, as the PTO believes, Lowell v. Lewis is still good law.

It may be recalled that the patented Terminator Seed technology produces a seed that sterilizes its offspring. As argued earlier, biotechnological inventions involving seed varieties might be excluded from the patent regime as a general policy because of the importance of that science to human needs for food and survival. If however, Congress, in its infinite wisdom, decided otherwise the question is whether the terminator technology should nevertheless be covered by the public policy exception as discussed above? We propose to examine that question below.

The express purpose for which Congress is empowered to enact patent laws is to promote science and the useful arts. Implicit, if not explicit, in the Framers’ design was the expansion of human knowledge through the patent system. This fundamental objective of the Framers seems to be undermined if the purpose or effect of an invention is to stultify the ingenuity of millions of farmers and traditional seed breeders who have practiced that art openly and freely for thousands of years. Granted that the Terminator Seed technology does not compel anyone to use the Terminator Seed; that, however, should not be the basis for determining its patentability. An invention that has as its motive, explicit or implicit, the destruction of a source of human ingenuity, the spread of knowledge, and the ability to tinker with ideas in nature should not be patentable. An invention that would preclude the use of natural techniques to improve on the quality, variety, or other characteristics of seeds by large numbers of people seems nefarious and to undermine the very

365. Supra notes 228-230 and accompanying text discussing the Terminator Seed technology.
goals sought to be achieved under the patent regime by the Framers. The fact that Monsanto has indicated that it will not practice the invention only goes to confirm the seriousness of the danger the technology presents.\textsuperscript{366} If Monsanto believes that the Terminator Seed technology should not be practiced then perhaps the patent should be revoked on public policy grounds.

There are other reasons why the Terminator Seed technology should not have been patentable under the public policy exception. With its own built-in biological patent protection, the actual patent protection extends beyond the statutory period for non-scientists. Besides, the invention creates the potential for absolute monopoly. The seed buyer must always return to the seed producer for its seasonal and other seed needs even after the patent has expired because the inventor can extend the protection indefinitely through self-help. An indefinite duration of protection would invite monopolistic output restrictions, price enhancement, and the abuse of dominant position. Moreover, the Terminator Seed technology has the potential for serious environmental damage. Through cross-pollination, the Terminator Seed technology could spread from farm to farm and into other varieties of seeds. Given that the Terminator Seed technology can be combined with ordinary non-patented seeds and with other genetically engineered technologies such as the herbicide-resistant plant technology, the spread of the Terminator Seed technology would be virtually unstoppable. Imagine the thousands of different varieties of maize in Mexico being exposed to the Terminator Seed technology from a few farms. With time the technology could threaten the bio-diversity of seeds in Mexico.\textsuperscript{367}

\textsuperscript{366} One should be careful about what to make of any statements by Monsanto on the issue of exploiting the Terminator technology. Monsanto apologized for its attitude and position on the technology but one should be careful about its genuineness. According to Fortune, Monsanto might have little choice in the matter. See David Stipp, The Voice of Reason in the Global Food Fight, FORTUNE, Feb. 21, 2000, at 164 (explaining that Monsanto had sought advice from Mr. Gordon Conway, a scholarly British ecologists who severely rebuked Monsanto and went public with his advice subsequently Monsanto followed with the apology); see also Michela Wrong, Monsanto Apologises for ‘Arrogance’, FIN. TIMES, Oct. 7, 1999, at 9 (The Chairman of Monsanto, Mr. Robert Shapiro, stunned the audience of environmentalists in the United Kingdom with an apology for corporate arrogance); Nikki Tait, Monsanto Pledge on Sterile Seeds, FIN. TIMES, Oct. 5, 1999, at 1 (explaining and discussing the commitment of Monsanto not to commercialize the terminator technology). As part of its efforts to improve its public image Monsanto also announced that it would make the working draft of the genetic structure of rice readily available to all. This announcement was made in China and has been well received. See Michela Wrong, Monsantoopts to Work with the Grain, FIN. TIMES, Apr. 11, 2000, at 11 (discussing the decision of the Monsanto to make the working draft of the genetic structure of rice available and the importance of such action as a model for other companies), Justin Gillis, Monsanto to Donate Patents for Rice, THE SACRAMENTO BEE, Aug. 4, 2000, at A6 (Monsanto has decided to make some of its patent rights in rice readily available to speed up the genetic modification of rice).

\textsuperscript{367} The threat to the seed varieties in Mexico has been commented upon by journalists. See, e.g., Anthony DePalma, The ‘Slippery Slope’ of Patenting Farmers’ Crops, N.Y. TIMES, May 24, 2000, at A4 (discussing the risk to the about 20,000 varieties of maize in Mexico from patenting plant genes which will put the maize in the hands of private companies and universities which cannot always sort their research priorities); Henry Tricks & Andrea Mandel-Campbell, Mexico’s Farming Habits under Pressure from Transgenics, FIN. TIMES, Oct. 12, 1999, at 8 (explaining that the 24,000 varieties of maize in the cradle of corn might be in jeopardy because the rich diversity of corn is under threat from imported genetically modified corn).
While the risks associated with the Terminator Seed technology are not the same or as dramatic as those associated with the technology for poisoning people or private assassinations, they nonetheless pose another type of risk to human survival and the environment. The potential impact of the Terminator Seed technology could be more severe, diffuse, and more pervasive than the technology for private assassinations. The user is more easily forewarned about the effects of a technology for private assassinations whereas the potential impact of the Terminator Seed technology is not that obvious to the user at the outset.

If the goal of the public policy exception is to protect society from the negative impact of inventions, it would serve that purpose very well if it is applied to revoke the Terminator Seed technology, and to prohibit its use.

VI. THE INCENTIVE TO INVENT AND THE EMPLOYMENT CONTRACT

Current intellectual discourse on the justifications for the patent system and the protection of ideas is that without such protection there would be too few new ideas invented or discovered. The theory is that human ingenuity is best engaged if some potential private gain is dangled in front as the carrot for creative effort. Thus, the incentive to invent seems to focus on the individual as the center of government policy. The suggestion that the grant of a patent to the individual inventor would spur inventive activities is somewhat misleading. The patent system is designed to reward corporations and the management of inventive resources and only secondarily, the inventor.

The idea of a starry-eyed, solo and rugged tinkerer burning the midnight oil in his attic to come up a spectacular invention is mostly illusionary, if not imaginary, particularly in the biotechnology industry. The notion of an individual with an innovative biotechnological invention sketched out on a piece of brown paper is equally less likely. For sure, some individual inventive activity takes place but such individual genius does not easily find expression outside the biotechnology industry or outside elaborate facilities or laboratories which are expensive to establish and maintain. Only corporations, universities, research foundations, and institutions that are sufficiently funded can support such activities and even then the cost can still be too high. The high cost and risk associated with biotechnology research has prompted the formation of alliances, networks, and collaborations among corporations to share the high cost of research and development.


369. The 1941 report by Professor Hamilton pointed out the important role of the corporations in the creation and maintenance of the patent system. That role has magnified given that the resources for inventive activities in biotechnology are mostly in the hands of corporations and other institutions.


371. Supra note 264-271 and accompanying text.

372. Stuart, supra note 208.
No matter how complex or how well equipped a research institution might be, it would still need at least one individual to function. Corporations do not invent; people do. Machines do not invent; people do. Neither machines nor corporations are tinkerers, rather it is people who tinker. Thus, at the end of the day, any policy that is designed to create the incentive to invent might best be directed first at the tinkerer, the starry-eyed dreamer, or the bespectacled nerd and only secondarily at the corporation, the university, or the research institution.

The motivation to invent or discover is a complex one. Inventors might be motivated by peer pressure, fame, bragging rights, idle curiosity, financial rewards, or a host of other reasons. Designing a policy to capture any of these motivations is not easy but designing a policy that focuses on the funding sources: corporations, universities, and research institutions is also too easy. On the other hand, the policy might be aimed at the link between the starry-eyed tinkerer and the corporation or university which is the employment contract. If the goal of the policy is to generate as many inventive ideas as possible, it might be useful to investigate the question of whether the employment contract between the inventor and his employer serves that purpose.

Current policy makers appear to assume that inventors and scientists, as rational economic agents, would only accept terms and conditions of employment most beneficial to them. If they are satisfied with the employment contract they will be encouraged to be inventively productive. Policymakers also seems to assume that the employer will impose only those terms and conditions most conducive to inventive conduct. Both of these assumptions may be false.

First, is the issue of the unequal bargaining power between the parties. Most inventors have a weak bargaining position in relation to their corporate or other institutional employers. A disparity in bargaining power may influence the rewards and penalty terms of the contract and ultimately the incentive to invent. Second is the question of the mobility of scientists and researchers. While the employment contract may not prohibit mobility of employees the conditions for resigning may effectively put clamps on the inventive capability of departing employees. Third, the type of secrecy agreements and termination conditions imposed on departing employees would have an impact on their inventive capacity. Finally, investigating the types of injunctive relief available to employers before the courts against departing employees would be useful. The more liberal the injunctive relief, the more restrictive the employment contract is likely to be of mobility and consequently of inventive activities. Thus, the employment contract might pose a greater burden on the incentive to invent than one might think. Whether this is the case, and if so to what extent, would become part of the task for Congress to investigate.

373. Secrecy contracts and non-competition provisions might limit unnecessarily the inventiveness of a departing employee.
A. Summary

Given the importance of the biotechnology industry to many aspects of life and the need for greater access to new ideas, it might be time for Congress to reexamine the incentive to invent policy from a new and different direction. The goal of such a new policy is not to replace any incentives to corporations, universities, or research institutions but, rather to make the inventive individual its primary focus by confronting the conditions under which individual inventive activities take place.

VII. RETHINKING THE POLICY OF ACCESS—THE USUFRUCT TO THE RESCUE?

Inherent in any patent system is the tension between the right of the public to have free and unimpeded access to all ideas and the right of inventors to exclude all others from patented ideas. The notion of creating property rights in things as fluid and ephemeral as ideas seems inconsistent with the essential role they play in the coherent and stable organization of human society. The tension is magnified the greater the number and rate at which ideas enter the patent regime as private property, even if for a limited duration of time. The problem of access is particularly serious in the case of the biotechnology industry because of the proliferation and multiplicity of patents. As discussed earlier, an ever increasing number of patents are issued covering various forms of genetic engineering, gene sequences, biomedical information, research results and their supporting data. These patents systematically decrease the pool of available knowledge in the public domain and, as the patent system continues to be permissive, the problem will be magnified.

There are several reasons why there is concern over the decreasing access to an increasing number of new discoveries and inventions in biotechnology. First, as pointed out by Dam, the line between basic and fundamental research and applied research is very thin. A permissive patent system that allows patents for ideas that properly belong to the public domain is likely to impose an unreasonable burden on society’s need for access to all ideas. Second, patenting research data, results and information seem to run contrary to the long established tradition of academic institutions having an open system of access to ideas. The tradition of openness facilitated the falsification of ideas and the propagation of knowledge. Third, the proliferation of patents have also created a problem of access since the transaction cost of organizing a multitude of patented information to be useful would outweigh any potential benefits. Finally, there is an undertone of nervousness that society is worse off with a permissive patent system. The view might be held that free

374. Dam, supra note 263.
375. Id.
376. Heller & Eisenberg, supra note 1.
access to ideas of any description at all times is part of the grant to humanity to use and teach its offspring for the good of mankind.

Given the existing patent system, various solutions to the problem of access have been suggested. Prominent among them is compulsory licensing under which others can practice a patented invention under certain statutory conditions and requirements. Compulsory licensing has been used by the United Kingdom to improve access to patents.\footnote{377} To alleviate the problem of access to researchers and those interested in scientific investigation an experimental use exception has also been suggested.\footnote{378} The solution to the lack of access might lie in patent pooling whereby all patents are put in a pool and made available to all within the pool or based on an agreement among the members of the pool.\footnote{379} Patent pooling might, however, pose other problems of access. The terms of the pooling agreement may admit only those with inventions or with inventions of certain characteristics. Moreover, patent pooling might raise serious antitrust questions. Yet another approach may be to put all inventions into a clearing house from which licenses can be obtained similar to what is found in the music industry. However, a clearing house for biotechnological inventions would also have to pass some anti-trust test and does not guarantee access.

This Article argues that a new regime of patents is necessary to address the needs and concerns of society over the biotechnological inventions. These suggested solutions, while relevant, seem to confront the issue of access by dancing around it. One solution Congress might consider that would guarantee an easier and wider range of access to patented ideas than those discussed above is to apply the \textit{usufruct} to patents. That is, Congress might make the grant of biotechnology patents subject to the \textit{usufruct}.

Claimed to have originated in Roman law, the usufruct is defined in the Justinian Code as the "right to use and enjoy the property of others without injuring its substance."\footnote{380} The right to enjoy the property includes the right to take the fruits from it.\footnote{381} Put differently, the right in the usufruct is in the material part of the thing which cannot be consumed or destroyed in the very fact of use.\footnote{382} Should the use and enjoyment of the usufruct compromise the material existence of it, the usufruct ceases to exist.\footnote{383} The existence of the usufruct and the rights and duties of those affected by it are dependent on various technical conditions that cannot be pursued here. The task at hand is merely to introduce the concept as a solution to the problem of access to patented ideas.

\begin{thebibliography}{99}
\bibitem{377} Case 19184 Pharmon BV v. Hoechst AG, 1985 ECJ Celex Lexis 3183.
\bibitem{378} Eisenberg, \textit{Experimental Use}, supra note 265.
\bibitem{379} Heller & Eisenberg, \textit{supra} note 1.
\bibitem{382} \textit{Hunter}, \textit{supra} note 381, at 226; \textit{Principles of Roman Law}, \textit{supra} note 64, at 356.
\bibitem{383} \textit{Hunter}, \textit{supra} note 381, at 226; \textit{Principles of Roman Law}, \textit{supra} note 64, at 356.
\end{thebibliography}
From its ancient origins, the usufruct migrated into civil law systems including that of the State of Louisiana384 and also seeped into the common law in the form servitudes, and other burdens on property. Elegant as its Roman law origins might be, the usufruct seems to have evolved independently in non-western collectivist societies with the emphasis on developing techniques for managing access to common property, communal resources, or private property. Because these societies have had extensive experience with the usufruct, in addressing needs similar to those confronted by the current intellectual property regime, an investigation of the concept and its evolution in those societies might shed some light on its possible use in the intellectual property regime of the United States. One region of the world where the usufruct has evolved and has become well entrenched in the property regime is Africa. In particular, the usufruct appears to have existed in the land tenure systems of African societies for time immemorial. Its importance in the customary property regime of Africa was explained by the Privy Council in the famous case of Amodu Tijani v. The Secretary, Southern Nigeria.385 Speaking for the Privy Council, Viscount Haldane described the usufruct as:

"a mere qualification of or burden on the radical or final title of the sovereign where that exists. In such cases the title of the sovereign is a pure legal estate, to which the beneficial rights may or may not be attached. But the estate is qualified by a right of beneficial user which may not assume definite forms analogous to estates. . . ."386

According to Viscount Haldane, the African usufruct was influenced by some elements of the law of trust. The holder of the legal title could enjoy the property but could not exclude other members of the community with the beneficial interest from using and enjoying it. The usufruct was most prominently used in communal property. As was further explained by the Privy Council, the community has "the possessory title to the common enjoyment of a usufruct, with customs under which its individual members are admitted to enjoyment, and even to a right of transmitting the individual enjoyment as members by assignment inter vivos or by succession."387 The concept of the usufruct, as explained by the Privy Council, affected the entire concept of property in African societies.388 Unlike the Blackstonian power theory of property, with its focus on absolute and despotic dominion over a thing

384. The Civil Code of Louisiana in Article 535 states: "Usufruct is a real right of limited duration on the property of another. The features of the right vary with the nature of things subject to it as consumable or non-consumables." See A. N. YIANNOPOULOS, LOUISIANA CIVIL LAW TREATISE. 10 (1989).
385. Amodo Tijani v. Secretary, Southern Algeria, 2 A.C. 399 (Court of Appeal 1921).
386. Id. at 403 (emphasis added).
387. Id. at 404.
388. An example of the application of the usufruct to the land tenure systems of African societies can be found in Ghana. See Gordon Woodman, The Scheme of Subordinate Tenures of Land in Ghana, 15 AM. J. COMP. L. 457 (1967) (explaining the nature, scope, and details of the rights of the usufruct in Ghana).
buttressed by the right of exclusion, the regime of usufructuary rights is concerned less with the power of exclusion and more with the right of access and use. A property regime driven mostly by the need to use and the right of access is not unique to Africa. According to the Privy Council, the usufruct could be found in India, among the Indians of Canada (Native Canadians), and even in Scotland. The question is whether the intellectual property regime of the United States would better serve the needs of society if Congress adopted the usufruct as the guiding light in designing solutions to the problems in the biotechnology arena.

It is apparent from this brief discussion of the usufruct and given the nature of ideas that the usufruct is well suited for the regime of intellectual property. Earlier sections of this Article notes that ideas have the characteristics of a “public good” in that they are diffusible and inexhaustible with multiple and simultaneous use. Unlike many tangible properties, ideas can be used concurrently over and over again by different people without ever depleting them. This inexhaustibility characteristic makes ideas most suitable for the application of the usufruct. As discussed earlier, under Roman law the usufruct can only exist if the property cannot be consumed or depleted by the mere use of it. Ideas by their very nature are incapable of depletion with use; thereby making them perfect for the use of the usufruct. Concern may be expressed that the usufruct would diminish the creative drive thereby reducing the total number of ideas made available to a usufructuary system. Such concerns go to the incentive to invent not the need for access and can be appropriately addressed in the relevant policy considerations.

However, the fact that ideas have the characteristics of a “public good” is not sufficient reason for the adoption of the usufruct. An important supporting policy reason is the importance to society of access to biotechnology ideas. As noted in our discussion of the classical jurists, certain types of property were excluded from the property regime because of the important role they played in society. We have also pointed out that the mission of the biotechnology industry appears to be tinkering with life and existence. Such experimentation has produced and will continue to produce ideas that are critical to human existence and the ecological balance of the environment. Access to these ideas may be critical to the survival of humanity and the usufruct could play an important role.

The application of the usufruct to biotechnological inventions might be approached with the understanding that not all biotechnological inventions have the same characteristics or have the same level of importance and potential impact on society. Some inventions may involve real breakthroughs, others may be mere extensions of existing knowledge; yet others may tackle the most stubborn human diseases. A sound usufructuary policy might draw distinctions between inventions. A single policy would not suit an industry that has shown remarkable vibrancy and

389. 2 A.C. at 404.
390. HUNTER, ROMAN LAW, supra note 381, PRINCIPLES OF ROMAN LAW, supra note 64, at 356.
unpredictable advances in many fields. However, the need for sensitivity in the application of the usufruct does not diminish the relevance of the usufruct to the biotechnological inventions.

While the focus of this Article is on the biotechnology industry, it should be pointed out that the application of the usufruct need not be limited to that industry. Indeed, the usufruct is also very suitable for industries where the inventive ideas are fluid and have a very short shelf life. Such is the case with many inventive ideas in the computer industry. Computer technology, hardware and software, has a very high rate of technological obsolescence. Patents that are obtained for seventeen years may be useless within three or two years if not sooner. Engineers and software designers continuously push the technological envelope building on old techniques and making new breakthroughs. Moreover, in today’s economy, knowledge is being widely diffused at an ever increasing rate. As such, new ideas can effectively remain proprietary only for a short time. A regime of property rights that locks up ideas in the domain of exclusivity may be detrimental to society particularly when those ideas have been “dumped” as obsolete. Allowing access and use would permit others to tinker with those ideas and perhaps come up with better and improved results.

A. Summary

The central focus of this section is to suggest another paradigm shift from the Blackstonian power theory of property, particularly as it relates to ideas, to one that stresses less exclusion and more inclusion. The shift demands fewer restrictions to ideas by owners and greater access and use by non-owners. As argued throughout this Article, a concept of property that is substantially dominated by the power of exclusion is neither historically accurate nor socially beneficial. Thurow recently suggested that the continuing vitality of knowledge based capitalism depends on the vigor with which intellectual property rights are protected. However, that existence of knowledge-based capitalism is threatened by the current intellectual property regime. An intellectual property regime that is as expansive as it is dominating in its creation and enforcement of rights would undermine the creation of the very knowledge on which capitalism relies so heavily. The power theory of property is therefore particularly troublesome as applied to ideas in general and biotechnological inventions and discoveries in particular.

If however, we are wedded to the idea of ownership of ideas, and also concerned about the dangers and the negative impact likely to be created by property rights in ideas, the usufruct offers a solution. Legal title to specific biotechnological discoveries and inventions can be held by their respective inventors or discoverers but the rest of society has the right to use them. This would make the experimental
use exception and other solutions redundant. Congress could adopt a policy whereby
all or certain categories of biotechnological inventions could be patented subject to
the usufruct.

Naturally, the adoption of a usufruct-based policy should be informed by a
thorough analysis of the nature, scope and impact of the usufruct on other policy
concerns. Any discussion of the policy considerations necessary for the usufruct and
its potential impact on secrecy, the incentive to invent, and other related topics must
await some future endeavor.

VIII. CONCLUSION

In the history of the world, seldom has a single event presented humanity with
so much promise for so much good or so much harm as did the discovery of DNA.
It may be argued that the single most important invention of the millennium was the
printing press because it irreversibly revolutionized human social, political
economic organization. However, as we enter the next millennium, the discovery of
DNA holds perhaps a deeper promise for humanity than did the printing press. DNA
science has irreversibly opened the gates to a deeper understanding of the mysteries
of life itself at the cellular level. It has given birth to an industry totally committed
to the decoding of the elements of all forms of life at their most fundamental or basic
level. With the mysteries of life and living organisms decoded, human civilization
will have entered into a new era, in which life forms can take on new and specific
designer characteristics. Parents can choose the perfect children and nations can
develop the perfect race. In this new era, life could be prolonged by altering the
genetic structure of people to eliminate defective genes; genetic engineering could
lead to the development of a cure for some of the most terrible human diseases such
as cancer, Alzheimer’s disease and cystic fibrosis. Not only could human life forms
be cloned but also the creation of human life itself de novo is not a remote
possibility any more. With the Human Genome mapped, a brave new world of
opportunities exists for using the power of genetic engineering to design specific
and targeted vaccines or pharmaceutical products to combat the most stubborn
diseases. But these advances may be only the tip of an iceberg. Future developments
and advances may lead to even more revolutionary and unfathomable discoveries
yet.

The advances and opportunities presented by the biotechnology revolution are
not limited to biological life forms, however. They extend to all life forms including,
in particular, those most critical to agricultural production. Through genetic
engineering, new seed and plant varieties are being created with specific designer
characteristics, such as high protein, herbicide-resistant, vitamin enhanced, or better
taste. Properly used, genetic engineering in agriculture could revolutionize modern
agriculture. It could be a powerful instrument for eliminating the curse of world
hunger and malnutrition.
However, the advances made in biotechnology pose several new and significant moral, ethical and legal questions for humanity. One of the questions raised is whether discoveries and inventions of such momentous importance to life and living should be the subject of private property. Indeed, the very mission of the biotechnology industry of uncovering, at the cellular level, the secrets of life—including creating life forms—has serious implications for property rights. Private ownership of the secrets of life and living organisms carries with it awesome powers over life that could transform the human social, political and economic organization as we know it. Unwittingly, the property regime has the potential for creating a human “god” and we are not sure of how that person might exercise any acquired “godly” powers. Thus, biotechnology presents perhaps the best case for revisiting the concept of property in ideas. Such revisionism must be sensitive to the dynamic and complex nature of the industry, its activities and the research results. This Article provides an analytical framework for addressing the question of ownership of biotechnological discoveries and inventions within the context of an intellectual property regime.

Relying on a historical account of the nature, classification, and justifications for property, we have found that certain things have always been excluded from the property regime because they better serve the needs of society in the public domain than in the hands of private owners. We have also argued that the mission and nature of biotechnological discoveries and inventions invites a journey back into history and an inquiry into whether certain inventions and discoveries should likewise be excluded from the regime of private property. Similarly, certain biotechnological inventions fall into the category of things to be excluded from the regime of private property. Even if biotechnological inventions should be owned there is need for a much more robust intellectual property regime with better criteria for determining patentability. The current patent system which was designed for mechanical and simple devices is ill-suited for the complex and dynamic issues generated by biotechnological inventions. The solution to such a systemic problem lies not in tinkering at its margins but in a total regime transformation by Congress. Any reforms that fall short of an overhaul of the current structure of patent policy would be inadequate. In short, *dancing around the fire may contain it but does not extinguish it.*

The Article presents a framework for Congressional action instructed by the nature of the industry and need to manage scientific advances for the good of society. First, it argues that a separate patent policy and legislation for biotechnology is necessary to confront the very special issues raised. Second, as a part of the structure for such policy, Congress should adopt what may be termed a hierarchy of norms for addressing the question of patentability. Under the first norm, Congress should create a category of things that cannot be owned and therefore are not patentable. This norm is rigorous because those things that cannot be owned cannot even be the subject matter of enforceable secrecy agreements. The second norm defines those things that can be owned and on that account are patentable.
However, being patentable does not mean that every patentable invention should be protected by a patent. Certain inventions may be specifically excluded from patent protection or put in the public domain to achieve specific policy goals. Other inventions may be excluded from patent protection based on a new set of patentability criteria. The third norm provides for the public policy exception to patents. Even when an invention satisfies all the elements of patentability that invention may still be excluded from patent protection on public policy or morality grounds. Since one cannot predict or foresee every type or category of future inventions, a public policy exception is necessary to ensure that there is a final check on the patenting of inventions. A final check provides an opportunity for ensuring that inventions that pose certain unacceptable risks or advance certain fundamental policy objectives are excluded from the patent regime on a case by case basis.

If one of the concerns of any patent policy is to create a balance between the incentive to invent and access to new ideas Congress might consider a new approach to both concerns. In the case of the incentive to invent, it might be useful for Congress to focus on the individual who is always at the center of any inventive activity by focusing on the employment contract between the inventor and the institution for which the inventor works. Such attention would allow the policy to ensure that private bargains do not undermine the incentive to invent. With respect to the issue of access to ideas, one approach Congress might adopt is to employ the Roman law concept of the usufruct which merely allows one to use that which belongs to another. Thus, all patents, or certain patents of a specific category, might be granted subject to the usufruct.

In view of the fact that biotechnology presents certain opportunities and risks, a systemic change is necessary to ensure the opportunities and risks are identified and managed effectively for the benefit of humanity. Trying to manage the biotechnological inventions within the current patent policy and legislation is likely to create confusion and unnecessary fear of the potential harm resulting in unwarranted retrenchment. In a new policy, Congress will be able to confront and address the risks in a rational manner so that the power of the biotechnology industry can be unleashed in the most fruitful manner for the benefit of all.