



2004

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PROPOSING RESOLUTIONS TO THE INSUFFICIENT GENE PATENT SYSTEM

Shanshan Zhang†

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I. INTRODUCTION

Advances in genetics and molecular biology have changed our views on what life means and what a human being is.¹ They will ultimately reshape the interpretation of terms such as “reproduction, individuality, history, freedom and subjectivity.”² For the past several decades, emerging frontiers of biotechnology have grown dramatically and continue to offer innovative methods to detect, diagnose, and treat diseases. Recently, much of the attention of the biotechnology industry has been focused on the Human Genome Project, which has a primary goal of producing a roadmap of the human genome.³ The potential being delivered by this gene map is immense, as the knowledge on gene sequences can serve as a starting point for scientists to understand the functions of genes and how alterations in gene’ structure and function may affect a disease state.⁴ Genomics⁵ has not only become a “vast scientific” venture but also a “commercial enterprise.”⁶ Both public and private sectors have entered into this arena to search for new and better ways to prepare vaccinations, cure diseases, and relieve the suffering caused by debilitating conditions. In the meantime, researchers have sought for and obtained patents to protect their knowledge of human genes.⁷ The World Health Organization has reported that an increasing number of patent applications have been filed to claim inventions related to gene sequences.⁸ These patent applications and granted

1. János Boros & András Guttman, *Genetism: Genes and Society*, 3 GENOMIC/PROTEOMIC TECH. 6 (2003).

2. *Id.*

3. NUFFIELD COUNCIL ON BIOETHICS, *The Ethics of Patenting DNA – A Discussion Paper* 3 (July 23, 2002), <http://www.nuffieldbioethics.org/filelibrary/pdf/theethicsofpatentingdna.pdf> (last visited Jan. 9, 2004) [hereinafter NUFFIELD COUNCIL].

4. Julian David Forman, *A Timing Perspective on the Utility Requirement in Biotechnology Patent Applications*, 12 ALB. L.J. SCI. & TECH. 647 (2002).

5. Genomics is generally defined as “investigations into the structure and function of very large numbers of genes undertaken in a simultaneous fashion.” See, UNIV. OF CAL. DAVIS GENOME CTR., *What is Genomics*, at <http://www.genomecenter.ucdavis.edu/what.html> (last visited Jan. 9, 2004).

6. Jonathan Kahn, *What's the Use? Law and Authority in Patenting Human Genetic Material*, 14 STAN. L. & POL'Y REV. 417 (2003).

7. NUFFIELD COUNCIL, *supra* note 3, at 3.

8. WORLD HEALTH ORG., GENOMICS AND WORLD HEALTH – REPORT OF ADVISORY COMM. ON HEALTH RESEARCH (Geneva, 2002), *available at* http://www3.who.int/whosis/genomics/pdf/genomics_report.pdf.

patents have generated considerable discussion and debate on the acceptability of gene patenting.⁹

Generally, in order to obtain a patent, an invention must be a patentable subject matter that is novel,¹⁰ non-obvious,¹¹ and useful,¹² and must comply with the written disclosure requirements in 35 U.S.C. §112.¹³ Under current U.S. patent law, a deoxyribonucleic acid ("DNA") sequence is a patentable subject matter as a composition of matter or an article of manufacture.¹⁴ However, naturally occurring genes are not eligible for a patent; therefore, to be patentable, a DNA molecule must be "isolated and purified" from its natural state.¹⁵ Similar to all other inventions, inventions directed to DNA sequences also need to fulfill all statutory requirements under U.S. patent law.

The U.S. economy has become increasingly dependent on technological innovations.¹⁶ The patent system has worked well for more than 200 years to foster innovation and its commercial development. As for other areas of inventions, patent protection for DNA sequences will be needed to provide incentives to invent and discover, and to secure new capital for growth.¹⁷

On the other hand, patenting DNA sequences is not free of problems. Because of the unique nature of DNA sequences, DNA technology has fundamentally changed the way that biological and medical research is conducted. The term, "invention," has acquired a new meaning, and patents on DNA sequences are intrinsically different from traditional mechanical patents. As discoveries of new genes and knowledge gained from genomic research continue to have substantial impact on development of drugs and therapeutics for humans,¹⁸ people have stronger feelings about DNA sequence patents. Some researchers, physicians, non-profit organizations and religious

9. NUFFIELD COUNCIL, *supra* note 3, at 3-4.

10. 35 U.S.C. § 102 (2000).

11. *Id.* § 103.

12. *Id.* § 101.

13. *Id.* § 112.

14. Utility Examination Guidelines, 66 Fed. Reg. 1092, 1093 (Jan. 5, 2001). *See also*, *Amgen, Inc. v. Chugai Pharm. Co.*, 927 F.2d 1200, 1206 (Fed. Cir. 1999) ("A gene is a chemical compound, albeit a complex one. . . .").

15. Utility Examination Guidelines, *supra* note 14, at 1,093.

16. Lee Bendekgey & Diana Hamlet-Cox, *Gene Patents and Innovations*, 77 ACAD. MED. 1373, 1375 (Dec. 2002).

17. Emma Toumi, *In Defence of Gene Patents*, 9 J. OF COM. BIOTECH. 135, 135 (Jan. 2003).

18. NUFFIELD COUNCIL, *supra* note 3, at 5.

groups have opposed patenting DNA sequences.¹⁹ They believe that granting patent rights on DNA sequences will lead to “private appropriation of the genetic commons.”²⁰ Furthermore, patents have been issued to cover short DNA fragments, such as expressed sequence tags (“EST”)²¹ and single nucleotide polymorphisms (“SNP”),²² as well as large fragments that contain genes of medical interest. Sometimes, the patented small fragments turn out to be part of the gene covered by the patent claiming the larger fragment. Under the current system, both patents can co-exist. However, “the second patent holder may have to obtain licenses from . . . the primary patent holder but is not prevented from obtaining the second patent.”²³ While the law allows multiple patents to be granted on the same sequence, certain groups fear that this trend will lead to more litigation.²⁴ Additionally, others argue allowing DNA patents will

19. *Id.* See also Rebecca S. Eisenberg, *Why the Gene Patent Controversy Persists*, 77 ACAD. MED. 1381, 1382 (Dec. 2002) (noting that professional associations of doctors have been particularly outspoken critics of disease gene patents and exclusive licenses for DNA diagnostics).

20. NUFFIELD COUNCIL, *supra* note 3, at 5.

21. See NAT'L CTR. FOR BIOTECH. INFO., *A Science Primer – ESTs: Gene Discovery Made Easier*, at <http://www.ncbi.nlm.nih.gov/About/primer/est.html> (last visited Nov. 22, 2003) [hereinafter *EST Primer*]:

[Expressed sequence tags] are small pieces of DNA sequence (usually 200 to 500 nucleotides long) that are generated by sequencing either one or both ends of an expressed gene. The idea is to sequence bits of DNA that represent genes expressed in certain cells, tissues, or organs from different organisms and use these “tags” to fish a gene out of a portion of chromosomal DNA by matching base pairs. The challenge associated with identifying genes from genomic sequences varies among organisms and is dependent upon genome size as well as the presence or absence of introns, the intervening DNA sequences interrupting the protein coding sequence of a gene.

22. See NAT'L CTR. FOR BIOTECH. INFO., *A Science Primer – SNPs: Variations On A Theme*, at <http://www.ncbi.nlm.nih.gov/About/primer/snps.html> (last visited Jan. 15, 2004) [hereinafter *SNP Primer*]:

A Single Nucleotide Polymorphism . . . is a small genetic change, or variation, that can occur within a person's DNA sequence. . . SNP variation occurs when a single nucleotide, such as an A, replaces one of the other three nucleotide letters—C, G, or T. An example of a SNP is the alteration of the DNA segment AAGGTTA to ATGGTTA, where the second “A” in the first snippet is replaced with a “T”. On average, SNPs occur in the human population more than 1 percent of the time. . . SNPs found within a coding sequence are of particular interest to researchers because they are more likely to alter the biological function of a protein.

23. John J. Doll, *The Patenting of DNA*, 280 SCI. 689, 690 (May 1, 1998).

24. John Murray, *Owning Genes: Disputes Involving DNA Sequence Patents*, 75 CHI.-KENT L. REV. 231, 250 (1999). See also, Melissa Horn, *DNA Patenting and Access to Healthcare: Achieving the Balance Among Competing Interests*, 50 CLEV. ST. L. REV. 253, 272 (2003).

result in higher expenses in obtaining licenses to conduct research, more costly products, and heavier burdens on the healthcare system. For example, Myriad Genetics, a U.S. company, holds patents on BRCA1 and BRCA2 genes, which indicates susceptibility to breast cancer.²⁵ It charges \$2,680.00 for each diagnostic test.²⁶ Healthcare professionals are worried that women at risk for breast cancer will be adversely affected by Myriad's monopoly.²⁷ Furthermore, while recognizing that patents protect the intellectual property and efforts of the inventors, many have expressed concerns that exclusive rights granted to the inventors of gene patents may block public access to important information, which in turn will impede genetic research, inhibit technology development, and ultimately produce an adverse effect on public health.²⁸

In order to maintain a balance among the competing interests with regard to patenting DNA sequences, changes are needed to avoid the pitfalls in the current system. Modifications to the current system will ensure that gene patents continue to serve their intended purpose of promoting science and exchange of information, while further ensuring that exclusive property rights on sequences do not impede the research and development of new technologies.

This paper argues that some of the concerns posed by patenting DNA sequences can be addressed through changes made by the United States Patent and Trademark Office ("USPTO"). First, the U.S. has recently revised its examination guidelines for the utility requirement and written description requirement.²⁹ The new heightened guidelines will work to eliminate ineligible claims,

25. U.S. Patent No. 5,710,001 (issued Jan. 20, 1998) and U.S. Patent No. 5,747,282 (issued May 5, 1998). The U.S. company, Myriad Genetics, the University of Utah and the US Secretary of Health filed these patent applications that were later granted. The applications claimed rights over the normal BRCA1 gene sequence and various mutations, diagnostic tests for detecting mutations in BRCA1, and methods for screening samples taken from tumors. A company called OncorMed received the patent on a "consensus sequence" of the BRCA1 gene. U.S. Patent No. 5,654,155 (issued Aug. 5, 1997). The patent claims rights over a method of identifying individuals with a normal copy of the gene, and of identifying seven mutations of the gene. Myriad Genetics later acquired the genetic testing business of OncorMed. In 2001, Myriad Genetics also received a European patent over the use of the BRCA1 gene. European Patent No. 699754 (issued Jan. 10, 2001). As a result, Myriad Genetics has a temporary monopoly in many European countries on BRCA1 diagnostic testing.

26. Meredith Wadman, *Testing Time for Gene Patent as Europe Rebels*, 413 NATURE 443, 443 (Oct. 5, 2001).

27. NUFFIELD COUNCIL, *supra* note 3, at 40.

28. *Id.* at 5-6.

29. Guidelines for Examination of Patent Applications under 35 U.S.C. § 112, ¶1, "Written Description" Requirement, 66 Fed. Reg. 1099 (Jan. 5, 2001).

improve the quality of DNA sequence patents, and reduce the likelihood that a patent may be challenged by a third party. Also, the *inter partes* re-examination procedure³⁰ can serve as an inexpensive alternative to full litigation in challenging a patent. Furthermore, this paper will propose solution-oriented reform structures, which are necessary to improve the current system. A patent pool can be used as a powerful tool to make obtaining a license much easier. Additionally, legislative changes including compulsory licensing schemes and research exemptions will ensure that the granting of DNA patents does not affect scientific research. Ultimately, a fundamental reform of the patent law may serve as the true gatekeeper in guarding against invalid patents.

II. MOLECULAR BIOLOGY – THE BASICS

A gene is the basic unit of heredity.³¹ It is a sequence of DNA on a chromosome³² that encodes a protein or regulates the transcription of such a sequence.³³ Before any cell divides, it produces a copy of its genes to pass on a complete set to each of its daughter cells upon division.³⁴ Thus, parent cells, such as sperm and egg cells, carry and pass on the hereditary information from one generation to the next.³⁵

A DNA molecule is a polymer consisting of four nucleotide bases.³⁶ Each nucleotide is represented by a letter in the alphabet: adenine (A), cytosine (C), guanine (G), and thymine (T).³⁷ The four bases are connected together by covalent bonds³⁸ to form a long chain of DNA.³⁹ Each long strand of nucleotides is paired up with its

30. Final Rule to Implement *Inter Partes* Reexamination Proceedings, 66 Fed. Reg. 76,756 (Dec. 7, 2000).

31. See PETER H. RAVEN & GEORGE B. JOHNSON, BIOLOGY 59 (2d ed. 1989).

32. See *id.* (stating that DNA is composed of two complementary chains of nucleotides arranged in a double helix format); *id.* at 88, G-5 (“Chromosome: The vehicle by which hereditary information is physically transmitted from one generation to the next; the organelle that carries the genes. In bacteria, the chromosomes consist of a single naked circle of DNA; in eukaryotes, they consist of a single linear DNA molecular and associated proteins.”).

33. See *id.* at 59.

34. BRUCE ALBERTS ET AL., MOLECULAR BIOLOGY OF THE CELL 98 (2d ed. 1989).

35. *Id.*

36. *Id.* at 99.

37. *Id.*

38. A covalent bond is defined as “a bond in which two electrons are shared by two atoms.” See RAYMOND CHANG, CHEMISTRY 184 (2d ed. 1984).

39. ALBERTS ET AL., *supra* note 34, at 99.

complementary strand⁴¹ to form a double helix, the three dimensional structure of DNA molecules.⁴² Normally, the double helices are tightly wound together in the cell's nucleus. When duplicates of the DNA sequences are needed, the helix structure unwinds, and two strands separate forming a replication fork.⁴³ With the aid of DNA polymerase,⁴⁴ two new strands of DNA identical to their parent strands start to form.⁴⁵ These replicated DNA molecules carry the information from the parent cells down to the next generation.

DNA sequences also affect the formation and expression of proteins. Proteins synthesized under the direction of particular DNA sequences determine a cell's chemical and physical properties.⁴⁶ Protein synthesis begins with a process called DNA transcription.⁴⁷ In this process, DNA in the double helix structure unwinds into single strand. Specific regions of the DNA, referred to as coding regions, are then copied into ribonucleic acid ("RNA").⁴⁸ RNA is similar to DNA. However, RNA is shorter in length, and differs in chemical structure.⁴⁹ After undergoing some chemical changes, RNA exits the cell's nucleus to function as messenger RNA ("mRNA"), which directs protein synthesis in the cytoplasm.⁵⁰ Then, the process of translation begins. Translation involves converting the nucleic acid

41. See *id.* A complementary strand contains sequences that are complementary to the other strand. For instance, if Strand A has a sequence of CTTAGGCTA, its complementary partner, Strand B, would have a sequence of GAATCCGAT.

42. *Id.*

43. RAVEN & JOHNSON, *supra* note 31, at 289, fig. 14-18, caption.

44. A DNA polymerase is an enzyme that catalyzes the process of DNA replication. See *id.*

45. *Id.*

46. ALBERTS ET AL., *supra* note 34, at 106.

47. RAVEN & JOHNSON, *supra* note 31, at 298.

48. ALBERTS ET AL., *supra* note 34, at 107.

49. *Id.* RNA is different from DNA in that (1) the sugar-phosphate backbone of RNA contains ribose instead of a deoxyribose sugar, and (2) the base thymine (T) in DNA is replaced by the very closely related base uracil (U). RNA is shorter than a DNA molecule because it is copied from a limited region of the DNA – enough to make one or more proteins. *Id.*

50. See *id.* at 107-8. ("The mRNA codons do not directly recognize the amino acids that they specify in the way that an enzyme recognizes a substrate. Translation uses "adaptor" molecules that recognize both an amino acid and a group of nucleotide bases. These adaptors consist of a set of small RNA molecules known as transfer RNAs . . .").

language, the genetic code, to protein “language.”⁵¹ The sequences of nucleotides in mRNA are “read” in sets of three, called a codon.⁵² Each codon specifies which amino acid should be incorporated into the protein sequence.⁵³ RNA is made of four different nucleotides. Thus, there are 64 possible codon triplets that can be “read” to direct the selection of amino acids.⁵⁴ Nonetheless, there are only 20 different amino acids commonly found in protein.⁵⁵ Therefore, most amino acids are specified by several codons; “that is, the genetic code is degenerate.”⁵⁶ Proteins formed through these processes will then act to control cell functions.⁵⁷

Today, much research work on DNA sequences focuses on deciphering the genome of various organisms, including human, mouse and yeast.⁵⁸ A DNA sequence is used to obtain a genomic sequence and identify a complete set of genes. Ultimately, the goal is to gain an understanding of how genes work in controlling protein production, a process commonly known as gene expression.⁵⁹ Once we begin to understand where and how a gene is expressed in normal conditions, we can then examine the gene’s function in an altered state, such as in a particular disease.⁶⁰ Before we can truly understand the genetic aspect of a disease, we must identify and study the link between a gene and the protein coded by the gene, and the relationship between a particular protein and a disease of interest.⁶¹

To study the interactions between genes, proteins and diseases, scientists use short DNA sequences to identify a large family of genes.⁶² ESTs or SNPs have been useful tools in the hunting for gene groups and families. Moreover, new technologies, such as DNA microarrays, have facilitated the process of gene identification and

51. See RAVEN & JOHNSON, *supra* note 31, at 299. (“This process of mRNA-directed polypeptide synthesis by ribosomes is called translation because nucleotide-sequence information is translated into amino acid-sequence information.”).

52. *Id.* at 300-301.

53. *Id.* at 301.

54. *Id.* at 300.

55. *Id.*

56. ALBERTS ET AL., *supra* note 34, at 108.

57. *Id.* at 106.

58. See EST Primer, *supra* note 21.

59. *Id.*

60. See *id.*

61. *Id.*

62. See *id.*

classification.⁶³ DNA microarrays permit the expression levels of thousands of genes to be compared and screened on a single glass chip within hours.⁶⁴ It is a powerful tool for DNA profiling, drug research and screening, and development of clinical diagnostic tools and gene therapies.⁶⁵

III. PATENT LAW – AN OVERVIEW

The current patent law has its origin in the United States Constitution. Congress is furnished with an exclusive power by Article I, Section 8, Clause 8 of the Constitution to “promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.”⁶⁶ Based on this power, Congress enacted the first patent statute in 1790.⁶⁷ Evolving through the years, modern patent acts have been codified in 35 U.S.C. §§ 100-376, which provide that “[w]hoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor”⁶⁸ The patent system was created to “reward inventions,” “promote

63. See NAT'L CTR. FOR BIOTECH. INFO., *A Science Primer – Microarrays: Chipping Away at the Mysteries of Science and Medicine*, at

<http://www.ncbi.nlm.nih.gov/About/primer/microarrays.html> (last visited Jan. 15, 2004).

With only a few exceptions, every cell of the body contains a full set of chromosomes and identical genes. Only a fraction of these genes are turned on, however, and it is the subset that is “expressed” that confers unique properties to each cell type. “Gene expression” is the term used to describe the transcription of the information contained within the DNA, the repository of genetic information, into messenger RNA (mRNA) molecules that are then translated into the proteins that perform most of the critical functions of cells. Scientists study the kinds and amounts of mRNA produced by a cell to learn which genes are expressed, which in turn provides insights into how the cell responds to its changing needs. Gene expression is a highly complex and tightly regulated process that allows a cell to respond dynamically both to environmental stimuli and to its own changing needs...DNA Microarrays are small, solid supports onto which the sequences from thousands of different genes are immobilized, or attached, at fixed locations. The supports themselves are usually glass microscope slides, the size of two side-by-side pinky fingers, but can also be silicon chips or nylon membranes. The DNA is printed, spotted, or actually synthesized directly onto the support.

64. See *id.*

65. See *id.*

66. U.S. CONST. art. I, § 8, cl. 8.

67. See DONALD S. CHISUM ET AL., *PRINCIPLES OF PATENT LAW* 18 (2d. 2001).

68. 35 U.S.C. § 101 (2000).

disclosure of inventions," and assure that "ideas in the public domain remain there for the free use of the public."⁶⁹

An American patent is a grant by the U.S. government, which gives the patent owner a "right to "exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States" for a period of 20 years.⁷⁰ In exchange for the monopoly, patent owners must provide a full disclosure of their invention to the public, which enables a person of ordinary skill in the art to make and use the invention.⁷¹ This scheme gives patent owners an opportunity to protect and recapture their intellectual and monetary investment, while allowing the general public to enjoy the benefit of new innovations in a timely fashion.⁷² To be patentable, an invention must meet the statutory requirements in 35 U.S.C. §§ 100-376, which include utility, novelty, non-obviousness, and specifications.

A. Subject Matter

First, the invention must be a patentable subject matter, which may be processes, machines, articles of manufacture, or compositions of matter.⁷³ The Supreme Court in *Diamond v. Charkrabarty* interpreted this section expansively, holding that Congress intended statutory matter to "include anything under the sun made by man."⁷⁴ Additionally, the Court also made clear that ideas, natural phenomena and laws of nature are not patentable.⁷⁵ In affirming the patentability of a genetically engineered bacterium that was capable of degrading components of crude oil, the Court concluded that the inventor has created "a new bacterium with markedly different characteristics from

69. *Aronson v. Quick Point Pencil Co.*, 440 U.S. 257, 262 (1979). The Supreme Court said the following about the purpose of the patent system:

First, patent law seeks to foster and reward invention; second, it promotes disclosure of inventions to stimulate further innovation and to permit the public to practice the invention once the patent expires; third, the stringent requirements for patent protection seek to assure that ideas in the public domain remain there for the free use of the public.

70. 35 U.S.C. § 154. Prior to June 8, 1995, the term for a U.S. patent was 17 years. See CHISUM ET. AL., *supra* note 67, at 2 n.6.

71. 35 U.S.C. § 112.

72. Courtney J. Miller, *Patent Law and Human Genomics*, 26 CAP. U. L. REV. 893, 904-05 (1997).

73. 35 U.S.C. § 101.

74. 447 U.S. 303, 309 (1980).

75. *Id.* (citing *Parker v. Flook*, 437 U.S. 584 (1978); *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972); *Funk Bros. Seed Co. v. Kalo Inoculant Co.*, 333 U.S. 127, 130 (1948); *O'Reilly v. Morse*, 15 How. 62, 115 (1854); *Le Roy v. Tatham*, 14 How. 156, 175 (1853)).

any found in nature and one having the potential for significant utility. His discovery is not nature's handiwork, but his own; accordingly it is patentable subject matter under § 101."⁷⁶ Applying the same logic, a "purified and isolated" DNA sequence is patentable because, after scientists extract DNA from its natural state and purify it, it possesses different properties from its natural counterparts. Under current law, DNA sequences are being patented as compositions of matter.⁷⁷

B. Utility

Secondly, an invention must be useful.⁷⁸ Originating from the Constitution, 35 U.S.C. § 101 sets forth that "any new and useful" invention and discovery is entitled to a patent grant.⁷⁹ An invention needs to be "operable,"⁸⁰ that is, it must function for its intended purpose.⁸¹ The inventor may receive an exclusive right to exclude only if he or she can show that the invention can serve its "intended purpose" or "a purpose discernible by a person of ordinary skill in the art." This utility requirement was enacted to maintain "a quid pro quo for society."⁸²

For mechanical and electrical inventions, establishing utility is straightforward, as drawings, diagrams or demonstrations are generally used to show utility.⁸³ However, the same does not hold true for chemical and biological inventions. Not only is it difficult to illustrate biological utility through drawings or diagrams, identifying the applicable utility may also be problematic. Unlike mechanical inventions that usually have an end result with a proposed use, biological inventions frequently "possess an evolving utility."⁸⁴ While the utility of some of biological inventions is considered general, other inventions have "specific and immediate societal

76. *Diamond*, 447 U.S. at 310.

77. Utility Examination Guidelines, *supra* note 14, at 1093, cmts. 2-3.

78. 35 U.S.C. § 101.

79. *Id.* ("Whoever invents or discovers any . . . useful process, machine, manufacture, or composition of matter . . . may obtain a patent . . ."). See also U.S. CONST. art. I, § 8, cl. 8. ("useful Arts").

80. Rebecca S. Eisenberg & Robert P. Merges, *Opinion Letter As to The Patentability of Certain Inventions Associated With the Identification of Partial cDNA Sequences*, 23 AM. INTELL. PROP. LAW ASS'N Q.J. 1, 4 (1995) (citing *Newmann v. Quigg*, 877 F.2d 1575 (Fed. Cir. 1989)).

81. CHISUM ET AL., *supra* note 67, at 707.

82. *Id.*

83. *Id.*

84. *Id.*

utility.”⁸⁵ Despite the rapid advances in biotechnology over the past quarter century, many started to question whether the uses purposed by the inventor are attainable or proven.⁸⁶ As a result, the utility requirement has caused more controversy in awarding gene patents.

In 1966, the Supreme Court in *Brenner v. Manson*,⁸⁷ for the first time, transformed the utility requirement into a more meaningful standard for patentability.⁸⁸ In rejecting a patent application for a process to make certain steroids, the court emphasized “the concept of utility has maintained a central place in all of our patent legislation.”⁸⁹ The process was not patentable because the asserted utility of the steroids was solely based on the established usefulness of the chemical compounds closely related in structure.⁹⁰ Thus, the Court concluded that an invention must have a “substantial” utility to be patentable.⁹¹

In the early and mid 1990s, patent applications for DNA sequences increased drastically in numbers. Many of the DNA sequences that were sought to be patented merely had a “proposed” utility. Now, in litigation, the patentability of these sequences has become the center of debate. In response to the concerns and to ensure only “useful” DNA sequences are patented, the USPTO modified its Utility Examination Guidelines in 1995 and 1999, raising the standard for utility, with a particular emphasis on DNA sequence

85. *Id.* at 708.

86. Utility Examination Guidelines, *supra* note 14, at 1094, cmt. 5.

87. 383 U.S. 519 (1966).

88. *Id.* at 531-36. See also Nathan Machin, *Prospective Utility: A New Interpretation of the Utility Requirement of Section 101 of the Patent Act*, 87 CAL. L. REV. 421, 428-30 (1999) (discussing the practical utility requirement that was created by the Supreme Court in *Brenner*).

89. *Brenner*, 383 U.S. at 529.

90. *See id.*

91. *Id.* at 534-35. Justice Fortas said,

The basic quid pro quo contemplated by the Constitution and the Congress for granting a patent monopoly is the benefit derived by the public from an invention with substantial utility. Unless and until a process is refined and developed to this point—where specific benefit exists in currently available form—there is insufficient justification for permitting an applicant to engross what may prove to be a broad field.

In 1967, the Court of Customs and Patents Appeals extended the reasoning in *Brenner* and twice affirmed the USPTO’s rejection based on lack of utility. Judge Rich and Judge Smith, the only two judges with patent law experience, offered dissenting opinions arguing for a more relaxed standard for utility. See *In re Kirk*, 376 F.2d 936 (C.C.P.A. 1967); *In re Joly*, 376 F.2d 906 (C.C.P.A. 1967). In the 30 years following *Brenner*, the Federal Circuit Courts seemed to hold a more lenient position when it came to showing utility. See *Cross v. Iizuka*, 753 F.2d 1040 (Fed. Cir. 1985); *In re Brana*, 51 F.3d 1560 (Fed. Cir. 1995).’

related patents.⁹² Currently, under the latest guidelines, an invention must pass a two-inquiry test to establish utility. The sequences claimed in an invention must have a “well-established” utility, or an asserted utility that is “specific, substantial and credible.”⁹³

C. Novelty

The third statutory requirement for patentability is novelty, found in 35 U.S.C. §§ 101 and 102, which require patent holders to “contribute something new to the society.”⁹⁴ When “the invention was known or used by others” either in the U.S., or “patented or described in a printed publication in this or a foreign country,” it is no longer eligible for a patent.⁹⁵ The reason behind this requirement is that “it makes no sense to grant someone a patent on an invention that already exists.”⁹⁶ Therefore, this requirement ensures that only new developments, not what is already in existence in the public domain, are given the privilege of exclusive control.⁹⁷

Genes in their natural state are not directly accessible and do not qualify as novel, because additional work is needed to isolate them. Therefore, an “isolated and purified” DNA molecule or a synthesized DNA molecule with the same sequence as a naturally occurring gene is eligible for a patent because the isolated form is a new and novel product that has been created.⁹⁸

92. 1995 Utility Examination Guidelines, 60 Fed. Reg. 36263, 36264 (July 14, 1995); The U.S. Patent & Trademark Office, Revised Interim Utility Guidelines Training Materials, at 3, available at <http://www.uspto.gov/web/menu/utility.pdf> (1999); Utility Examination Guidelines, 66 Fed. Reg. 1098, §§ B(1)(c), (2)(a) (Jan. 5, 2001). See *The Fate of Gene Patents Under the New Utility Guidelines*, 2001 DUKE L. & TECH. REV. 8, at ¶9, available at <http://www.law.duke.edu/journals/dltr/ARTICLES/2001dltr0008.html> (2001) (“The 1999 Revised Interim Utility Guidelines established a heightened standard for utility . . .”).

93. Utility Examination Guidelines, *supra* note 14, at 1092-93.

94. 35 U.S.C. § 101 (2000) (“Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement . . . may obtain a patent.”); 35 U.S.C. § 102. See also CHISUM ET AL., *supra* note 67, at 323.

95. 35 U.S.C. § 102 (“A person shall be entitled to a patent unless—(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent. . . .”).

96. CHISUM ET AL., *supra* note 67, at 323.

97. Byron V. Olson, *The Biotechnology Balancing Act: Patents for Gene Fragments, and Licensing the “Useful Arts,”* 7 ALB. L.J. SCI. & TECH. 295 (1997).

98. Utility Examination Guidelines, *supra* note 14, at 1093.

D. Non-obviousness

Finally, an invention must be non-obvious.⁹⁹ The invention claimed to be patented must not be obvious to "a person having ordinary skill in the art" at the time the invention was made.¹⁰⁰ In determining whether a DNA molecule is obvious at the time of invention, the USPTO must consider whether the DNA with a particular structure would have been obvious to one of ordinary skill in the art at the time the invention was made."¹⁰¹ It is important to note that in making such a determination, the method used to isolate the DNA sequences is deemed irrelevant; only the structure of the molecules is evaluated.¹⁰² In *In re Bell*, the court held that when the inventor tries to patent compositions of matters, the issue is "the obviousness of the claimed compositions, not of the method by which they are made."¹⁰³

E. Written Descriptions

Lastly, to secure a patent, the inventor must provide specifications as required by 35 U.S.C. § 112 ¶ 1.¹⁰⁴ This section has two major elements, the written description and the claims. In the written description, the inventor must disclose his invention in full detail as to enable any person skilled in the art to make and use the invention, and set forth a best mode known to the inventor to carry out the invention.¹⁰⁵ In other words, the claimed invention must be adequately supported by a disclosure so that a "skilled practitioner" can utilize it without undue experimentation.¹⁰⁶ Additionally, the applicant also needs to "particularly point out and distinctly claim the

99. 35 U.S.C. § 103. ("A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.").

100. *Id.*

101. *In re Deuel*, 51 F.3d 1552, 1559 (Fed. Cir. 1995) ("[T]he existence of a general method of isolating cDNA or DNA molecules is essentially irrelevant to the question whether the specific molecules themselves would have been obvious..."). See also Utility Examination Guidelines, *supra* note 14, at 1095 (citing *In re Deuel*).

102. NUFFIELD COUNCIL, *supra* note 3, at 30.

103. 991 F.2d 781, 785 (Fed. Cir. 1993).

104. 35 U.S.C. § 112 ¶ 1.

105. *Id.*

106. Eisenberg and Merges, *supra* note 80, at 4.

invention.”¹⁰⁷ The claims give notice to the public of what the patentee and the USPTO “have agreed constitute the metes and bounds of the claimed invention.”¹⁰⁸ Section 112 serves two functions—notice to the public and dissemination of information. It allows third parties to avoid unauthorized infringing conduct. Meanwhile, it gives the public opportunities to receive “information that enlarges the storehouse of knowledge” and use it to create something new or enhance and design around the claimed invention—ultimately leading to improvement in technological advances and revolution.¹⁰⁹

With respect to DNA patent applications, guidance on what kind of description is needed to satisfy § 112 is found in *Regents of University of California v. Eli Lilly & Co.*¹¹⁰ The Federal Circuit Court held that an adequate description of a DNA “‘requires a precise definition, such as by structure, formula, chemical name, or physical properties,’ not a mere wish or plan for obtaining the claimed chemical invention.”¹¹¹ Thus, the written description requirement must be “a description of the invention, not an indication of a result that one might achieve if one made that invention.”¹¹²

IV. DNA SEQUENCES PATENTS

The rush of patenting of DNA sequences began in the early 1990s when researchers at the National Institute of Health (“NIH”) discovered a new sequencing technique. The technique utilizes ESTs as probes to locate specific genes or place-markers on a longer chain of DNA.¹¹³ Even though, at that time, ESTs were only proven to have limited functions as probes or markers, people saw the downstream commercial value of ESTs: using or licensing ESTs that may code for a particular gene, which may be used to study and create a blockbuster drug that can treat a specific condition. NIH filed patent applications for more than three hundred cDNA sequences and ESTs.¹¹⁴ In the subsequent ten years, companies began grabbing up

107. § 112.

108. *London v. Carson Pirie Scott & Co.*, 946 F.2d 1534, 1538 (Fed. Cir. 1991).

109. CHISUM ET AL, *supra* note 67, at 161.

110. 119 F.3d 1559 (Fed. Cir. 1997).

111. *Id.* at 1566 (citing *Fiers v. Revel*, 984 F.2d 1164, 1171 (Fed. Cir. 1993)).

112. *Lilly*, 119 F.3d at 1568.

113. *EST Primer*, *supra* note 21.

114. See Linda J. Demaine & Aaron Xavier Fellmeth, *Reinventing the Double Helix: A Novel and Nonobvious Reconceptualization of the Biotechnology Patent*, 55 STAN. L. REV. 303, 323 (2002).

any and all sequences they could put their hands on, skyrocketing the number of patent applications for gene sequences. Big players include Human Genome Sciences with 450 patent applications claiming more than 34,000 sequences, Millennium Pharmaceuticals with over 300 patents containing 2,753 sequences, Incyte Pharmaceuticals with 4,500 sequences from more than 570 patent applications, and many more.¹¹⁵ Nearly a million sequences have been claimed in patent applications worldwide.¹¹⁶

Patents on human genes can be divided into four basic categories, which are diagnostic tests, research tools, protein coding sequences, and gene therapies.¹¹⁷ When a DNA sequence is "significantly implicated in a disease" it "can provide the basis for a diagnostic test."¹¹⁸ For example, OncorMed patented sequences coding for the BRCA1 gene which have diagnostic properties.¹¹⁹ They can be used for screening individuals with an increased genetic susceptibility to breast or ovarian cancer.¹²⁰ Another example of a patented diagnostic gene is ING1, which is useful in diagnosing both brain cancer and breast cancer.¹²¹

Research tools are sequences that have a use in research, but usually have "no immediate therapeutic or diagnostic value."¹²² Expressed sequence tags are examples of research tools. In 1998, the first EST patent was issued to Incyte Pharmaceuticals, Inc.¹²³ The patent claims EST sequences encoding novel protein kinases which can be used to identify homologous protein kinases expressed in various human cells and tissues.¹²⁴

DNA sequences that code for proteins are also being patented. One type of protein coding sequence encodes a particular protein

115. Giles Stokes, *Patent Applications of Genetic Sequences on the Up* (Apr. 2000), at <http://thomsonderwent.com/ipmatters/patlife/8205003> (last visited Jan. 14, 2004).

116. *Id.* at *illius*.

117. NUFFIELD COUNCIL, *supra* note 3, at 64. See also Jorge A. Goldstein & Elina Golod, *Human Gene Patents*, 77 ACAD. MED. 1315, 1316 (Dec. 2002) (noting the USPTO issues patents to isolated or purified human genes encoding protein drugs, diagnostic probes, receptors, immunogens, and gene replacement therapies).

118. NUFFIELD COUNCIL, *supra* note 3, at 48.

119. U.S. Patent No. 5,750,400 (issued May 12, 1998).

120. *Id.*

121. U.S. Patent No. 6,238,918 (issued May 29, 2001).

122. NUFFIELD COUNCIL, *supra* note 3, at 56.

123. U.S. Patent No. 5,817,479 (issued Oct. 6, 1998).

124. *Id.* See WEBSTER'S II NEW COLLEGE DICTIONARY 530 (2001) (defining "homologous" as "similar or corresponding in position, value, structure, or function; corresponding in structure and evolutionary origin . . . ; having the same linear sequence of genes as another chromosome.").

where the protein itself has a therapeutic function. ARCH Development patented a series of sequences encoding calpain 10 that can be used to diagnose and treat type 2 diabetes.¹²⁵ Another type of sequence patented under this category includes genes that encode targets such as receptors. Human Genome Sciences, Inc. holds a patent on sequences coding for human trl0 receptor, which is a member of the tumor necrosis factor receptor family and the TRAIL receptor family.¹²⁶ The receptor expressed by the claimed gene is useful in high-throughput drug screening.¹²⁷

V. CONCERNS AND PROBLEMS POSED BY PATENTING SEQUENCES

As biotechnology is rapidly growing, patents have been used to protect developments and commercial possibilities and potentials arising from genetic research.¹²⁸ Because the number of applications filed to claim DNA sequences is dramatically increasing, many are concerned that patenting DNA will lead to problems having a negative impact on technological development in the molecular biology area.¹²⁹ The questions and fears may be classified into two groups, upstream research and downstream products.

A. *Effect of Upstream Research on Downstream Development*

Thirty years ago, when Garrett Hardin introduced the “commons model,” upstream research was generally pre-market research funded by the federal government, created to encourage wide dissemination and propagation of results in the public domain.¹³⁰ Now, biomedical research has been moving toward a “privatization model,” as it is supported by private funds, carried out in private organizations, or protected by patents that guarantee exclusive private ownership.¹³¹ Patent rights for upstream research tools were initially offered to attract private investments.¹³² Now academic institutions use patent rights to secure subsequent material transfer agreements, which can

125. U.S. Patent No. 6,235,481 (issued May 22, 2001).

126. U.S. Patent No. 6,214,580 (issued Apr. 10, 2001).

127. *Id.*

128. See NUFFIELD COUNCIL, *supra* note 3, at 13.

129. *Id.*, at 4-6.

130. Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (Dec. 13, 1968). See Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698 (May 1, 1998).

131. Heller & Eisenberg, *supra* note 130.

132. *Id.*

produce additional, hefty royalty payments.¹³³ Private companies, such as genomics firms, seek to market patented research tools to pharmaceutical companies.¹³⁴ Consequently, DNA sequences, involved in upstream research and usually patented as research tools, have been particularly troubling to the scientific community.

Upstream research can directly affect downstream product development. Professors Heller and Eisenberg noted that the patenting of research tools leads to “the tragedy of the anticommons.”¹³⁵ The tragedy arises “when multiple owners each have a right to exclude others from a scarce resource and no one has an effective privilege of use.”¹³⁶ The result is an under-use of resources, arising under two mechanisms:—multiple patent holders and “stacking licenses.”¹³⁷

For sequences that can be used as research tools, the “tragedy of the anticommons” occurs when there are many patent holders each claiming a sequence or fragment.¹³⁸ For instance, many different SNP sequences can be patented, resulting in many different patent owners holding exclusive rights. Often, common diseases in humans are not caused by a genetic variation within a single gene but are influenced by complex interactions among multiple genes.¹³⁹ Therefore, multiple SNPs would be needed to conduct research on a single disease. In this case, when a scientist wants to study a disease or research for a new drug using relevant SNPs on a microarray chip, he would have to obtain multiple licenses from multiple patent holders. Even if he wants to use very short fragments not exclusively claimed but falling within the sequence of longer strands of DNA that are patented, he would also need to get a license. The cost and effort needed to secure various licenses could be detrimental to future research. Usually when a patent license is prepared, professional and legal assistance is sought to determine the scope of license, and to negotiate and draft licensing agreements.¹⁴⁰ While getting a good royalty rate is the

133. *Id.*

134. John H. Barton, *Patents, Genomics, Research, and Diagnostics*, 77 ACAD. MED. 1339, 1339 (Dec. 2002).

135. Heller & Eisenberg, *supra* note 130, at 698.

136. *Id.*

137. *Id.* at 699.

138. *Id.*

139. SNP Fact Sheet, Human Genome Project Information, at http://www.ornl.gov/sci/techresources/Human_Genome/faq/snps.shtml (visited Jan. 19, 2004).

140. See generally CHARLES M. FOX, WORKING WITH CONTRACTS – WHAT LAW SCHOOL DOESN'T TEACH YOU (Jan. 2002).

major focus of a licensing deal, the related “hidden” transactional expenses should not be overlooked. As multiple licenses are necessary, standardized agreements may not work for all licensors, so individual agreements must be prepared. To secure a license, negotiation with the patent holder is necessary to secure deals beneficial to the licensee. When there are multiple patents involved, the legal counsel would have to negotiate with each patent holder for each license. All the work involved with obtaining multiple licenses would dramatically increase the total cost of research.¹⁴¹ As a result, it would be too expensive to conduct research. Eventually the “overlapping patent filing” and the piling of numerous license agreements may plague research and product development.¹⁴²

The second mechanism by which the “tragedy” may emerge is under the effect of “stacking licenses,” which result from the use of reach-through licenses.¹⁴³ Reach-through licensing is a way of licensing patent rights, where the patented technology is used in upstream research, not directly incorporated into the downstream product, and royalties are determined by a percentage of sales of the end products.¹⁴⁴ For instance, the patent holder of a DNA sequence can collect royalties based on the sales of a licensee’s end products even if the licensee *only uses the patented sequence in research* for its end product, which does not specifically incorporate the patented sequence. Theoretically, reach-through licensing provides opportunities for researchers with limited resources to use patented technologies and defer royalty payments until valuable results and end products are produced by the research.¹⁴⁵ In return, patent holders collect bigger compensation from the sales of downstream products.

However, in reality, problems arise when upstream patent holders “stack overlapping and inconsistent claims on potential downstream products.”¹⁴⁶ This is particularly true when patents contain claims of wide scope. Often, the term, “comprising,” is used in claims to DNA sequences. In patent law, “comprising” commonly

141. See Kate Murashige, *Patents and Research – An Uneasy Alliance*, 77 ACAD. MED. 1329, 1330 (Dec. 2002).

142. Heller & Eisenberg, *supra* note 130, at 699.

143. *Id.*

144. Thomas J. Kowalski & Christian M. Smolizza, *Reach-Through Licensing: A US Perspective*, J. OF COM. BIOTECH. (July 14, 2000), at http://pharmalicensing.com/features/dispatch/963567614_396edffe132c5.

145. See Heller & Eisenberg, *supra* note 130, at 699.

146. *Id.*

means “including.”¹⁴⁷ When a claim is composed with this word, it is “open-ended to the addition of [DNA sequence] elements not recited in the claim itself, and would be infringed even if the accused sequence contains elements other than” the sequence described in the claim.¹⁴⁸ With such wide claims, patent holders are able to “expand” their negotiating power at the bargaining table; the result is that the “reach-through” patents have become “profit-draining encumbrances.”¹⁴⁹ Therefore, if downstream product development is over-shadowed by heavy licensing fees of upstream research tools, potential licensees will be discouraged from investing funds into product development, and consequently, both upstream research tools and downstream development will come to suffer “the tragedy of the anticommons.”¹⁵⁰

B. Exclusive Ownership of Diagnostic Tools

Many professional associations of doctors and clinical geneticists openly criticize the patenting of sequences with diagnostic functions.¹⁵¹ They believe exclusive ownership over diagnostic genes interferes with the practice of medicine and hinders “incremental innovation” in DNA diagnostics.¹⁵²

A patent owner has exclusive power to determine who may lawfully use his or her invention. The patent holder of a diagnostic sequence may “prevent any other entity from testing for a particular disease gene.”¹⁵³ For instance, medical research is likely to be hindered by the patenting of SNPs with strong implications to a predisposing condition.¹⁵⁴ To maximize the understanding of a disease, a researcher would need to examine the expression of a wide range of genes, and “correlate these expressions with the specific characteristics of the patient that are revealed by a specific SNP.”¹⁵⁵

147. Goldstein & Golod, *supra* note 117, at 1319.

148. *Id.* Compare the use of “comprising” with the use of “consisting of” “claim language where “consisting of” is said to be “closed,” and “is not infringed by the addition of other, unrecited elements to the basic elements of the claim.” *Id.*

149. See *id.* at 1325. See also Heller & Eisenberg, *supra* note 130, at 699.

150. Heller & Eisenberg, *supra* note 130, at 699.

151. Eisenberg, *supra* note 19, at 1382.

152. *Id.* at 1383.

153. Lori B. Andrews, *The Gene Patent Dilemma: Balancing Commercial Incentives With Health Needs*, 2 HOUS. J. HEALTH L. & POL’Y 65, 89 (2002).

154. Barton, *supra* note 134, at 1340.

155. *Id.*

However, his mission will not be accomplished if the patent owner of the particular SNP refuses to grant a license.

Moreover, the quality of diagnostic tests and accessibility to them has become a concern. The patent holder or exclusive license holder is the only entity that may legally use the patented diagnostic sequence and develop tests that use the sequence. Currently, diagnostic testing services conducted in-house are faced with less stringent regulatory structures than testing performed by distributed products.¹⁵⁶ To avoid demanding regulations, a patent holder tends to require that samples be sent to the holder's own lab rather than to develop and distribute a readily available kit.¹⁵⁷ For example, Myriad Genetics, the patent holder of the breast cancer gene, BRCA1, has demanded all samples for BRCA diagnostic testing be sent to its main laboratory in Utah.¹⁵⁸ On the other hand, medical practitioners prefer using facilities within their institutions for diagnostic testing rather than shipping the samples off to a distant laboratory.¹⁵⁹ However, lacking permission from the patent holder to use the patented sequences at their preferred locations, doctors are left with no choice but sending their samples to sites designated by the patent holder. The resulting effect of these confining restrictions imposed by patent owners of DNA diagnostic tests is seen as "an unaccustomed obstacle to their work as healthcare providers and researchers."¹⁶⁰

Furthermore, accessible and affordable healthcare is at the center of concerns. Because patent owners have the right to exclude others from making or using the patented invention,¹⁶¹ they are in the exclusive position to decide how the patented DNA diagnostic sequence might be used or developed. Often, the patent holder who desires to maintain domination on the market chooses to develop further diagnostic tests and kits on its own, instead of licensing the technology to third parties. Myriad Genetics is a perfect example. It holds patents both on the BRCA1 gene and diagnostic tests using the gene.¹⁶² It has not licensed any other firm to develop a different testing method or to conduct breast cancer diagnostic tests using BRCA1 genes. In the meantime, Myriad charges \$2,680.00 for each diagnostic test carried out at its own labs in Utah, the only labs

156. Andrews, *supra* note 153, at 77.

157. *Id.*

158. NUFFIELD COUNCIL, *supra* note 3, at 39-40.

159. Eisenberg, *supra* note 19, at 1382.

160. *Id.*

161. 35 U.S.C. § 154(a) (2000).

162. NUFFIELD COUNCIL, *supra* note 3, at 39-40.

allowed to conduct such testing.¹⁶³ Alternatively, patent holders of DNA diagnostic sequences may choose to grant exclusive licenses to large corporations with strong financial promises. The licensee is then able to control the market for the patented DNA sequences.

Either scheme leads to limitations on "innovation and development of alternative potentially higher-quality or lower-cost methods."¹⁶⁴ If a patent sanctioned monopoly in the market of diagnostic testing were created, the resulting limited access to healthcare would place patients, who need genetic testing, in a highly disadvantageous position.

C. Problem of Submarine Patents

The use of DNA sequences as research tools is faced with legal challenges. Those who oppose the patenting of research tools say many sequences claimed by patent applications lack utility as required by 35 U.S.C. § 101. ESTs and SNPs are examples of such accused research tools. ESTs are used to locate useful full genes. Thus, they have high value in downstream research platforms that "open up new and uncharted areas of investigation."¹⁶⁵ Since NIH initiated the patenting of ESTs, the USPTO has received a large influx of patent applications for ESTs. In the race for patent grants, inventors file for patents as quickly as possible; sometimes even before functions of the target product encoded by the claimed sequences are fully elucidated.¹⁶⁶ Therefore, they assert that the sequences are useful as research reagents or probes, or speculate that the sequences can be used to diagnose disorders. Consequently, applications are filed with "best guess" utilities, which are insufficient to satisfy the statutory requirements for patenting.

The problem of "submarine patents" arises when patents are sought for gene sequences of which functions are not fully understood.¹⁶⁷ A "submarine patent" is a slang term for a patent with broad claims that "surfaces when another inventor's work gives it commercial significance."¹⁶⁸ For example, an inventor discovered a

163. Wadman, *supra* note 26.

164. Jon F. Merz et al., *Diagnostic Testing Fails the Test*, 415 NATURE 577, 579. (Feb. 7, 2002).

165. Arti K. Rai, *Genome Patents: A Case Study in Patenting Research Tools*, 77 ACAD. MED. 1368, 1369 (Dec. 2002).

166. NUFFIELD COUNCIL, *supra* note 3, at 56.

167. Andrews, *supra* note 153, at 86.

168. Kathleen A. Marrs, *Patents: Genes as Intellectual Property*, at <http://www.biology.iupui.edu/biocourses/Biol540/11patents2k1.html>. (Oct. 23, 2001).

particular function of a DNA sequence, and, then, his patent application with broad claims over the sequence was issued. Subsequently, another inventor, through his or her independent effort, finds the gene possesses a new function or use, which was unknown to the first inventor. Although the USPTO does not bar the second inventor from obtaining a patent on his or her discovery, it holds that the second inventor must obtain a license from the first inventor in order to use the patented sequence.¹⁶⁹ As a result, the first inventor is able to preclude the second inventor from making or using the patented sequence.

Human Genome Sciences' (HGS) patent¹⁷⁰ on the CCR5 gene has been criticized as a "submarine patent."¹⁷¹ HGS claimed that CCR5 codes for chemokine receptor and covered "all possible embodiments associated with the receptor, including 'all DNA and amino acid sequences corresponding to the receptor or virtually any portion thereof, and any process for making, using or administering the receptor, including diagnostic assays.'"¹⁷² Later, a group of researchers at NIH discovered that CCR5 receptor was responsible for binding to the HIV virus, which was unknown to HGS when it filed the patent application for CCR5 gene. Nonetheless, the HGS patent had already covered nearly all potential uses of the CCR5 gene. As a result, HGS is able to preclude the NIH researchers from continuing research on CCR5's role and functions related to HIV.¹⁷³

Although the USPTO holds a view that the issuing of broad claims over upstream research tools does not preclude the second inventor from patenting his or her discovery, and does not deter inventions in genomics, these "submarine patents" have caused the scientific community to warn that patents on early scientific processes create "a disincentive for the further research necessary to actually provide a health benefit."¹⁷⁴

VI. ANSWERS TO THE IMPERFECT GENE PATENT SYSTEM

There are two existing schemes, the utility examination guidelines and inter partes re-examination procedure, both of which

169. Doll, *supra* note 23, at 690.

170. U.S. Patent No. 6,025,154 (issued Feb. 15, 2000).

171. Andrews, *supra* note 153, at 87.

172. *Id.* (citing Pat Carson & Melissa Mandrgoc, *Gene-Based Drugs Challenge Patent Process*, 226 N.Y. L.J. S5, S8 (Oct. 15, 2001)).

173. Andrews, *supra* note 153, at 88.

174. *Id.*

can be used to address the concerns associated with gene patenting. First, the USPTO's refined utility examination guidelines can serve as a gatekeeper against insubstantial patent claims on gene sequences. Second, the inter partes re-examination procedure can be used as an alternative approach to challenge invalid patents.

A. Existing Schemes That Can Be Used to Alleviate Concerns

1. 2001 Utility Examination Guidelines

In 2001, the USPTO modified its utility examination guidelines in response to the widespread outcry regarding gene patenting.¹⁷⁵ In particular, the guidelines were put in place to address the issue of DNA sequence inventions not having a sufficient utility. In affirming that DNA fragments, such as ESTs and SNPs, are patentable, the new guidelines raised the standard for utility requirements by requiring all inventions related to gene sequences to have a utility that is well-established, or specific, substantial and credible.¹⁷⁶ In other words, the new standard calls for all patentable sequences to have a well-known utility that is either "immediately apparent, or implied by the specification's disclosure" of the invention, considered with the knowledge of one skilled in the art.¹⁷⁷ Alternatively, in the absence of a well-established utility, the inventor may assert a utility that is particular to the subject matter claimed, defines a "real world" use, and is currently available for use.¹⁷⁸ The USPTO clarified that the inventor cannot advance a "throw away" utility, or a use of sequences "as a gene probe or chromosome marker."¹⁷⁹ Consequently, the new guidelines will become a gatekeeper to preclude insubstantial inventions with inadequate utilities from being patented. Also, they will prevent frivolous patents from blocking the genomic frontier.¹⁸⁰

175. Utility Examination Guidelines, *supra* note 14, at 1092.

176. *Id.* at 1093, cmt. 2.

177. THE U.S. PATENT & TRADEMARK OFFICE, REVISED INTERIM UTILITY GUIDELINES TRAINING MATERIALS, at 7, available at <http://www.uspto.gov/web/menu/utility.pdf> (1999) [hereinafter TRAINING MATERIALS].

178. *Id.* at 6.

179. *See id.* at 5, 7.

180. John J. Doll, *Talking Gene Patents*, 285 SCIENTIFIC AM. 28 (Aug. 2001), available at <http://watson.fapesp.br/nuplitec/artigos/scicamer.htm> (Aug. 17, 2001) (last visited Jan. 19, 2004).

2. Inter Partes Re-examination Procedure

The USPTO's inter partes re-examination procedure is a "potentially useful" tool in challenging invalid patents.¹⁸¹ It can operate as a cheaper alternative to litigation for resolving simple disputes. Re-examination is a procedure by which "the patentee or a third party may request that the USPTO reexamine any patent claim in view of cited prior art."¹⁸² The first re-examination statute was enacted in 1980.¹⁸³ Congress intended the statute to achieve the three principle benefits – providing an avenue to "settle validity disputes more quickly and less expensively," allowing courts to refer patent validity questions to an agency with expertise in both the patent law and technology," and strengthen "investor confidence in the certainty of patent rights by affording an opportunity to review patents of doubtful validity."¹⁸⁴ To use the re-examination procedure, the requester must set forth a "substantial new question of patentability" based on a prior art document.¹⁸⁵ The re-examination process is conducted according to the procedure established for initial examination.¹⁸⁶ Prior to 1999, a third party requester's involvement in the process was limited to filing the initial re-examination request and a reply to the patent owner's statement.¹⁸⁷ In 1999, the Optional Inter Partes Re-examination Procedure Act was passed and provided for an optional inter partes procedure.¹⁸⁸ Under the new procedure, third party requesters are able to participate in the re-examination process in a more meaningful fashion. They have the opportunity to file written comments within 30 days of each Office Action as well as to the patent owner's responses.¹⁸⁹ They may refute arguments made by the patent owner, present further arguments supporting the

181. Natalie M. Derzko & John W. Behringer, *Inter Partes Reexamination: A Potentially Useful Approach to Challenging Invalid Biotechnology Patents*, 21 NATURE BIOTECH. 823 (Jul. 7, 2003).

182. CHISUM ET AL., *supra* note 67, at 149.

183. See generally H.R. REP. NO. 96-1307, at 6462. (1980).

184. In re Portola Packaging, Inc., 110 F.3d 786, 789 (Fed. Cir. 1997). See also, H.R. REP. NO. 96-1307 (1980), available at http://www.ipmall.info/hosted_resources/lipa/patents/Patent_Misuse_Reform.pdf (last visited Jan. 19, 2004); Patlex Corp. v. Mossinghoff, 758 F.2d 594, 601 (Fed. Cir. 1985).

185. 35 U.S.C. § 303 (2000).

186. 35 U.S.C. § 314(a). See also DONALD S. CHISUM, 4 CHISUM ON PATENTS § 11.07(4)(d)(ii) (2004).

187. CHISUM ET AL., *supra* note 67, at 158.

188. See 35 U.S.C. §§ 311-318 (2003).

189. 35 U.S.C. § 314(b).

examiner's findings, and cite additional prior art that did not become known or available to the requester until after the request was filed.¹⁹⁰

Because the inter partes re-examination procedure is relatively low cost¹⁹¹ and allows for participation of third party requesters, it has become an attractive approach to challenging invalid patents with respect to prior art. However, this procedure is not without its problems. One of the greatest limitations imposed by the inter partes re-examination procedure is estoppel.¹⁹² First, a third-party requester is "estopped from asserting at a later time, in a civil action, the invalidity of any claim finally determined to be valid and patentable on any ground which the third-party raised or could have raised during the inter partes re-examination proceedings."¹⁹³ However, if the requester later discovers new "prior art that was not previously available," he or she may still assert claims of invalidity.¹⁹⁴ Second, a third party requester is also estopped from challenging, in a later civil action, any fact determined during the re-examination process, unless the fact is later "proved to be erroneous based on information unavailable at the time of the inter partes reexamination decision."¹⁹⁵ As a result, a third party who is in possession of a new prior art reference and wishes to challenge the validity of a patent through the inter partes re-examination proceeding may be deterred from instituting such processes. Parties fear that in the event that the USPTO rules in favor of the patent holder, it could never rely on the same reference again to try to invalidate the claims, either in a subsequent inter partes re-examination proceeding or a civil action. Also, if a party has a particular prior art reference that was available but not used at the inter partes re-examination proceeding, it would have become an issue that could have been raised, and the party could be precluded from raising any validity issue related to this prior art. Consequently, these substantial risks would have a deterrent effect on anyone who wishes to use this procedure.¹⁹⁶

190. 37 C.F.R. § 1.948 (2003).

191. The estimated average cost for a reexamination proceeding is \$8800, a relatively low expenditure compared to the costs of litigation. See Rules to Implement Optional Inter Partes Reexamination Proceedings, 65 Fed. Reg. 76756, 76757 (Dec. 7, 2000).

192. Derzko & Behringer, *supra* note 181, at 824.

193. 35 U.S.C. § 315(c). See also Derzko & Behringer, *supra* note 181, at 824.

194. Derzko & Behringer, *supra* note 181, at 824.

195. Pub. L. No. 106-113, § 4607 (Nov. 29, 1999). See also Derzko & Behringer, *supra* note 181, at 824; CHISUM ET AL., *supra* note 67, at 159.

196. See Derzko & Behringer, *supra* note 181, at 824.

In order to allow the inter partes re-examination procedure to serve its intended purposes, modification to the system is needed. A new bill should be introduced to remove the estoppel provisions from patent statutes. Third party requesters ought to be allowed to reassert the invalidity of claims in another civil action, rely on the prior art reference that was not used in previous inter partes re-examination proceedings, and challenge any fact determined in the proceeding. Once the restraints are eliminated, third party rights will be protected. Everyone who is interested in challenging the validity of a patent based on prior art will be able to fully benefit from the advantages the inter partes re-examination procedure has to offer.

However, even with modifications, the existing procedures alone will not be adequate to address the concerns posed by gene patenting. Additional changes to the system are needed to allow patents on DNA sequences to serve their intended purposes in promoting exchange of information, attracting investment and advancing technology.

B. Proposed Remedies to Curtail the Negative Impacts from Gene Patenting

1. Patent Pool

A patent pool can be used to resolve problems created by gene patenting. Pooling patents on gene sequences will provide social and economic benefits including the elimination of problems caused by “blocking” patents and “stacked licenses,” a significant reduction of licensing transaction costs, an increased likelihood of recovering R&D costs, and the promotion of technological information exchange.¹⁹⁷

A patent pool is “an agreement between two or more patent owners to license one or more of their patents to one another or third parties.”¹⁹⁸ A patent pool may also be defined as the “aggregation of intellectual property rights which are the subject of cross-licensing, whether they are transferred directly by patentee to licensee or

197. See generally Robert P. Merges, *Institutions for Intellectual Property Transactions: The Case of Patent Pools*, 43-44 (Aug. 1999), at <http://www.law.berkeley.edu/institutes/bclt/pubs/merges/pools.pdf> (last visited Jan. 20, 2004).

198. James Love, *An Essential Health Care Patent Pool*, Address at the 14th Annual AIDS Conference in Barcelona (July 8, 2002), available at <http://www.cptech.org/cm/patentpool.html> (last visited Jan. 20, 2004).

through some medium, such as a joint venture, set up specifically to administer the patent pool.”¹⁹⁹

In the past, patent pools have notably affected the legal and industrial history of the United States.²⁰⁰ In the last one hundred and fifty years, patent pools have taken many different forms.²⁰¹ One of the first patent pools formed in 1856 consisted of sewing machine patents.²⁰² The aviation and radio industries subsequently created patent pools in the early 1900s. The aircraft patent pool of 1917 allowed the production of new aircrafts, which was initially controlled and blocked by two major patent holders.²⁰³ This pool was crucial to the U.S. government since it fulfilled the desperate need for airplanes as the country prepared to enter World War I.²⁰⁴ The standardization of radio parts, airway frequency locations and television transmission standards were made possible by the creation of the Radio Corporation of America, an organization designed to control the licensing of the large number of radio patents, which combined the interests of companies like American Marconi, General Electric, AT&T, and Westinghouse.²⁰⁵ More recent patent pools were formed in 1998 and 1999 to control DVD-ROM and DVD-Video standard specifications and formats.²⁰⁶

The U.S. law affecting patent pools has also changed dramatically. In the early 1900's, courts established the dominance of patent law over antitrust law, giving patent pooling activities virtual

199. Joel I. Klein, Cross-Licensing and Antitrust Law, Address at the American Intellectual Property Law Association Spring Meeting (May 2, 1997), available at <http://www.usdoj.gov/atr/public/speeches/1123.htm>.

200. Steven C. Carlson, *Patent Pools and the Antitrust Dilemma*, 16 YALE J. ON REG. 359, 373 (1999).

201. David B. Resnik, *A Biotechnology Patent Pool: An Idea Whose Time Has Come?*, 3 J. OF PHIL., SCI. & L. § 6, available at <http://www.psljournal.com/archives/papers/biotechpatent.cfm> (last visited Jan. 20, 2004).

202. See Merges, *surpa* note 197, at 17.

203. Harry T. Dykman, *Patent Licensing Within the Manufacturer's Aircraft Association*, 46 J. PAT. OFF. SOC'Y 646, 648 (1964).

204. See *id.* at 647-48.

205. See *The Radio Manufacturers Association*, at <http://www.netsonian.com/antiqueradio/radiodocs/RETMA/ccodeindex.htm> (last visited Jan. 20, 2004).

206. See Letter from Joel I. Klein, Assistant Att'y Gen., Dep't of Just., Antitrust Div., to Garrard R. Beeney, Esq. (Dec. 16, 1998), available at <http://www.usdoj.gov/atr/public/busreview/2121.htm>; Letter from Joel I. Klein, Assistant Att'y Gen., Dep't of Just., Antitrust Div., to Carey R. Ramos, Esq. (June 10, 1999), available at <http://www.usdoj.gov/atr/public/busreview/2485.htm> (last visited Jan. 20, 2004).

immunity from the Sherman Act.²⁰⁷ Over the next forty years, however, patent pools were faced with serious setbacks as the courts “target[ed] patent pools as shelters of collusive activit[ies].”²⁰⁸ The courts dissolved several major patent pools.²⁰⁹ Toward the end of the 1960s, the Department of Justice (DOJ) deployed an aggressive policy against patent licensing. The department announced nine patent licensing activities, known as the “Nine No-Nos,” as per se antitrust violations.²¹⁰ This policy hindered patent holders’ motivation to collaborate through the use of patent pools.²¹¹ Consequently, as a result of policy mandates, few patent pools remain today.²¹²

It was not until recently that patent pools are again being recognized by the DOJ and the Federal Trade Commission (FTC) for their “pro-competitive” effects and capabilities in promoting propagation of technology.²¹³ In 1995, the DOJ and FTC issued Antitrust Guidelines for the Licensing of Intellectual Property (IP Guidelines) setting forth policies for the enforcement of intellectual property licensing.²¹⁴ The IP Guidelines provide that intellectual property pooling is valuable when it is pro-competitive. Patent pools’ pro-competitive function can be achieved when the pool integrates complementary technologies, reduces transaction costs, clears blocking positions, avoids costly infringement litigation, and promotes dissemination of technology.²¹⁵

In order to tackle the problems caused by gene patenting, a “pro-competitive” patent pool containing patents on gene sequences needs to be created. The pool would be administered by an independent

207. See generally *E. Bement & Sons v. Nat’l Harrow Co.*, 186 U.S. 70 (1902) (holding that party’s decision to grant an exclusive license to use a patent did not violate antitrust laws). See also Carlson, *supra* note 200, at 373.

208. Carlson, *supra* note 200, at 374.

209. See *Standard Sanitary Mfg. Co. v. United States*, 226 U.S. 20 (1920) (dissolving a patent pool that fixed prices and excluded unlicensed manufacturers); *Hartford-Empire Co. v. United States*, 323 U.S. 386 (1945) (dissolving a patent pool of major glass manufacturers because the pool allowed its members to maintain unreasonably high prices).

210. Carlson, *supra* note 200, at 375.

211. See *id.* at 376.

212. Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CAL. L. REV. 1293, 1355 (1996) (“[F]ederal antitrust policy is the most likely explanation for the small number of patent pools existing today.”).

213. *Id.*

214. U.S. DEP’T. OF JUSTICE & FED. TRADE COMM’N, ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY (Apr. 6, 1995), available at <http://www.usdoj.gov/atr/public/guidelines/ipguide.htm>. (last visited Jan. 20, 2004).

215. *Id.* at 27-28.

non-profit organization that maintains the patent portfolio and oversees strict regulations for the pool. The administrator would be in charge of collecting and distributing royalties and enforcing and terminating licenses.²¹⁶ Additionally, the administrator can also solicit and negotiate licenses to non-members on behalf of its participating members to maximize the values of patents in the pool.²¹⁷ An automated database linked with the USPTO should be put in place to monitor and flag changes to patents' status, to maintain the integrity of the pool by eliminating expired or unscrupulous patents in a timely manner. The pool would be created with a mechanism in place that would act to avoid antitrust problems. Licensing fees should be determined according to market values, which can be achieved by regular market evaluations. All members participating in the pool should agree to license their patents to prevent blocking patents from arising. To "maximize convenience and access and minimize transaction costs," the patent pool should be "comprehensive in scope."²¹⁸ The sequence patent pool needs to have a broad horizontal scope within a discipline.²¹⁹ For instance, it should encompass "genetic information likely associated with a particular biological function."²²⁰ Particularly, it may include DNA, RNA, proteins, receptors and more. Moreover, the pool may be furnished with a "more vertical integration of scientific methods across various disciplines,"²²¹ incorporating techniques such as recombinant DNA technology, gene therapy techniques, cell lines, computer modeling, and more. Finally, to protect the rights of pool members, information contained in the pool is open to the public with a nominal access fee for participating members and a slightly higher fee for non-members. This format is analogous to that of the music industry in managing copyrights.

A sequence pool with the design mentioned above will be beneficial to patent holders and the public at large. The major problem of gene patenting, "the tragedy of the anticommons," will be addressed by the pool. First, the pool would significantly reduce

216. Lawrence M. Sung, *Greater Predictability May Result in Patent Pools*, Presented at FTC/DOJ Hearings to Highlight Business and Economic Perspectives on Competition and Intellectual Property Policy 6 (Apr. 17, 2002), available at <http://www.ftc.gov/opp/intellect/020417lawrencemsung1.pdf> (last visited Jan 20, 2004).

217. Resnik, *supra* note 201.

218. *Id.*

219. Sung, *supra* note 216, at 6.

220. *Id.*

221. *Id.*

transaction costs. It would be fairly easy and simple to obtain necessary licenses to use patented gene sequences. A researcher, who would otherwise need to obtain licenses from multiple parties, now would only have to contact one entity to secure a number of licenses, saving time, money and resources.²²² Second, the pool can alleviate the problem associated with “stacking licenses.” By abolishing “reach-through” licensing agreements, the pool would encourage cooperative efforts needed to realize the true economic values of genomic inventions.²²³ It would provide sufficient access to patented technologies. A party in need of a patented sequence would not have to fear rejection from patent holders, nor need to take a compromising reach-through license with high license fees. By using the pool, he or she would be confident of obtaining a license to use the patented sequence at a reasonable royalty rate.

Furthermore, a sequence pool will increase the likelihood of a company recouping its investments in research and development. A structure built into the pool can allow all members to receive a set income based on a percentage of the pool’s royalty regardless of the economic value. This arrangement distributes benefits and risks evenly to all its members,²²⁴ thus providing incentives for inventors to participate in the pool. Also, the pool fosters free information exchange among its members and licensees.²²⁵ The more information a party receives, the more competitive it gets. As more members join into the pool, more information would be available for exchange. In order to maximize limited resources, participants would be motivated to share information and avoid overlapping efforts. Consequently, upstream research and downstream product development will be more efficient as each party focuses on its core abilities, thereby advancing genomic innovations at a faster pace.

Lastly, the use of a patent pool would make patented diagnostic sequences more accessible and more convenient. The pool would not preclude anyone from using the patented sequences. As more parties are allowed to use patented sequences and build on them, more competitive diagnostic products will be introduced to the market. It would drive up the quality while lowering the cost of diagnostic testing tools. Meanwhile, the pool would also produce an inhibiting effect on monopoly. Doctors, who wish to use a patented diagnostic

222. See *Merges, supra* note 197, at 25.

223. See *Sung & Pelto, supra* note 216, at 3-5.

224. See *id.*

225. *Merges, supra* note 197, at 22.

tool to detect the presence of certain diseases in their patients, would no longer be compelled to send samples to the patent holder's laboratory for results. Upon acquisition of a license through the patent pool, physicians would be able to conduct testing procedures within their own facilities. Moreover, by allowing greater involvement by more parties, implementation of patent pools would ensure that essential inventions are fully exploited and appreciated. In addition to reducing transaction costs, the pool would serve to promote wide adoption of patented inventions and related products. Eventually, the public will be benefited by more affordable and easily accessible diagnostic tests.

2. Research Exemptions

In addition to a patent pool that preserves the incentive nature of the patent system, Congress should enact a research exemption for non-commercial researchers. The exemption would allow researchers to utilize patented genetic sequences for non-commercial purposes.²²⁶ A researcher, who experiments to understand and improve the patented product or method, would not be held liable for infringement. In contrast, a developer who experiments to exploit the invention would be liable for infringement.²²⁷ Such an exemption addresses the "perceived need to allow patents for developing new research tools and instrumentation."²²⁸

The U.S. patent law does not have a statutory exemption for non-commercial or experimental use of a patented invention, except for two specific provisions, 35 U.S.C. § 271(e)(1) and § 287 (c). Section 271(e)(1), enacted in 1984 as part of the Hatch-Waxman Act, exempts infringing activities that are "solely for uses reasonably related to the development and submission of information" to the Food and Drug Administration for approval.²²⁹ Section 287(c) releases medical practitioners and institutions from liability if they merely practice a patented procedure of treatment that does not involve a patented drug or device.²³⁰ Neither of these two exemptions applies to the use of patented inventions in research or experimental contexts.

226. Donna M. Gitter, *International Conflicts Over Patenting Human DNA Sequences in the United States and the European Union: an Argument for Compulsory Licensing and A Fair-Use Exemption*, 76 N.Y.U. L. REV. 1623, 1684 (Dec. 2001).

227. Barton, *supra* note 134, at 1342.

228. *Id.*

229. 35 U.S.C. § 271(e)(1) (2000).

230. 35 U.S.C. § 287(c).

Nonetheless, the academic community would argue that a judicial doctrine of experimental use defense should be available. The original evidence for this claim dates back to 1813. In *Whittemore v. Cutter*, the Supreme Court said in dictum that "it could never have been the intention of the legislature to punish a man, who constructed [a patented] machine merely for philosophical experiments, or for the purpose of ascertaining the sufficiency of the machine to produce its described effects."²³¹ Although the statement had no binding effect on subsequent courts, it paved the road for experimental defense. By 1861, it was well settled that experimentation "for the sole purpose of gratifying a philosophical taste, or curiosity, or for mere amusement" is not infringement.²³² In 1935, the court in *Ruth v. Stearns-Roger Manufacturing Co.* held that the use of a patented invention in a university laboratory meets the criteria of experimental use defense.²³³ However, in recent years, courts have been leaning toward the other direction. Twenty years ago, in *Roche Products, Inc. v. Bolar Pharmaceutical Co.*, the Federal Circuit denied that the experimental use defense applies to a generic drug manufacturer's use of a patented drug to carry out clinical trials.²³⁴ Congress responded to the decision by enacting the Hatch-Waxman Act to expressly permit this particular experimental use.²³⁵ The most recent decision addressing the applicability of the experimental use defense is found in *Madey v. Duke University*.²³⁶ The Federal Circuit further narrowed the scope of the experimental use defense. The court concluded that the important factor is whether the use of patented inventions was "in keeping with the alleged infringer's legitimate business, regardless of commercial implications."²³⁷ When noncommercial projects at a major research institution "unmistakably further the institution's legitimate business objectives, including educating and enlightening students and faculty participating in these projects," the experimental use defense is not applicable.²³⁸ The ramifications of this decision is alarming as it virtually makes the experimental use defense worthless to research institutions.

231. 29 F. Cas. 1120, 1121 (D. Mass. 1813).

232. *Poppenhuisen v. Falke*, 19 F. Cas. 1048, 1049 (S.D.N.Y. 1861).

233. 13 F. Supp. 697 (D. Colo. 1935).

234. 733 F.2d 858 (Fed. Cir. 1984).

235. See *supra* note 229 and accompanying text.

236. 307 F.3d 1351 (Fed. Cir. 2002).

237. *Id.* at 1362.

238. *Id.*

In contrast to the U.S., patent laws in European Union nations and Japan contain statutory exemption provisions for research.²³⁹ The EU's provisions expressly exempt liability for otherwise infringing "acts done for experimental purposes relating to the subject-matter of the patented invention."²⁴⁰ The European case law also supports that the experimental use doctrine may be applied not only to non-commercial situations but also to a commercial context under certain circumstances.²⁴¹

Research exemptions in the U.S. are urgently needed to allow the academic community to continue to pursue its mission. One of the major objectives for research universities is to "push the needle on the state of the art, to pinch, touch, poke and feel the latest innovations."²⁴² Without a research exemption from patent infringement claims, researchers operate without shields when they are immersed into works that further their main goal of developing cutting edge technologies. Researchers should not live in fear that a patent owner might assert an infringement claim against them. Non-commercial research efforts should not be undermined because patent rights produce a curtailing side effect.

It is clear that there is an immediate need for Congress to codify statutory provisions to exempt non-commercial research activities. Statutory exemption provisions would provide researchers with a solid legal base for asserting the experimental use defense against infringement actions. They would also protect academicians conducting research from undesirable situations where the patent owner is unwilling to grant licenses.²⁴³ Furthermore, the exemptions would help to sustain the confidence of research communities by allowing more freedom in utilizing patented technologies.

As an example, to facilitate research exemptions, Congress could pass the two bills introduced by Representative Lynn Rivers of Michigan in 2002, the Genomic Science and Technology Innovation

239. Murashige, *supra* note 141, at 1335. See also William R. Cornish, *Experimental Use of Patented Inventions in European Community States*, 29 INT'L REV. INDUS. PROP. & COPYRIGHT L. 735, 735-36 (1998).

240. Gitter, *supra* note 226, at 1689 (citing Gen'l Secretariate of the Council of the Eur. Communities, Records of the Luxembourg Conference on the Community Patent 1973 [sic, 1975], art. 31(b), at 302).

241. Cornish, *supra* note 239.

242. Stephen B. Maebius & Harold C. Wegner, *The Looming Crisis Over the Research Use Exception To Patent Infringement: What Madey Taught Duke University*, FindLaw.com, at http://library.lp.findlaw.com/educationlaw_1_145_1.html (Jan. 2003) (last visited Jan. 20, 2004).

243. Gitter, *supra* note 226, at 1686.

Act of 2002 (“Innovation Act”)²⁴⁴ and the Genomic Research and Diagnostic Accessibility Act of 2002 (“Accessibility Act”).²⁴⁵ The bills were created to address the increasingly burdensome effects of human gene patenting. They are intended to provide limited exemptions “designed to minimize some of the negative impacts of [gene] patents on the practice of medicine and the advancement of science.”²⁴⁶

The Innovation Act requests the Director of the Office of Science and Technology Policy to conduct studies on the effects of gene patenting.²⁴⁷ The study would assess the impact of gene patenting on genomic technology innovation, and examine the current intellectual property schemes, as well as alternative mechanisms of protection and incentives. The Accessibility Act proposes two exemptions and a provision on rapid disclosure of genomic sequence information.²⁴⁸ The first provision contains an exemption for research uses. Defining research as an investigation “designed to develop or contribute to generalized knowledge,”²⁴⁹ the provision exempts uses of patented gene sequence information for non-commercial research purposes. It also provides that, if a researcher discovers a valuable commercial application, the researcher may not exploit it without permission from the patent holder. The second section introduces a diagnostic use exemption.²⁵⁰ Without this provision, physicians may be using less effective methods because of fear of infringement, and time-consuming license negotiation may block the usage of the most effective disease detection systems. Under this exemption, medical personnel may use genetic diagnostic tests without being subject to patent infringement actions.²⁵¹ Broader than the current exemption under section 287(c), the new provision protects not only uses of patented procedures but also uses of patented products, giving more discretion to physicians. Lastly, the third section of the Accessibility Act calls for a faster disclosure of genetic sequence information contained in patent applications that are filed for inventions funded by

244. Genomic Science & Technology Innovation Act of 2002, H.R. 3966, 107th Cong. (2d Sess. 2002) [hereinafter Innovation Act].

245. Genomic Research & Diagnostic Accessibility Act of 2002, H.R. 3967, 107th Cong. (2d Sess. 2002) [hereinafter Accessibility Act].

246. 148 CONG. REC. E. 353 (daily ed. Mar. 14, 2002) (remarks by Rep. Rivers).

247. Innovation Act, *supra* note 244.

248. Accessibility Act, *supra* note 245.

249. *Id.*

250. *Id.*

251. *Id.*

the federal government. To promote information sharing in a timely manner, this provision requests the information to be published in 30 days from the filing of application, instead of 18 months under the USPTO's guidelines.

Together the two bills will serve to protect the interests of researchers working on projects without commercial purposes. They would enhance the "availability and usefulness of gene-based diagnostics in the overall health care system," and to allow for the "essential medical progress to continue un-abated."²⁵²

VII. CONCLUSION

In the past 200 years, patents have played a remarkable role in encouraging technological inventions and promoting commercial development.²⁵³ The inherent innovative nature of the patent system will likely allow genomic patents to be embedded in bioscience and be carried into the next biological revolution. Because DNA sequences are uniquely different from traditionally patented subject matters, changes are necessary to resolve the shortcomings caused by gene patents.

Viewed constructively, the existing policies, the USPTO's revised utility examination guidelines and inter partes re-examination procedure, will serve to resolve some of the present concerns on gene patenting. By requiring all gene related inventions to have a well-established utility or an asserted utility that is specific, substantial and credible, the guidelines will become a gatekeeper against insubstantial patents. The inter partes re-examination procedures provide an inexpensive and quick means for a third party to challenge invalid patents.

In addition to current schemes, a patent pool and a research exemption should be built into the system. A pool of genomic patents will be an effective solution to avert "the tragedy of anticommons." By designing and implementing a patent pool that promotes information sharing and encourages cooperation among patent holders, both commercial industry and the general public will be granted efficient access to patented sequences. Ultimately, the pool will serve to eliminate any hindering effects from patenting DNA sequences. A statutory research exemption provision will relieve the restraints that gene patents have placed on non-commercial research.

252. 148 CONG. REC. E. 353 (daily ed. Mar. 14, 2002) (remarks by Rep. Rivers).

253. David Korn & Stephen J. Heinig, *Introduction: Patents, Genomics, and Academic Medicine*, 77 ACAD. MED. 1301 (Dec. 2002).

The exemption will allow researchers, even with limited financial resources, to access the latest inventions and discoveries without worrying about infringing others' patents. The research community as a whole will benefit from the freedom to work with and build on patented technologies.

By integrating plausible mechanisms, gene patenting will foster more genomic inventions and discoveries, further information dissemination and sharing, allow more competitive products to be cultivated, and ultimately provide essential benefits to the public.

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