



THE GENETIC AGE: WHO OWNS THE GENOME?  
*A SYMPOSIUM ON INTELLECTUAL PROPERTY AND THE HUMAN  
GENOME*

Featuring the Remarks of

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“The rewards of new scientific knowledge will flow to those persons, organizations and nations that put a premium on anticipating and shaping the future rather than simply reacting to it.”<sup>4</sup>

INTRODUCTION<sup>5</sup>

Woodrow Wilson once said, “I can use all the brains that I have and all those I can borrow.”<sup>6</sup> The Woodrow Wilson Center, created to bridge the worlds of scholarship and policymaking,<sup>7</sup> adopted this credo of its namesake, and nowhere is the remark more poignant than when applied to the mapping of the human genome. Few areas of knowledge will have a more profound impact on our society than

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<sup>1</sup> This is the second in a series of Genetic Age programs supported by the Affymetrix Corporation that are aimed at fostering a greater understanding of human genome research and its implications for society. For more information, *see infra* note 5.

<sup>2</sup> This article is based on a transcript of the event “Who Owns the Genome?” that took place at the Woodrow Wilson International Center for Scholars in Washington, D.C. on Sept. 24, 2002. The webcast version of the event is available at <http://www.geneticage.org/> (last visited Oct. 17, 2002). The event was co-sponsored by the Affymetrix Corporation. The Wilson Center and Affymetrix have made the transcript available for educational purposes. The actual transcript in full text is available at <http://wwics.si.edu/NEWS/geneticage.htm> (last visited Oct. 17, 2002).

<sup>3</sup> Editor’s note: The Review of Intellectual Property Law would like to thank Adrienne N. Kitchen for her editorial contributions in converting the transcript of the program into article format.

<sup>4</sup> Hon. Lee H. Hamilton, *Welcoming Remarks to “Who Owns the Genome?”*, Sept. 24, 2002, at <http://wwics.si.edu/NEWS/leegenome.htm> (last visited Oct. 28, 2002).

<sup>5</sup> The introduction is comprised of remarks by Lee Hamilton, Director of the Woodrow Wilson Center and Dr. Stephen P.A. Fodor, Founder, Chairman, and CEO of Affymetrix. Mr. Hamilton’s biography may be found at <http://wwics.si.edu/mediaguide/hamilton/htm> (last visited Oct. 17, 2002). Affymetrix Corporation, a co-sponsor of the event, began operating from Santa Clara, CA in 1993 and is now considered a leader in developing new technologies for analyzing complex genomic information for use in biomedical applications. The Affymetrix website is located at <http://www.affymetrix.com/index.affx> (last visited Oct. 5, 2002).

<sup>6</sup> *See* Quotations by Author: Woodrow Wilson (1856 – 1924), at [http://www.quotationspage.com/quotes/Woodrow\\_Wilson/](http://www.quotationspage.com/quotes/Woodrow_Wilson/) (last visited Oct. 17, 2002).

<sup>7</sup> *See* Woodrow Wilson International Center for Scholars, at <http://wwics.si.edu/> (last visited October 8, 2002) (noting the recent events at the center including “The Genetic Age 2: Who Owns The Genome?”).

genetics. Indeed, it is hard to imagine a world changing more rapidly than the world of genetics. Next year we mark the fiftieth anniversary of Watson and Crick's discovery of the structure of DNA,<sup>8</sup> one of the most profound scientific discoveries of the twentieth century. Yet to put this in perspective, the sequencing of the human genome was only announced just over two years ago.<sup>9</sup> The distance that genetic science has traveled in those two years is astounding in comparison to its fifty-year history. Future historians will refer to the sequencing of the human genome<sup>10</sup> as one of the greatest scientific accomplishments of mankind.

In addition to the substantive research benefits that genome mapping creates, it should be noted that the sequencing procedure may rank as once of science's most beautiful endeavors.<sup>11</sup> The experiments of Newton,<sup>12</sup> Cavendish,<sup>13</sup> Millikan,<sup>14</sup> Young,<sup>15</sup> Rutherford<sup>16</sup> and others are comparable to genome sequencing in that they combine a simplicity of analysis with the beauty of science grappling with the mysterious.<sup>17</sup>

The application of this knowledge will be just as stunning and also profoundly challenging to public policy. How we prepare both the public and our policymakers to deal with the flood of new genetic knowledge and its applications will be critical to our ability to harvest its benefits in this new world that is upon us. As Dr. Rita

<sup>8</sup> See The Structure of DNA, Crick and Watson, 1953, at [http://www.phy.cam.ac.uk/camphy/dna/dna15\\_1.htm](http://www.phy.cam.ac.uk/camphy/dna/dna15_1.htm) (last visited on Oct. 18, 2002) (discussing briefly Crick and Watson and how they discovered the structure of DNA).

<sup>9</sup> See David Baltimore, *Our Genome Unveiled*, 409 NATURE 814 (2001), available at [http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v409/n6822/full/409814a0\\_fs.html](http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v409/n6822/full/409814a0_fs.html) (last visited Oct. 28, 2002) (speaking to the profound developments expected following the unveiling of our human genome).

<sup>10</sup> See The Human Genome Project Information, available at <http://www.ornl.gov/hgmis/> (last visited Oct. 5, 2002) (citing the goals and current status of the United States Department of Energy sponsored project intending to sequence the entire human genome; announcing completion of the first near-complete human genome in June 2000).

<sup>11</sup> See George Johnson, *Here They Are, Science's 10 Most Beautiful Experiments*, THE NEW YORK TIMES, Science, Sept. 24, 2002 (referring to and describing the top experiments that have grabbed the world's attention because of their "beauty").

<sup>12</sup> See Sir Isaac Newton, at <http://wwwgap.dcs.stand.ac.uk/~history/Mathematicians/Newton.html> (last visited Oct. 8, 2002) (providing a brief synopsis of Newton's contributions to science).

<sup>13</sup> See Henry Cavendish, at <http://chemistry.mtu.edu/PAGES/HISTORY/HenryCavendish.html> (last visited Oct. 8, 2002) (providing a biography of Cavendish including his well-known accomplishments of determining the composition of water and his early measurements for the density of the earth). See also Henry Cavendish, *Experiments on Air*, excerpted from PHILOSOPHICAL TRANSACTIONS 75, 372 (1785), available at <http://webserver.lemoyne.edu/faculty/giunta/Cavendish.html> (last visited Oct. 5, 2002) (featuring a narrative from Cavendish's early experiments on air, with illustrations).

<sup>14</sup> See Robert A. Millikan, Biography, available at <http://www.nobel.se/physics/laureates/1923/millikan-bio.html> (last modified Sept. 24, 2002).

<sup>15</sup> See NEW BEER IN AN OLD BOTTLE: EDUARD BUCHNER AND THE GROWTH OF BIOCHEMICAL KNOWLEDGE (A. Cornish-Bowden ed., *Universitat de València* 1997), available at <http://bip.cnrs-mrs.fr/bip10/harden.htm> (last modified Sept. 26, 2002).

<sup>16</sup> See A Science Odyssey: People and Discoveries, Ernest Rutherford 1871-1937, at <http://www.pbs.org/wgbh/aso/databank/entries/bpruth.html> (last visited Oct. 8, 2002).

<sup>17</sup> Johnson, *supra* note 11.

Colwell,<sup>18</sup> Director of the National Science Foundation, remarked last year, “[W]e need to develop a broader, more anticipatory perspective in our research. We need to increase our emphasis on envisioning future possibilities, good or ill, as a mechanism to predict.”<sup>19</sup> Anticipation, though, is not an easy task, and the science of genetics will challenge us in many ways. Thus, we need a much more vigorous and open debate on both the science and its implications.

The public policy changes in modern genetics are formidable, made even more so by the speed with which life sciences are advancing. A combination of public and private resources is now driving progress, and we now have tools to enable whole genome analysis. However, we should all realize that our knowledge of the human genome is still vastly outweighed by what we still do not know.

Nowhere are these challenges greater than in the field of intellectual property.<sup>20</sup> Policymakers face the daunting task of constructing, interpreting and administering a framework of laws and regulations that must strike a balance between the private sector’s need to reward innovation and the public’s right to reap the benefits and advances in genomics in order to improve the quality of our lives. The mission of this conference is to address future long-term policy challenges to our society and government. Through discussions such as these, we hope to better understand the present and prepare ourselves for a future that will certainly hold many surprises and present many obstacles. Patenting the genetic sequence presents potential benefits and consequences to the economy and the public at large, and many of these “pros and cons” will be addressed and challenged in this article from several varying perspectives.

Section I, Part A of this article provides background information on the patenting system in the United States, including its history and function as well as outlining the requirements for a patent. Part B discusses the standards involved in the patenting of genetic material and provides examples of drugs and tests that have been developed and patented over time. Part C examines the progression of gene patenting standards, including the utility, novelty, and non-obviousness requirements, at the United States Patent and Trademark Office (USPTO).

Section II, Part A discusses the economic realities of patenting genetic material, including the high costs of research and development, the various investment methods companies employ, and the challenge of identifying a gene that will lead not only to a potential cure but to a healthy profit margin. Part B presents a critical view from the academic world on the qualifications of genetic materials for patenting and outlines the ongoing debate between the scholars and the legal community. Part C describes the ethical issues that arise when genes are patented and hints that limited access to information and the potential for accidental disincentivation of innovation may arise as the debate continues and technology advances. Finally, Part

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<sup>18</sup> See Dr. Rita R. Colwell’s Biography, National Science Foundation, Office of Legislative and Public Affairs (OLPA), at <http://www.nsf.gov/od/lpa/forum/colwell/rrcbio.htm> (last visited Oct. 5, 2002).

<sup>19</sup> See Remarks to the Council of Scientific Society Presidents at the American Chemical Society Building, Washington, DC, (Nov. 19, 2001), at <http://www.nsf.gov/od/lpa/forum/colwell/start.htm> (last visited October 2, 2002).

<sup>20</sup> See Genetics and Patenting, available at <http://www.ornl.gov/hgmis/elsi/patents.html> (last visited Sept. 27, 2002) (providing a general overview of the broad issues involved in genetics and patenting).

D introduces a sample real-life scenario in the “Canavan case” and touches on the consequences of patenting life-saving genetic “discoveries.”

Section III suggests solutions to several of the problems in patenting the genome that were introduced in Section II. Part A suggests that patent licensing procedures require closer scrutiny by both parties involved – the researcher licensors and the industry licensees. Part B encourages drug development to continue at later stages of the game in order to foster competition and lower prices for actual consumers. Part C advocates the establishment of standards in light of 35 U.S.C. § 103 to determine a “real total value” of the potential economic and social returns of these processes that will give investors as well as the public the benefit of their bargain. Part D suggests that the USPTO and the courts reexamine the “inventive act” standard and its application in order to guide the standards for patenting the genome. The Conclusion of the article acknowledges that this issue will remain controversial as technology advances and genetic innovation becomes more easily applicable to and essential to solving medical diseases and disorders that affect us all.

## I. BACKGROUND<sup>21</sup>

It is probably safe to say that when Watson and Crick published their discoveries in April of 1953,<sup>22</sup> they could not have imagined that their field would eventually become a battleground in quite the way that it has. Two years ago, of course, the world tuned in as President Clinton and Britain’s Prime Minister, Tony Blair, hooked up by satellite and announced a monumental achievement: the draft sequences of the human genome.<sup>23</sup>

Even as they spoke, commercial interests were following that research, and for twenty years they have shadowed the public science of genetic research, because

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<sup>21</sup> Section I consists primarily of the remarks of Justin Gillis and Q. Todd Dickinson, J.D. Justin Gillis served as the moderator for this panel discussion. Mr. Gillis is a reporter on the business news desk of The Washington Post and specializes in coverage of the biotechnology industry. For more information on Justin Gillis, visit [http://web.med.harvard.edu/healthcaucus/bg\\_gillis.html](http://web.med.harvard.edu/healthcaucus/bg_gillis.html) (last visited Oct. 7, 2002). Q. Todd Dickinson is a partner at the law firm of Howrey Simon Arnold & White and is the former Under Secretary of Commerce for Intellectual Property. Mr. Dickinson served as Deputy and then as Commissioner of the United States Patent and Trademark Office (USPTO) from 1997-2001. Mr. Dickinson has more than twenty-five years of experience in all aspects of intellectual property law and public policy, including patents, trademarks, copyrights, and trade secrets and has written extensively on subjects from genomic patents to e-commerce and IP enforcement in a knowledge-based economy.

<sup>22</sup> See James D. Watson & Francis Harry Compton Crick, *A Structure of Deoxyribose Nucleic Acid*, 171 NATURE 737 (1953), available at <http://www.dna50.org/main.htm> (last visited Oct. 28, 2002) (“We wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.”).

<sup>23</sup> See Joint Statement by President Clinton and Prime Minister Tony Blair of the U.K., The White House Office of the Press Secretary (Mar. 14, 2000), available at <http://usinfo.state.gov/topical/global/biotech/00031401.htm> (last visited Oct. 2, 2002) (“[U]ncumbered access to this information will promote discoveries that will reduce the burden of disease, improve health around the world, and enhance the quality of life for all humankind.”).

they want to ultimately produce cures for disease.<sup>24</sup> The means by which they aim to do that is by patenting the genetic sequence. For two decades, United States policy has permitted private interests to patent pieces of the genome and the genetic sequence.<sup>25</sup> For some time, this patenting procedure slouched under the radar, evoking little public discussion or audible dissent. In recent years, however, the dialogue has increased so extensively that we now have a vigorous debate about whether the current policy is the right policy, and whether we are creating problems for ourselves down the road.<sup>26</sup>

### *A. The Patenting System in the United States*

To understand the issues at odds here, we must begin by discussing the patent system in the United States, namely: (1) what patents are; (2) what the patenting process is; and (3) how it relates to genomics. Essentially, patents are grants from the federal government that give inventors the right to prevent others from copying their inventions. In this way, the title of this program, “Who Owns the Genome?” is a bit of a misnomer. Inventors holding patents do not actually *own* the invention – they own the right to restrict others’ access to it for the statutorily-designated period of time. Currently, that term stretches twenty years from the date that the patent application is filed.<sup>27</sup>

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<sup>24</sup> See Marshfield Clinic, Accomplishments in the Lab, Center for Medical Genetics: \$22 Million Allows Additional Research of Disease-Causing Genes, *available at* [http://www.marshfieldclinic.org/home/systemreview/mmr/medical\\_genetics.asp](http://www.marshfieldclinic.org/home/systemreview/mmr/medical_genetics.asp) (describing how a \$22 million funding extension will allow researchers to continue mapping disorder-influencing genes). Lead scientist Dr. James L. Weber explained the goal of the further research, saying, “We’re hunting for the genes that cause disease. Once the gene is isolated, we can use it in prevention. We can screen for people who have risk factors and ameliorate the disease.” *Id.*

<sup>25</sup> See Rebecca S. Eisenberg, *Patent Rights in the Human Genome Project*, in GENE MAPPING: USING LAW AND ETHICS AS GUIDES 226, 226-28 (George J. Annas and Sherman Elias eds., 1992), *available at* <http://www.bumc.bc.edu/www/sph/lw/pvl/book2/14-Patent%20Rights%20in%20the.pdf> (last visited Oct. 28, 2002) (discussing the law and policies surrounding patents and the human genome project). The work concludes that the main policy “rests on the assumption that patenting helps to ensure widespread availability of the results of sponsored research through commercial dissemination.” *Id.* at 240.

<sup>26</sup> See *id.* at 229-30 (“[P]erhaps the biggest danger that patenting presents to progress in the Genome Project is that researchers seeking to preserve patent rights will defer publication of their findings and thereby retard the dissemination of new knowledge. . . [A] potentially more harmful consequence of patenting discoveries made in the course of the Genome Project is that patent holders could restrict access to these discoveries in ways that impede subsequent research.”); see also Dr. David King, Statement at Human Genetics Alert Press Briefing (June 14, 2000), *available at* <http://www.hgalert.org/topics/lifePatents/patent.htm> (last visited Oct. 22, 2002) (discussing the negative policies surrounding patenting discoveries made in the Human Genome Project).

<sup>27</sup> 35 U.S.C. § 154(a)(2) (1994 & Supp. 1999).

### 1. History and Function of the Patent System

Why do we have this system? First, it is historically founded in the United States Constitution.<sup>28</sup> The inaugural Congress of the United States crafted the first patent law. The purpose of this system is to encourage innovation and also to provide incentive for inventors to disclose their inventions, rather than keep them private as “trade secrets.”<sup>29</sup> In so disclosing the inventions, the inventors allow others to take that novel information and build on it to move technology forward.<sup>30</sup> Patents provide monetary incentive and an economic underpinning for a great deal of investment, particularly in high-tech or start-up biotechnology companies that are pounded with questions by potential venture capitalists such as, “What kinds of patents do you have?” and “How can you protect these new inventions from being stolen by others?”

The United States government, through the U.S. Patent and Trademark Office (USPTO) grants patents to a variety of inventions in broad categories.<sup>31</sup> Chemicals, processes, machines and apparatuses, among other things, are some examples of “things” that may be patented. Any inventor may apply for a patent,<sup>32</sup> including a private interest inventor, a public sector inventor, any institutional or university inventor, and non-profit organizations.

### 2. Patent Requirements

There are, however, limitations on the right to patent. There are four statutory requirements that must be fulfilled in order to obtain a patent. First, the patent must show a use or utility.<sup>33</sup> Much of the debate over patenting the genome centers on where the standard for utility lies in the law at the moment.

The second requirement is that the patented invention must be new.<sup>34</sup> The inventor must be the first inventor.<sup>35</sup> If it is discovered that someone else invented

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<sup>28</sup> See U.S. CONST. art. I, § 8, cl. 8. “The 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.” *Id.*

<sup>29</sup> See *Forest Laboratories, Inc. v. Formulations, Inc.*, 299 F. Supp. 202, 205 (E.D. Wis. 1969) (“A trade secret is. . . [a]ny formula, pattern, device or compilation of information which is used in one’s business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. It may be a . . . process of . . . treating or preserving materials.” (quoting RESTATEMENT OF TORTS § 757 cmt. b (1939), *superseded by* RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 39 (1995))).

<sup>30</sup> See *Bonito Boats, Inc. v. Thunder Craft Boats, Inc.*, 489 U.S. 141, 150-51 (1989) (explaining the policy that the exclusive rights of the patentee are granted for a limited time, and then the knowledge of the invention is given to the people, who can then use it without restriction). “The attractiveness of such a bargain, and its effectiveness in inducing creative effort and disclosure of the results of that effort, depend almost entirely on a backdrop of free competition in the exploitation of unpatented designs and innovations.” *Id.*

<sup>31</sup> See 35 U.S.C. § 101 (1994) (“Whoever 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 therefore, subject to the conditions and requirements of this title.”).

<sup>32</sup> *Id.*

<sup>33</sup> *Id.*

<sup>34</sup> *Id.*

your invention before you did, and that is confirmed by a search of prior art at the USPTO, you will not receive that patent. For example, during the course of the human genome project, the National Institute of Health<sup>36</sup> would enter each day's discoveries into an Internet database nightly. Interestingly enough, this created prior art;<sup>37</sup> because they did not seek patents on what they invented when they posted on the Internet, the practice created a priority against all others.

Third, the patented invention must be non-obvious.<sup>38</sup> The invention cannot be so incrementally different from prior inventions that it is obvious to a "skilled practitioner in the art."<sup>39</sup>

Finally, the patented invention must be fully disclosed.<sup>40</sup> The laws governing this are statutory and are hence subject to interpretation by the courts. Essentially, this means that Congress and the United States courts carry much of the burden of interpreting these disclosures. Yet at the ground level, the USPTO has to deal with disclosure issues every day of the week.

### *B. Patenting Genes: Standards and Examples*

Genes, particularly human genes, present themselves as difficult subjects for patenting, depending on who is asked. Genes are essentially complex chemical compositions.<sup>41</sup> Chemical compositions, along with pharmaceuticals and other discovered or invented chemicals have been patentable since the earliest stages of the patenting system.<sup>42</sup> However, issues arise when genes are asserted to be

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<sup>35</sup> See 35 U.S.C. § 102 (1994 & Supp. 1999) (defining the circumstances in which a person is not entitled to a patent).

<sup>36</sup> See National Institute of Health, U.S. Department of Health and Human Services, Mission, available at <http://www.nih.gov/about/> (last visited Oct. 26, 2002) (explaining that the Institute is the "steward of medical and behavioral research for the Nation" and that "[i]ts mission is science in pursuit of fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to extend healthy life and reduce the burdens of illness and disability.").

<sup>37</sup> See 35 U.S.C. § 102 (1994 & Supp. 1999) (describing what constitutes prior art, thereby barring patentability); see also Walter J. Blenki, Jr., *Considering What Constitutes Prior Art in the United States* 43 (6) JOM 45 (1991), available at <http://www.tms.org> (discussing the statutory definitions of prior art under § 102 and defining prior art as "the entire body of knowledge from the beginning of time to the present.").

<sup>38</sup> See 35 U.S.C. § 103 (1994 & Supp. 1999) (describing the conditions that may lead to a patentability rejection based on obviousness).

<sup>39</sup> *Id.*

<sup>40</sup> See 35 U.S.C. § 112 (1994) (requiring an inventor to include a written description, a description that is enabling, and the best mode of their invention).

<sup>41</sup> See *Hitzeman v. Rutter*, 243 F.3d 1345, 1348 n.1 (Fed. Cir. 2001) ("[D]NA is deoxy-ribonucleic acid, a generic term encompassing the many chemical materials that genetically control the structure and metabolism of living things."); see also *Elan Pharmaceuticals v. Mayo Found. for Med. Ed. and Research*, 2002 U.S. App. LEXIS 18007, 3 ("[A] gene is a segment of DNA.").

<sup>42</sup> See 35 U.S.C. § 101 (1994) (stating that composition of matter is one of the four categories of patentable subject matter). But see *Animal Legal Defense Fund v. Quigg*, 932 F.2d 920, 922 (Fed. Cir. 1991) ("An article of manufacture or composition of matter occurring in nature will not be considered patentable unless given a new form, quality, properties or combination not present in the original article existing in nature in accordance with existing law.").

products of nature, as products of nature are not patentable.<sup>43</sup> A patent cannot issue to something that is found in nature in its naturally-occurring form. The argument follows that if humans carry their genes with them and are in fact composed of genes, this could be considered to be naturally-occurring, as there is no outside force at work or discovery to be had.

To mend this oppositional dichotomy as it pertains to genes, the patent issues on the isolated and purified form of the genome.<sup>44</sup> Simply put, the chemical composition must be discovered, isolated, and purified, and then put forward for a use that has not been known as of that time. In this case, the gene is patented, albeit not necessarily in its naturally-occurring form.<sup>45</sup>

One example of a similar method of characterization involves the patent issued on the drug Penicillin. Penicillin, as the familiar story goes, was “invented” in 1928 when mold in a petri dish was found to have anti-bacterial capabilities.<sup>46</sup> Dr. Flemming then isolated the active anti-bacterial ingredient from the mold, and a patent subsequently issued to the resulting drug, Penicillin.<sup>47</sup>

A second example that illustrates the non-importance of the “human” element in this patenting process is the patenting of human insulin. After the discovery that insulin served as the active component in the regulation of sugar metabolism, it was isolated and purified from its source, the human pancreas, making it patentable. Over time, the USPTO also issued patents to naturally-occurring insulin as well.

As a final example, the cancer-inhibiting drug Taxol,<sup>48</sup> when isolated from United States’ yew trees, is patentable. These examples show that significant numbers of pharmaceutical patents, in particular, issue to naturally-occurring substances that have been discovered and isolated from their natural sources.

### *C. Utility, Novelty & Non-Obviousness: Complexities in the Progression of Genetic Patenting Standards at the USPTO*

The three major issues involved in patenting the genome are the same as those that affect every patent and are required by statute: utility, novelty and non-obviousness.

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<sup>43</sup> See *Quigg*, 932 F.2d at 923 (“[P]roducts found in nature will not be considered to be patentable subject matter under 35 U.S.C. 101 and/or 102.”).

<sup>44</sup> See Utility Examination Guidelines, 66 Fed. Reg. 1092, 1093 (Jan. 5, 2001) (addressing public concerns by distinguishing the patenting of a genome, which is not allowed, from the patenting of a gene, which is allowed if done for a specific, substantial, and credible use).

<sup>45</sup> *Id.* at 1093.

<sup>46</sup> For a simple background of Dr. Flemming’s “accidental” discovery of Penicillin, see Susan Streble, The Evolution of Resistance to Penicillin (Dec. 12, 2001), at <http://www.webpub.alleggheny.edu/employee/r/rmumee/FS101/ResearchPapers/SusanStreble.html> (last visited Oct. 28, 2002). The drug was discovered when Flemming forgot to clean a petri dish containing staphylococcus bacteria. *Id.* Where a ring of mold had grown in the dish, the bacteria had died. *Id.* Flemming used his mistake to further research and develop the antibiotic he later named Penicillin. *Id.*

<sup>47</sup> *Id.*

<sup>48</sup> See The Taxol (paclitaxel) Story, at <http://www.taxol.com/timeli.html> (last visited Oct. 9, 2002) (outlining the history of the development of the drug Taxol).

Discussion of these issues begins with initial inquiries posited as to whether anything “inventive” occurs in the production of genetic data. After all, sequencing machines calculate the data and generate the information – it would outwardly appear as though this production involves little to no actual invention at all. The rebuttal to this argument lies in § 103 of the Patent Act, which states that the way an invention “comes about” does not negative whether a patent is issued or not. In fact, § 103 was originally intended to challenge a United States Supreme Court decision on the so-called “flash of genius” test.<sup>49</sup> The result negates the idea that tedious and conscientious efforts on the part of the inventor towards production of her invention are required. Thus, whether an amazing idea for an invention comes to an inventor in a dream, or while driving up the California coast, or over the course of thirty years of meticulous experimentation, the inventor is still entitled to a patent.

The issue of whether genes should be patented has been studied extensively. There have been numerous public hearings both at the USPTO and in Congress, not to mention countless private debates. The USPTO deals with these questions in a manner that has developed over time. It has been suggested that the history of patenting the genome resembles a swinging pendulum, in that the USPTO was extremely restrictive when genetic patenting began and then shifted to a somewhat looser standard. When the first patent applications for genes were filed, the USPTO maintained step-wise, fairly restrictive set of rules involving “wet biology” in the disclosure because of as-yet unclear utility questions.

The intervention of the courts changed this process. The courts looked to the language of the Patent Act and applied it liberally, essentially holding that satisfaction of the requirements entitled an inventor to a patent. As a result, the USPTO went back to the drawing board and crafted, among other rules, a set of guidelines for their patent examiners in line with the utility requirement. The basic question of utility, after all, asks what use these inventions are being put to and for what purpose are they sought out in discovery.

The USPTO received ample feedback from the public sector on their utility guidelines. The guidelines had little chance to remain static, however, upon the 1997 Federal Circuit decision *Regents of the Univ. of Cal. v. Eli Lilly*,<sup>50</sup> which cast new light on the utility and disclosure issues. The guidelines were revised once more after additional formal testimony as to its functionality in light of *Eli Lilly*.<sup>51</sup> Once again, the bar on utility guidelines was raised.

The Patent and Trademark Office now requires a three-part test of utility that demonstrates a difficult standard to meet, one that is certainly much tougher than the low-water marks of the past. Today an inventor must show (1) specific utility, (2) substantial utility, and (3) credible utility.<sup>52</sup> An example of credible utility may be demonstrated in an inventor’s claim to cure a disease formerly thought to

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<sup>49</sup> See *Graham v. John Deere Co.*, 383 U.S. 1, 17, n.8 (1966) (explaining that when it comes to patenting an invention, “[i]t is immaterial whether it resulted from long toil and experimentation or from a flash of genius.”).

<sup>50</sup> 119 F.3d 1559 (Fed. Cir. 1997), *cert. denied*, 523 U.S. 1089 (1998).

<sup>51</sup> See *id.*

<sup>52</sup> See Utility Examination Guidelines, 66 Fed. Reg. 1092, 1093 (Jan. 5, 2001) (“[W]here the application discloses a specific, substantial, and credible utility for the claimed isolated and purified gene, the isolated and purified gene composition may be patentable.”).

have no cure. The USPTO now requires the inventor to produce substantial trustworthy evidence to support that utility claim.<sup>53</sup>

The scope of these genome-patenting issues reaches far beyond what was likely ever imagined fifty years ago. At the moment, roughly 6500 patents relate to genes themselves or to open reading frames. Nearly 1300 of those patents are to the human genes, although many more exist in non-humans, such as the rice gene and the mouse genes. Collectively, about 20,000 patents are pending for genes themselves, fragments, snips, ESTs, and other genetic material.

One category that mixes in to the application pool is comprised of provisional, or place-holding, applications. Many of these never ripen into full patent applications and become actual patents themselves. The advantages to filing a provisional application, however, are that they require much less disclosure, and they cost far less. There are currently about 30,000 provisional applications on file at the USPTO.<sup>54</sup>

## II. ANALYSIS

### *A. The Economic Realities of Patenting the Genome*<sup>55</sup>

The premise of the human genome project is to decipher as much as possible about causes of human disease in order to find cures, refine therapies, and develop diagnostic tests to better our existence. That being said, privately-owned pharmaceutical and biotechnology companies conduct their business in furtherance of this goal.

#### *1. High Costs of Development and Production*

To develop such tests and cures, however, requires a great deal of money. The cost of creating a single drug that successfully passes FDA inspection and reaches patients in the public market requires an estimated \$500 million to \$800

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<sup>53</sup> *Id.*

<sup>54</sup> For an example of how provisional applications can be used in a somewhat “preemptive” manner, consider that the biotechnology company Celera announced that they would file 6,000 applications to genes they had discovered. In reality, they meant that they were going to file 6,000 provisional applications. After later clarification, Celera elected to file only 300 applications on actual gene sequence.

<sup>55</sup> The remarks contained in Section A are those of Scott A. Brown, J.D. Mr. Brown is the Vice President and Chief Patent Counsel of Millennium Pharmaceuticals, Inc. In his position at Millennium, Mr. Brown oversees development and implementation of Millennium's intellectual property strategy, including procurement of patents, review of intellectual property aspects of company transactions and analysis of intellectual property issues relating to Millennium's activities. Prior to joining Millennium, Mr. Brown was Senior Patent Counsel at Genetics Institute, Inc. and an attorney with the firms of Kenyon & Kenyon and Dorsey & Whitney.

million investment by a company.<sup>56</sup> Public interests do not generally invest in this kind of research and technology, and certainly do not do so at such high-dollar levels.<sup>57</sup> While private sector remains the main financier of this remarkable endeavor that ultimately benefits the public, it cannot and will not operate without a return on that investment.

Hence, the patent system plays a huge role in obtaining the investment that spawns these companies. Patent protection of the products of these industries ensures that investors and shareholders will recoup their initial capital and subsequent investments.<sup>58</sup>

## *2. Investment Methods and the Patent Lure*

There are three forms of investment, particularly in the biotech industry, that must be retained in order to produce successful pharmaceuticals. The three investment methods share a common theme, with the patent serving as the security on the multi-million dollar investments that get drugs on the market for public benefit.

Initially, one must obtain the venture capital to get the company started; to do that, there must be a great idea for a cure or test that is the product of very basic research. The first questions the venture capitalist will ask are whether a patent

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<sup>56</sup> See Joe Moser, *The Cost of New Drugs: A Fact Sheet*, GALEN INSTITUTE (May 7, 2002), available at <http://www.galen.org/news/050702.html> (last visited on October 18, 2002) (listing the average cost of developing a new drug at \$802 million USD); see also James Love, *How Much Does It Cost to Develop a New Drug?*, Consumer Project on Technology, (April 2, 2002) at <http://www.cptech.org/ip/health/econ/howmuch.html> (presenting report written for a meeting of the MSF Working Group on Research and Development in Geneva on April 2, 2000, showing how much it costs to develop new drugs).

<sup>57</sup> However, public academic institutions also file their fair share of patents. The Regents of the University of California system, for example, is known as the birthplace of biotechnology and genomic research and owns one of the largest collections of patents; they also license patents to private interests. See University of California, Los Angeles, *UCLA Patents (Selected)*, at <http://www.research.ucl.edu/patents/> (last visited Oct. 12, 2002) (showing UCLA issued patents from 1997 to 2002); see also The Regents of University of California, *UCLA Research Expertise*, at <http://www.research.ucla.edu/faculty> (last visited Oct. 12, 2002) (providing search engine to find faculty at the Regents of University of California who specialize in genetic research); UCLA Office of Intellectual Property, *Inventions Available for Licensing*, at <http://www.research.ucla.edu/oipa/industry.htm#invention> (last visited Oct. 12, 2002) (displaying numerous UCLA patents in various areas of science and technology which are available for licensing).

<sup>58</sup> See generally, *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.*, 122 S. Ct. 1831, 1837 (2002).

The patent laws 'promote the Progress of Science and useful Arts' by rewarding innovation with a temporary monopoly. U.S. CONST., Art. I, § 8, cl. 8. The monopoly is a property right; and like any property right, its boundaries should be clear. This clarity is essential to promote progress, because it enables efficient investment in innovation... as part of the delicate balance the law attempts to maintain between inventors, who rely on the promise of the law to bring the invention forth, and the public, which should be encouraged to pursue innovations, creations, and new ideas beyond the inventor's exclusive rights.

*Id.*

has been secured, what the patent specifically covers, how long the patent will last, and what the scope of the protection of the patent is.<sup>59</sup> Without patents, venture capitalists will not knock on the proverbial door. Fledgling company startups with great ideas for innovative and useful drugs and tests thus require patent protection of in order to secure investments.

Another type of investment that may be obtained comes from companies such as Millennium.<sup>60</sup> Millennium began as a venture capital entity,<sup>61</sup> but over the years, it has taken a patent to state that covers targets that could be used to find small molecule drugs. These are not drugs that are genomic themselves, but rather are those that are based on DNA or protein and that act to seek out genetic targets, *i.e.*, proteins in the body that the drugs act on in order to affect human disease. Taking the patent to state that is based on those types of genomic properties and obtaining investment from larger pharmaceutical companies creates an important partnership with the jointly assumed goal of developing potentially life-saving drugs.<sup>62</sup> Between stock offerings, bond offerings and partner investment, sums are raised that can amount to billions of dollars in the reinvestment process.

The final type of investment, which mainly applies to large pharmaceutical companies, is the commercial return.<sup>63</sup> As stated before, patents on drugs allow companies to recapture their initial investments by selling the drugs at a profit. When patent terms expire, generic drugs enter the market, prices go down, and as a result, the opportunity for regaining the investment dollars fades away. Entire companies have been built on a single patent; if that patent is challenged, the fate of the company is just as much at risk as the patent.

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<sup>59</sup> See *generally*, WHAT YOU NEED TO KNOW ABOUT: Biotech/Biomedical, Before You Seek Venture Capital, Biotech/Biomedical, at [http://biotech.about.com/library/weekly/aabyb\\_venture\\_capital.htm](http://biotech.about.com/library/weekly/aabyb_venture_capital.htm) (last visited Oct. 16, 2002) (demonstrating the factors that venture capital companies consider before investing in biotechnology and providing tips on obtaining venture capital).

<sup>60</sup> See About Millennium Pharmaceuticals, Inc., Corporate Overview, at <http://www.mlnm.com/about/overview.html> (last visited Oct. 7, 2002). Millennium was founded in early 1993 and is headquartered in Cambridge, MA. A leading pharmaceutical company, Millennium focuses its efforts on the discovery and development of small molecule, biotherapeutic, and predictive medicine products, including proteins and antibodies. *Id.*

<sup>61</sup> See Millennium and Hoffman-LaRoche Sign Collaborative Agreement to Apply Genomics Technologies to Two Disease Areas, at <http://www.mlnm.com/news/1994/3-30--0.html> (last visited Oct. 7, 2002) (reporting that the Mayfield Fund led the raising of \$8.45 million in seed financing capital). Other venture capital investors in Millennium are Paine Webber, CW Ventures, Sofinnova, Inc., Venrock Associates, Greylock Management Corporation, and Kleiner Perkins Caufield & Byers. *Id.*

<sup>62</sup> See About Millennium Pharmaceuticals, Alliances, at <http://www.mlnm.com/about/alliances/html> (last visited on Oct. 7, 2002) (providing a comprehensive table of Millennium's key partnerships, including a 2001 alliance with Abbott Laboratories focusing on technology exchange and development in metabolic diseases).

<sup>63</sup> See *Abbott Laboratories Investor Fact Sheet*, ABBOTT LABORATORIES, at [http://abbott.com/investor/investor\\_fact\\_sheet.html](http://abbott.com/investor/investor_fact_sheet.html) (last visited Oct. 16, 2002) (displaying the company's revenue profile, financial strengths in various products, and sales by country).

### 3. Identifying Potential Cures and Profit-Boosters

One major function of these biotech and pharmaceutical companies involves seeking out the genes with the greatest potential for drug therapy development in a vast pool of intellectual property. There are, as previously stated, 20,000 patent applications pending at the USPTO. In each of those 20,000 applications, there may be between one and 10,000 genes covered in *each* application. The task of a company seeking success is to locate the most promising genes and premise their investment strategies on the research and promotion of their actual and potential uses. The American patent system, thus, works to incite companies to develop cures for the public but also provides commercial opportunities for private investors to achieve financial success.

#### *B. Academic Institutions: Considerations and Dissent from the Research Labs*<sup>64</sup>

The distaste of the academic community for patenting drugs and genes lies not in the existence of the system but in its scope. The patent system is in fact absolutely essential to produce drugs in the United States. Investing \$500 to \$800 million dollars only to have someone else swoop in and sell your drug would kill innovation of such drugs and therapies. There is likewise no question that a patent must protect such products - protein in a bottle, or insulin, or a growth hormone that will be injected into a patient for use in a clinical trial. The protection is necessary, but the reach is too far as it applies to very early research tools.

#### 1. "What's New?"

The dialogue between academia and the legal community began as a naïve, back-and-forth series of discussions. The academic community questioned the patenting of genes, which it considered products of nature similar to the moon and the planets.<sup>65</sup> Patent lawyers responded by stating that what was actually going on involved sophisticated purification, a process done in order to demonstrate utility and encourage innovation.<sup>66</sup>

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<sup>64</sup> The remarks contained in Section B are those of Eric S. Lander, Ph.D. Dr. Lander is a Professor of Biology at the Massachusetts Institute of Technology and Director of the Whitehead Center for Genome Research. He is a geneticist, molecular biologist and a mathematician and one of the driving forces behind today's revolution in genomics, the study of all of the genes in an organism and how they function together in health and disease. He has been one of the principal leaders of the Human Genome Project. Under Lander's leadership, the Whitehead Center for Genome Research has been responsible for developing many of the key tools of modern mammalian genomics.

<sup>65</sup> For a discussion of the academic criticisms, see Ned Hettinger, *Patenting Life: Biotechnology, Intellectual Property, and Environmental Ethics*, 22 B.C. ENVTL. AFF. L. REV. 267, 280 (1995).

<sup>66</sup> *See id.* at 288. "The product of nature doctrine has been rendered vacuous by allowing that the isolation, purification, or alteration of an entity or substance from its natural state turns the entity or substance into something not 'found in nature.'" *Id.*

Academics then distinguished patenting the DNA sequencing library from patenting Penicillin<sup>67</sup> and Taxol<sup>68</sup> by noting that in taking all the fragments out of the human genome, what has occurred is the unmasking and purification of many individual components. The academics argued that this was not an inventive, novel purification of individual distinct molecules out of nature.<sup>69</sup> Rather, it was completely laid out in a library, invented by the founders of molecular biology.<sup>70</sup> They asserted that the patent advocates were promoting a legal fiction by attributing utility properties to DNA pieces. Isn't it true, they wondered, that most of the claims in the beginning involved usage of a piece of DNA as a probe in order to recognize *itself* by Crick-Watson base pairing? One may as well produce it to use as packing peanuts – the intellectual content remains the same.

## 2. Mindless Innovation?

Academics also argued that innovation in genetics was essentially mindless because of the constant sequence run-throughs. They saw a bad social bargain in awarding limited-time monopolies to “mindless generic innovation” that they felt discouraged investment in “hard stuff” and function.<sup>71</sup> The real work involved converting the genetic sequence into a therapy.

Patent lawyers responded with Section 103 of the Patent Act, which simply says that it makes no difference how “mindless” the innovation is. Further, as noted before, the bar had been raised for patent requirements to include substantial, specific, and credible evidence of utility.<sup>72</sup>

The academics then changed the focus of their discontent with the patent system from the black letter law to the social and economic policies at work. They saw in the patent system a bargain between society and inventors, in which society agreed to grant limited time monopolies and inventors agreed to disclose their

<sup>67</sup> See *supra* note 46.

<sup>68</sup> See *supra* note 48.

<sup>69</sup> See *Diamond v. Chakrabarty*, 447 U.S. 303, 306-09 (1980) (discussing the “products of nature” doctrine and holding that respondent’s micro-organism constituted a “manufacture or a composition of matter” within the meaning of 35 U.S.C. § 101 and thus “qualified as patentable subject matter.”).

<sup>70</sup> See *Human Genome Project Information*, U.S. DEPARTMENT OF ENERGY, at <http://www.ornl.gov/TechResources/HumanGenome/home.html> (last visited Oct. 16, 2002) (demonstrating what has been accomplished with the human genome since its innovation as well as other information regarding the project).

<sup>71</sup> See Timothy Worrall, *Intellectual Property B. Patent 3. Patentability a) Utility Requirement: The 2001 PTO Utility Examination Guidelines and DNA Patents*, 16 BERKELEY TECH. L.J. 123, 134-35 (2001).

Since automated sequencing techniques allow scientists to acquire DNA sequences at a very low cost, obtaining patent rights to such DNA sequences can be extremely profitable. . . [W]ith very valuable rights available at low cost, requiring an inventor to assert a specific, substantial and credible utility may prevent “shotgun” sequencers, who assert only speculative utility for a putative protein, from obtaining patent protection.

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

<sup>72</sup> See 35 U.S.C. § 103 (1994 & Supp. 1999).

inventions. The flaw in the system lay in the inherent inequality of the bargain.<sup>73</sup> Handing monopolistic power to inventors for menial work would create an unconscionable exchange.

### *C. Ethical Issues in Patenting the Genome*<sup>74</sup>

Early concerns about patenting human DNA had to do with issues like human dignity, and there was a feeling that granting a patent on a human gene somehow gave a property right in the inventor over another person. This was perceived as some kind of violation of human dignity.<sup>75</sup> These kinds of arguments were based on the naïve misunderstanding that patents grant ownership for one thing. People did not understand that the patent system perceives the DNA that is being patented as something different than the completely natural DNA that is in the human body.

#### *1. The “Common Heritage” Debate*

There was a second variance on the argument that maintains an intuitive appeal but hasn't reached very far. This has to do with the idea of human DNA as being part of the common heritage of humanity.<sup>76</sup> There are some ideas out there

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<sup>73</sup> Eric Lander compared the disproportionate benefits of the patent system to the Homestead Act of 1862, explaining, “We didn't just hand away land for walking the boundaries and just filing a claim – you had to work the claim and really add value to it.” For more information on the Homestead Act, see Homestead National Monument of America, *Homestead Act*, at [http://www.nps.gov/home/homestead\\_act.html](http://www.nps.gov/home/homestead_act.html) (last visited Oct. 16, 2002).

<sup>74</sup> The remarks contained in Section C are those of Dr. Pilar Ossorio. Ossorio holds a Ph.D. as well as a J.D. and serves as both Assistant Professor of Law & Medical Ethics and Assistant Director of the Center for the Study of Cultural Diversity in Health Care at the University of Wisconsin. In addition to her work at the University of Wisconsin, Professor Ossorio taught law at the University of Chicago and worked in bioethics research for the United States Department of Energy in Los Alamos, New Mexico. Professor Ossorio has written extensively in the field of bioethics and the law and serves on the Committee on Intellectual Property Rights at the National Research Council and the National Academy of Sciences.

<sup>75</sup> See generally Boston University Journal of Science and Technology Law, *Symposium On Bioinformatics And Intellectual Property Law April 27, 2001 - Boston, Massachusetts, Molecules vs. Information: Should Patents Protect Both?*, 8 B.U. J. SCI. & TECH. L. 190, 206-11 (Winter 2002) (presenting a speech made by Professor George Annas on the subject of why patents should not be allowed on the human genome from the public's view). Annas asserts that perhaps humans are attempting to assert too much control over nature. *Id.*

<sup>76</sup> See Melissa L. Sturges, *Who Should Hold Property Rights to the Human Genome? An Application of the Common Heritage of Humankind*, 13 AM. U. INT'L L. REV. 219 (1997) (providing a comprehensive explanation of the “common heritage” platform); see also Maxwell J. Mehlman and Kirsten M. Rabe, *THE GENETICS REVOLUTION: CONFLICTS, CHALLENGES AND CONUNDRAS: ARTICLE: Any DNA to Declare? Regulating Offshore Access to Genetic Enhancement*, 28 AM. J. L. AND MED. 179, 183 (2002).

[M]any religious leaders are concerned that gene therapy may be ‘one more factor tending to reduce perceptions of humanity to mechanistic interpretations.’ They fear a more mechanistic view of humanity will result in less focus on values, ultimately threatening the ‘sanctity of human life.’ The Universal Declaration on

that we all have a human genome, and somehow we all have an interest in The Human Genome. If this is true, the proponents of this position wonder, then how can only a few inventive entities stake out a position on that human genome and have rights to it when we all ought to have access to it because we all possess one? Shouldn't everyone have some kind of universal rights to the human genome as a part of the common heritage of humanity?<sup>77</sup>

There are real problems with the common heritage – common ownership argument. First, the human genome is an abstract concept – each person has his or her own genome in his or her body, one that is not the same as another person's unless that person is an identical twin. It is unclear what it would mean to treat the human genome as a common heritage.

The human genome is not being depleted by someone who does research on it. It is not as though a human genome researcher takes someone's genome away from her in any way. Other things that are treated as part of the common heritage of humanity, such as forests and other natural resources, are often things can be depleted. This is not true of the research process that involves the human genome.

Along the lines of this argument, other persons felt that as the genome is part of the common heritage of humanity, people should not change it inside of the body.<sup>78</sup> However, the human genome actually changes all the time, with each generation. Part of the confusion had to do with the fact that people felt that once someone had a patent on a transgenetic technology, it gave them the right to use that technology, which it does not. As stated earlier, patents only grant the right to exclude others from doing what you have patented. For example, if someone has a patent on some method of biotechnology, it may still be regulated in ways that prevent that person from doing activity A, B or C with that technology. Thus, some of the early debates had to do with genuine ethical concerns about the human genome, but such concerns are more than likely not to be played out through the patent system.

## *2. Access to Information – an Ethical Right for All?*

More recently, there has been a real concern voiced about access to medication and patenting of human DNA as part of a larger question of patenting in the medical profession.<sup>79</sup> The major issue is how patents may inhibit access to

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the Human Genome and Human Rights states that the human genome is 'the heritage of humanity' and that 'everyone has a right to respect for their dignity and for their human rights regardless of their genetic characteristics.

*Id.*

<sup>77</sup> See generally Sturges, *supra* note 76.

<sup>78</sup> *Id.* at 258.

<sup>79</sup> See Arti K. Rai, *Symposium: Intellectual Property Challenges In The Next Century: Article: The Information Revolution Reaches Pharmaceuticals: Balancing Innovation Incentives, Cost, and Access in the Post-Genomics Era*, 2001 U. ILL. L. REV. 173, 177 (2001) (“[U]nlike health care economics generally, prescription drug economics is profoundly shaped by intellectual property rights, primarily patent rights.”); see also Michael J. Malinowski, *Legal Development: Globalization of Biotechnology and the Public Health Challenges Accompanying It*, 60 ALB. L. REV. 119 (1996) (analyzing the impact of the globalization of biotechnology on access to public health care in the United States and the United Kingdom).

genetic information in various ways. Also, the interest of the ethicist has moved much closer to the interest of academic scientists, so that there are real concerns about patents on biological materials in general. Do patents on publicly-funded science experiments, including DNA sequences produced with public funding, undermine the values of academia? Do they constitute or create a double-dipping situation in which the public pays once to have the initial research done, and then pays even higher prices again for a final product that incorporates the patented item?

Patent law, in a sense, is very straightforward in its goals. It is trying to achieve a public good by getting the highest number of items to the public. Patent law exists to give incentivizing rewards to inventors to create the most public good.<sup>80</sup>

The legal academics ask where the bars should be set in creating this public good, because for something like access to medicine or access to research tools, the disagreement isn't involving the public right to the invention versus the private right of the inventor. Rather, the debate should center on the public's short-term interest in access versus a longer-term interest in access to more things if a stronger patent exists.

### *3. Disincentivizing Innovation*

Another concern about academia and patenting what is produced in academia is whether we will disincentivize the patent system by creating "incentives" that actually undermine invention and innovation rather than increase them. This could happen if too many patents are issued, or if there is too much difficulty in granting licenses for patents between companies and academia. For example, patents on very early technologies could create "rights stacking."<sup>81</sup> This means that in order to produce some final end product, so many patented things are used, and so many independent negotiations have to be made, that the end product would never be reached. The red-tape effect would be too expensive and too time-consuming for potential inventors to deal with, thus creating a disincentive to invent. These issues create discussions of patent pooling and raising the bar on granting patents so that they are not being granted for things as their very earliest stages. It is possible that if the bar is set in the wrong place, invention will be undermined rather than incentivized.

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<sup>80</sup> See *Apotex USA, Inc. v. Merck & Co.*, 254 F.3d 1031, 1038 (Fed. Circ. 2001) ("[T]he spirit and policy of the patent laws encourage an inventor to take steps to ensure that 'the public has gained knowledge of the invention which will insure its preservation in the public domain.'").

<sup>81</sup> See John Murray, *Owning Genes: Disputes Involving DNA Sequence Patents*, 75 CHI.-KENT L. REV. 231, 254 (1999) (explaining the issue of "stacking" of patent rights and the subsequent impact on research, development and sales of patented materials).

*D. The “Canavan” Quandry: a Rare Example of Bad Practice or Poignant Representative of Problems Ahead?*<sup>82</sup>

As a case study of this entire debate, consider the recent “Canavan” case.<sup>83</sup> Canavan disease is a terrible genetic disorder in which a child never physically develops properly, never learns to speak, walk, or talk, and does not live past childhood.<sup>84</sup> Ten or fifteen years ago, parents of children with Canavan disease, dismayed at the lack of research into the ailment, organized to press researchers for a cure.<sup>85</sup> They recruited scientists to work with them and gave the very flesh and blood of their children to perform the research.<sup>86</sup> At the Miami Children’s Hospital, one researcher who did this work ultimately uncovered the defective gene that causes Canavan disease; he subsequently patented that gene as well as antibodies to the gene and everything associated with it.<sup>87</sup> The researcher then granted a license for that patent to a company that essentially shut down genetic testing for Canavan disease in hospitals nationwide.<sup>88</sup> The parents of the afflicted children became outraged and are currently suing the academic researchers.<sup>89</sup>

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<sup>82</sup> The remarks contained in Section D’s introduction of the Canavan case are those of Justin Gillis. *See supra* note 21.

<sup>83</sup> *See* Peter Gorner, *Parents Suing Over Patenting of Genetic Test*, CHICAGO TRIBUNE (Nov. 19, 2000), at 1. Along with the New York-based Canavan Foundation and other foundations, the parents of children suffering from Canavan disease sued Dr. Rueben Matalon and his institution, Miami Children’s Hospital, in federal district court in Chicago on October 30, 2000. *Id.* The plaintiffs sought to block the hospital’s “commercial use” of the Canavan gene and to recover money damages based on royalties that the hospital had collected from licensing a patented test that screened for the Canavan gene. *Id.* at 9. The Canavan Foundation alleged that it was forced to stop offering free genetic screening after learning that it would have to pay royalties and comply with licensing terms it considered burdensome. *Id.*

<sup>84</sup> *Id.* Canavan disease affects one in 6,400 children born to Ashkenazi Jewish parents. *Id.* The disease destroys the myelin sheaths that protect brain cells and usually causes the infected children to die between the ages ten and fifteen. *Id.*

<sup>85</sup> *See* Justin Gillis, *THE HUMAN BLUEPRINT: Patenting Life? Gene Research Success Spurs Profit Debate*, WASHINGTON POST, Dec. 30, 2000, available at <http://www.canavanfoundation.org/news/newswp.html> (last visited October 12, 2002).

[W]orking from Matalon’s papers, academic laboratories began to offer testing for Canavan disease to people who might be carriers. Pregnant couples who were carriers could undergo early prenatal testing to determine if the baby had Canavan. Work on potential treatments could begin. Along with other parents, the Greenbergs felt they had wrung an accomplishment from their tragedy.

*Id.*

<sup>86</sup> *Id.*

<sup>87</sup> U.S. Patent No. 5,679,635 (filed Sept. 4, 1994; currently withdrawn).

<sup>88</sup> Karen Rafinski, *Hospital’s Patent Strokes Debate on Human Genes*, MIAMI HERALD, November 14, 1999, at § A, p. 1, col. 1, available at <http://www.canavanfoundation.org/news/miamiherald.htm> (last visited on October 12, 2002). The hospital began enforcing its genetic patent right by licensing the test for a royalty and limiting the number of tests being done. *Id.*; *see also* Gorner, *supra* note 83, at 9.

<sup>89</sup> *See* Greenberg v. Miami Children’s Hosp. Research Inst., Inc., 208 F. Supp. 2d 918 (N.D. Ill. 2002).

III. PROPOSALS<sup>90</sup>*A. Licensing Procedures Require Careful Consideration by Both Researchers and Industry*

In the Canavan situation, the lawyer's cliché, "Bad cases make bad law," applies. This case is a bit of the tail wagging the dog. Here is an exception where there are many difficult issues in terms of how the licensing played out through the actions of the patent holder. This case should not necessarily be used as an example that would drive a change in the law, as the issues in this case in particular will likely be taken care of through the kinds of processes discussed here.

The researcher who applied for and received the patent was the inventor; he discovered the isolated gene, purified it and devoted his innovation to it. The issues around who owned the tissue samples are entirely different issues.

The key question deals with access and licensing procedures. When the holders of gene patent develop their licensing programs, they must be extremely mindful of the kind of public reaction they will incite – the Canavan case is demonstrative of this reaction.

The Myriad Genetics case<sup>91</sup> is another example of a licensing system that proved problematic. The test in this case cost nearly \$300. Of that \$300, twelve dollars, or 4%, is devoted to the royalty payment. This payment is a standard royalty in almost any industry for licensing the patent. The rest of the cost consisted of the test itself. The issue is whether the licensee company or the hospital was right in asserting a unilateral right to offer the test. Patent law says that the inventor of the test has the right to offer it. Is this the smartest thing to do in light of the political, commercial and public interests in access?

These are examples of biotechnology companies acting poorly. Morally-driven companies would be more careful about these issues. There should be the utmost care devoted to the manner in which tissues are taken from patients, so that they are fully aware of what they will be used for. Additionally, patients should receive proper compensation when it is appropriate, and careful consideration should be given when deciding how tests will be marketed, and to whom they will be made available. If nothing else, a company should be concerned with these examples and should pay closer attention to these issues so that they will not find themselves in a similar quagmire.

The Canavan and Myriad Sciences cases obscure the real issue, however, when one considers a case in which a company does not act unethically or poorly.

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<sup>90</sup> The proposals in Section III are gleaned from the remarks of all of the featured speakers as well as several audience members. This section is meant to reflect a conglomeration of their ideas and any counterarguments made. For information on statements made by particular panelists, please refer to the full-text transcript of the discussion, available at <http://www.wics.si.edu/NEWS/geneticage.htm> (last visited Oct. 17, 2002).

<sup>91</sup> For more information on the Myriad case, see Deborah Smith, *Test for Cancer Gene May Cost Thousands*, SYDNEY MORNING HERALD, March 14, 2001, available at <http://old.smh.com.au/news/0103/14/pageone/pageone6.html> (last visited on October 12, 2002) (explaining that the test looks for mutations on two genes that increase the risk of breast cancer).

For example, imagine a drug company that discovers a receptor, files a patent on it and now wishes to assert its right to be the only company to screen for a small molecule against that receptor to treat breast cancer. What would be the company's response to women with breast cancer who argue that they would benefit from ten pharmaceutical companies competing with one another to each make the best molecule to act against that receptor? Economically, this promotes less innovation at the later stage of research because a monopoly has been granted at this earlier stage. This is not an exceptional case – this is the rule.

*B. The Patenting Process Must Foster Competition by Encouraging Development to Continue at Later Stages*

Yet part of the issue is also the patients' and public's short-term interest versus their long-term interest. Patent law accepts that there must be some restriction, such as higher prices when a patent is in place, in order to encourage innovation. In theory, that restriction will ultimately increase what the public has.

While this is true, the system gives a monopoly for a very inexpensive innovation of discovering a receptor, while we learned earlier that it costs \$500-\$800 million to develop the drug. This is the stage at which you want competition. The black letter law can support a right to restrict others' access to the innovation vis-à-vis a patent. However, a good social policy encourages competition further down the line, at the development stage; by that time, the innovation is far enough removed from the therapy.

The challenge for public policy makers, Congress, and the courts is to determine where to draw the line and develop definitions in this area. Deciding where to define a research tool exception, for example, when research moves from purely academic investigation to incorporating commercial motives and benefits can be nearly impossible without guidance. Universities derive significant revenues from their research today. Every academic institution hopes to exploit their own patent portfolio in hopes of keeping their education costs to a minimum.

Those arguments may be based on several assumptions that lack real world practicability. First, there are only very few instances of people running around stopping other people from using the receptors to screen for drugs. The counterargument to this is that there are countless instances where companies have dropped their research and development programs because of their clouded patent portfolio.

However, such instances are not readily apparent. The National Academy of Science is studying this issue and has commissioned a paper on it that shows that the pharmaceutical industry gives a *de facto* research tool exemption that does not inhibit research. There are also numerous situations in which companies have gone forward despite that landscape, continuing to develop drugs. Of course, there are also situations in which this does not happen, and the companies do not push for it. In reality, there is not nearly the kind of data that one would like to have about the influence of programs that are dropped. They are not easily seen and are not able to be captured with the data that exists at present. This is one area in which good research would be invaluable but does not currently exist.

Instances where individuals have refused to grant licenses have been few and far between. Clearly, if a company with two otherwise equal projects must choose between which to pursue, one of which is a patent mess and the other that is clean, they will pursue the clean one. However, if the other project is better for or more important to the good of society, but for the patent mess, the investment should go there. Companies make these choices all the time; if the one that involves a patent mess is the one that is more significant, either from what it will do for medicine or the potential economic returns, the company still must make this decision.

*C. All Parties to the Process Must Establish Standards for Determining a “Real Total Value” of Investment and Return in Light of the Utility Requirements of § 103*

In a different test case, a real situation, a foundation has a resource of serum cell lines containing DNA library of 430 multiplex families who are affected by autism, a complex genetic disorder. The foundation spent \$6 million finding the families, training diagnosticians and flying phlebotomists and pediatric neurologists all over the county to give the families the best ascertainment possible of the potential for a cure.

Such foundations and similar academic entities want desperately for biotech and pharmaceutical companies to come in and work with the samples. They offer to pay highly subsidized prices for the biomaterials and have a twelve-month exclusive right to them during which period they cannot give them to any academic researcher. The foundations want to use the samples, but would not possibly consider giving a royalty back to organization that funds biological research and autism, especially when the purple test tube is empty, and there is nothing to be done.

Companies could reply that the system of agreeing to license and never withhold unilateral licensing, despite being so close to joint inventor status, would be reasonable for someone else, but not them. What is left for the foundation to do? How do they get 430 family samples into use?

As patient groups get smarter, they realize that if they are going to give the flesh and blood of their children’s bodies, they should not give it for nothing in return. Thus, one of the answers that are beginning to be worked out is what kind of consideration will be offered in exchange for such personal gifts. When the research products involved do not involve rare genetic diseases, but something that instead affects many people, perhaps the incentives should be higher. Yet paradoxically, when a great deal of money is at stake, companies are more reluctant to give it up.

To solve the problem from an economic investor standpoint, companies must look at the value equation of what they are getting. The more rare the material is and the more unique the material is, the more valuable the material becomes. Essentially, the return that you may be able to get from that source is only one factor in the decision; in fact, it may be the only path to produce the drug that will treat patients and make the company money.

Companies must recognize the real total value of the innovation. If there is truly a market for a drug that will be viable as a development candidate, there will be someone who will pay proper value for it. Again, companies exist that deal with sources of tissue in ways that are commensurate with the value of what is being

presented. Possessors of genetic innovations and material must use caution in choosing the company to develop the drugs so that they receive the rightful benefit of their bargain.

This issue relates directly to licensing problems. Despite the close relationship of innovators and industry, there exists a whole world of economic theory and political theory that impacts licensing and the ways these deals are put together; questions of what is reasonable, how to properly structure the deal, and how to incentivize them play into the procedures. That is, if there was nothing to license – no intellectual property, trade secret, real property, personal property, or anything else – this would not be an issue. Sometimes that something comprises a patent, but in this situation, the problem is more of a licensing problem than a patenting problem.

There is a learning curve that universities must utilize in order understand what is rational behavior in patent licensing. Many times, perhaps, these institutions do not make good patent licensing choices, and when there is licensing between public institutions and private ones, whether large or small, the learning curve must operate. In rebuttal to the argument that the universities have learned from former mistakes, it is argued that the academic license sources have become more aggressive, have become more difficult to deal with, and have become less understanding over time. The higher costs for licenses in connection with this seem to support such a contention. The system is challenging, and there remains controversy and kinks to be worked out. There is a pendulum-like, back-and-forth situation here, in which the academics in the beginning were unsophisticated and companies took advantage of them. Now, however, the institutions match the aggression as far as getting the fair market value for their innovations.

An interesting irony exists in situations where people worry that commercial entities will get patents and then control the licensing process. If the academics at the universities obtained patents on genome fragments, they could control the access in that respect. They could have controlled all of the licenses and set the royalties at nothing. This would prevent the commercial entities from moving in, patenting something the same or similar and setting the royalties at a greater figure. By giving up the control in good faith, the institutions actually would be giving up a significant opportunity for control that the patent system provides.

The debate seems to gain ferocity when one reaches a very nascent stage of technology, including the uncovering of genomic information. Because this is a *de facto* industry standard and not a happenstance problem, this lends fuel to the fire on both sides. There is little realistic opportunity for an entity to do “their own thing” and follow different research approaches.

What potentially develops is a bottleneck at the very upstream portion of the technology that affects all downstream applications. This is why the swirl of issues surrounding statutory patenting requirements of utility, written descriptions, and obviousness comes into play again and again. We cannot look at how routine a particular methodology is to uncover the technology in question because under our system, that does not matter.

*D. The USPTO and the Courts Should Reexamine the “Inventive Act” Standard to Guide the Genomic Patenting Process*

The issue of whether an inventive act occurs is especially troublesome from a legal perspective and outside the rules of the Patent Act in sections 101,<sup>92</sup> 103<sup>93</sup> and 112.<sup>94</sup> As noted earlier, federal courts have wrestled with the concept of invention in relation to what the conception of a piece of DNA, a genetic sequence, or a genetic molecule is. The conception does not actually occur until the sequence information becomes apparent, as the structure of the chemical molecule remains unknown until that point. Who is the inventor in this situation? Is it the machine that the genetic material is deposited into, or is it the person who visualizes the scenario, or is there an identifiable inventor at all?

One answer to the question disposes of the visualizing person scenario. The researcher puts the genetic material into the sequencer, and the sequencer produces the letters. The letters are then piped into a computer, which tells the researcher what compound or protein the material sequence is like; it is this computer response that lays out what will be filed in a patent application. In fact, sometimes the computer response travels directly to a word processing program, which produces a patent application before a human being ever views it. The issue could be to whom the invention should be ascribed, but a more important issue may be whether something such as this should even be considered an inventive act at all.

Perhaps the battleground on utility requirements was the wrong forum in which to address whether inventive acts are involved in this process. The directly corresponding issue is whether there is an invention produced at all or whether the system is being abused, section 103 notwithstanding.

Section 103 plays a role in the “invention” argument as an act of Congress that responded to a particular Supreme Court case that involved a particular set of facts about how one inventor, in a very traditional, almost American-like way, had a sudden flash of genius. Similarly, the Supreme Court decided in *Feist Publ., Inc. v. Rural Telephone Service Co., Inc.*<sup>95</sup> that a certain level of creativity was necessary to obtain copyright protection.<sup>96</sup> The Court held that standard telephone book white pages listings could not be copyrighted because they lacked creativity in their composition.<sup>97</sup> The opportunity exists for someone to challenge, in a similar manner, whether there is enough “creativity” or inventorship involved in our genetic research and patenting procedures. The Supreme Court may be open to such an argument in the same way the USPTO has been in their policy decisions. The Court would be free

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<sup>92</sup> 35 U.S.C. § 101 (1994).

<sup>93</sup> 35 U.S.C. § 103 (1994 & Supp. 1999).

<sup>94</sup> 35 U.S.C. § 112 (1994).

<sup>95</sup> 499 U.S. 340 (1991).

<sup>96</sup> *Id.* at 363-64 (“[A]s a statutory matter, 17 U.S.C. § 101 does not afford protection from copying to a collection of facts that are selected, coordinated, and arranged in a way that utterly lacks originality.”).

<sup>97</sup> *Id.* at 361. The Court reasoned that “[t]hese bits of information are uncopyrightable facts; they existed before Rural reported them and would have continued to exist if Rural had never published a telephone directory” and determined that the arrangement and selection of listings lacked “the modicum of creativity necessary to transform mere selection into copyrightable expression.” *Id.* at 361-62.

to overturn such a decision, and Congress could also take a look at revising section 103 to reflect the recent developments in light of the genome controversy.

A more complicated quandary is whether an entity that discovers and patents a gene sequence or function may also patent the regulation of its expression without first discovering a means to do so. Or, must an entity that discovers a way to regulate the expression of a gene that is patented by another entity license the right to regulate that gene's expression from the other entity before commercializing its discovery? From a Patent Office legal perspective, the answer to the first question would be yes, while the answer to the second is more difficult.

The enabling requirement to patenting something plays into the answers to these questions. In order to get the bargain of a patent monopoly, the inventor must disclose not only what she believes has been created or accomplished, but enough information about it to explain to another how to make and use the invention. Technically, she could be a disembodied head sitting on a table and never do anything except tell other people how to create her invention, but she could still receive a patent if the enabling requirements have been met. If a person has a blinding flash of inventive genius without having ever set foot in a lab, and that person proceeds to hypothesize what the experimental procedures and development tactics could be, that would be sufficient for the enabling requirement. On the opposite side, a flash of genius or an objective alone is not enough to secure a patent.

#### CONCLUSION

The general topic of patenting the genome is deceptive in its simplistic description. Many issues that play heavily into the debate over patenting the genome were only touched upon briefly in this forum, and others were surely left out due to time constraints and the broad scope of the issue.

For example, the issue of access to genomic material is one that garners a great deal of attention. The USPTO works with genomics companies to make sure that the companies do not, so to speak, kill the goose that lays the golden egg. The USPTO commissioned a white paper to deal with the question of what happens if there are too many entities to break through to get licenses for patents. Patent pooling is a typical solution to this problem, but many questions remain to be answered.

The discussion surrounding patents and genes and life-saving developments will inevitably intensify and continue for many years to come. With every bit of research acquired and every discovery documented, the old questions will breed new arguments in the academic institutions, the biotechnology companies, the ethical thinktanks, the USPTO, and the courts. The issue is ripe and will remain so, as there are no limits to the potential for a better human existence that emerges from unyielding innovation.