Chicago-Kent Law Review

Volume 84
Issue 1 *Symposium: Who Owns Your Body?*

Article 5

December 2008

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UPSTREAM WITHOUT A PADDLE: GENE PATENTING AND THE PROTECTION OF THE "INFOSTRUCTURE"

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The U.S. patent system, designed to protect rights to specific, marketable gadgets, has increasingly over the past few decades granted patents on comparatively abstract and amorphous ideas and codes that stretch the system beyond recognition. The calamitous results undermine the system, hamper innovation, and are proving nearly impossible to adjudicate.

I.

Many worthy objections have been raised about the U.S. Patent and Trademark Office's decision, roughly a decade ago, to begin granting patents on human genes and tissues. Most critics of such patents argue that the special attributes of human genes and tissues ought to exempt them from consideration by the patent office. For instance, some have held that human genes and tissues should not be considered patentable material because they are products of nature.[1] Others have opposed human gene and tissue patenting on moral grounds, arguing that humans are debased by private ownership claims, including those over their constituent biological parts.[2] Despite the salience of these arguments, I take issue with the patenting of human genes and tissues not as special cases but rather as examples of a broader, pervasive misunderstanding at today's U.S. Patent Office, a flawed conception that poses a threat to the philosophical underpinnings of the patent system itself. The problem has already triggered profound problems not only in the biomedical field but in many other high-tech areas as well. At root, this flawed conception stems from the U.S. patent office's anachronistic adherence to what we might call "the toaster model of invention."

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1. *See* Mark Sagoff, *Intellectual Property and Products of Nature*, AM. J. BIOETHICS, Summer 2002, at 12, 13.

2. For a discussion, see, for example, Annabelle Lever, *Ethics and the Patenting of Human Genes*, J. PHIL. SCI. & L., Nov. 2001, *available at* http://www6.miami.edu/ethics/jpsl/archives/papers/ethics_lever.html.

II.

Several years ago, after I published a book about patenting in today's "knowledge-based" economy,[3] I had the opportunity on National Public Radio to debate Q. Todd Dickinson, then commissioner of the U.S. Patent and Trademark Office.[4] Dickinson noted that the U.S. patent system had given us a host of time-saving gadgets and he cited the toaster as a prime example. Without the patent system, Dickinson argued, we would likely still be burning our bread over an open flame.[5]

Dickinson was on solid ground invoking the toaster. The useful kitchen gadget is a good example of the success of the U.S. patent system. The toaster story (stripped to admittedly allegorical essentials) goes something like this: back around the turn of the last century, someone thought of using electric coils to toast a slice of bread and took the trouble to design and build a machine to do the job. In exchange for making the design for this machine publicly known, the U.S government awarded a time-limited monopoly over the use and implementation of this particular, pathbreaking design. The patent helped compensate the inventor for the costs incurred in bringing the design to the marketplace where it benefited breakfast lovers everywhere.

But wait, there is more. Seeing the popularity of the newfangled electric toaster, competitors were quickly inspired to improve upon it. One inventor had the bright idea for a radically different design with spring-loaded slots for the bread slices. This new and improved "pop-up" toaster also received patent protection and came to the market. The public, seeing its advantages, overwhelmingly traded in their old toasters for new ones. Progress was fostered. The economy benefited. And, as hard as it may be to believe, the U.S. Patent office continues, even today, to issue patents on new toaster designs. A good, fairly recent example is U.S. Patent 5,943,948, issued in 1999. This patent covers the design of a machine that allows the user to toast a selection of images—including one of Mickey Mouse©—onto their bread.[6]

Leaving aside for the moment the question of the extent to which this latest innovation truly represents progress, the central point is this: by granting patents over specific toaster designs, U.S. Patent Office officials

3. *See* SETH SHULMAN, OWNING THE FUTURE (1999).

4. *Science Friday: Patents and Intellectual Property* (NPR Broadcast March 5, 1999) (transcript on file with Chicago-Kent Law Review).

5. *Id.*

6. *See* U.S. Patent No. 5,943, 948, (filed Jan. 29, 1998). For those who can't live without, the resulting product, now available, is known as the Villaware Disney Mickey Mouse Toaster.

like Dickinson can reasonably claim that they have helped promote improvements in toaster technology. In so doing, the patent system has arguably added "the fuel of interest to the fire of genius" just as Abraham Lincoln famously hoped it would.[7]

Bruce Lehman, Dickinson's predecessor as U.S. patent commissioner, made an argument strikingly similar to Dickinson's using an even more classic example. As Lehman explained in a 1995 interview "[w]hen I walk into my office every morning, I see the patent model of Thomas Edison's light bulb sitting there . . ."[8] The display, Lehman said, never failed to remind him that "intellectual property protection, patents and copyrights have been a major part of the economic growth of America from the very beginning."[9]

III.

It is probably no coincidence that Dickinson's toaster and Lehman's lightbulb both emerged near the end of the 19th century. It was then, after the U.S. Civil War, that the U.S. Patent system really came into its own. The historian Thomas P. Hughes has noted, for example, that the number of patents issued between 1866 and 1896 grew exponentially, doubling each year during this period.[10] This was, of course, the Gilded Age, a time of dramatic technological change that altered our thinking about innovation in ways that are still relevant more than a century later. Consider, for instance, the extraordinary fact that Thomas Edison, patron saint of this era, still holds the record for the most patents (1,093) ever issued to a single individual.[11] Edison invented many things, from motion pictures to the use of poured concrete in construction, but he is best remembered for the incandescent light bulb, an archetypal product that has come, for us today, to symbolize invention itself.[12]

7. ABRAHAM LINCOLN, *Lecture on Discoveries and Inventions, Jacksonville, Illinois, in* ABRAHAM LINCOLN: SPEECHES AND WRITINGS 1859–1865 at 3, 11 (Don E. Fehrenbacher ed., 1989).

8. Seth Shulman, *Patent Medicine*, TECH. REV., Nov.–Dec. 1995, at 28, 30.

9. *Id.*

10. THOMAS P. HUGHES, AMERICAN GENESIS: A CENTURY OF INVENTION AND TECHNOLOGICAL ENTHUSIASM, 1870–1970, at 14 (1989).

11. Between 1869 and 1933 the U.S. Patent Office issued 1,093 patents to Thomas Edison and the record for patents issued to a single individual holds to this day. For a complete listing of Edison's patents, see The Edison Papers, Edison's Patents, http://edison.rutgers.edu/patents.htm (last visited May 1, 2009).

12. Lest there be any doubt about the pervasiveness of this symbol, interested readers may wish to pay an online visit to the homepage of the U.S. Patent and Trademark Office and watch their browser's logo icon in the upper left-hand corner of the screen turn instantly into a light bulb. United States Patent and Trademark Office, http://uspto.gov (last visited May 1, 2009).

It is worth dwelling for a moment on the pervasive image of a light bulb over someone's head to connote that he or she has just had a (potentially patentable) brainstorm. The favored status of the light bulb as a symbol for ideas and innovation is, I believe, linked to our profound conceptual problem in apportioning rights to intellectual property today. This is true because our economy has passed through what some have termed the "second wave" of the industrial age and into the "third wave" of a so-called "knowledge-based" economy.[13] Put simply, we have come to a time when ideas, concepts, and codes—software codes and genetic codes—have become some of the most valuable things one can own in our society.

Examples abound. Today's software firms such as Adobe and Microsoft, have won patents on so-called software subroutines—the basic building blocks of computer code needed to write new programs—and used their ownership to stymie would-be competitors. Such software firms have thus made literally millions of dollars not by bringing products to market but rather by leveraging ownership rights over parts of the languages our computers speak.

The same is true in the biomedical field. Pharmaceutical firms in pursuit of blockbuster, billion-dollar drugs have increasingly laid proprietary claim not just to new drug formulations but to the genes from wild plants, insects, and microorganisms from the globe's far reaches as well as to human genes linked to particular diseases. There is little doubt that some of this now-patented genetic information will ultimately prove valuable in the creation of new drugs and treatments. But let's be clear: such patents grant rights to "potentially useful knowledge" rather than to know-how embodied in a particular product's design.

It also bears noting that such "potentially useful knowledge" has become big business itself. The corporate giant IBM, for instance, now earns nearly *$1 billion* each year by granting licenses to the "potentially useful knowledge" in its patent portfolio. For some time now, companies such as Texas Instruments, have even brought in as much cash by licensing their often-conceptual patents as they have by actually selling products.[14]

Today, new ideas are still frequently embodied in the designs of marketable products like toasters and light bulbs. But the U.S. patent system, successfully designed to protect rights to such specific, tangible gadgets has, in our knowledge-based society, been increasingly forced to contend with claims that it is ill-suited for: claims over ideas and codes—in other words multifaceted, *conceptual tools*. In its efforts to apportion proprietary

13. *See* ALVIN TOFFLER, THE THIRD WAVE (1980) (discussing these terms throughout).
14. *See* Norm Alster, *New Profits from Patents*, FORTUNE, Apr. 25, 1988, at 185, 186.

rights to these kinds of claims, the U.S. patent system has failed calamitously.

We have arrived, in other words, at a point where disembodied and multifaceted conceptual tools are enormously powerful and potentially lucrative. And, while these tools are not products in any traditional sense of the word, that light bulb still hovers over the heads of our idealized inventors: we still think of ideas primarily as products. Even more problematic than our own conceptual limitations, however, are those of the officials in charge. The world has changed. But the examiners at the U.S. patent office remain caught within the confines of the toaster model of invention.

IV.

In the long sweep of history, the patent system's current problems are relatively recent. Consider for instance that, as recently as the 1870s, the U.S. Patent Office required applicants to submit a prototype—an actual working model—of any invention they sought to patent. In 1876, the U.S. Senate considered a bill calling upon the U.S. Patent Office to do away with this requirement.[15] At the time, the problem presented was a logistical one: supporters of the bill, sponsored by Connecticut Senator James E. English, testified that the Patent Office's attic coffers were literally overflowing.[16] There was no space to put the roughly 20,000 new models the agency expected to receive annually in the ensuing years.[17] So Congress, in a belt-tightening exercise, ultimately decided to abolish the rule requiring prospective patent applicants to submit tangible prototypes of their inventions.

The mostly forgotten story of the patent's office's abandonment of the model requirement merits our attention today because it illustrates just how far away we have moved from this prior formulation. What kind of working model would the biotechnology firm Myriad Genetics have built en route to garnering U.S. Patent 5,837,492, which covers the naturally occurring, so-called human breast cancer gene known as BRCA2?[18] What kind of model would Amazon.com have submitted to win U.S. Patent 5,960,411 on its so-called "One-Click Technology"[19] that gives the company exclu-

15. *See* SETH SHULMAN, THE TELEPHONE GAMBIT: CHASING ALEXANDER GRAHAM BELL'S SECRET 30–31 (2008) (discussing *United States Patent Laws: Main Points of the Senate Bill Amending the Present Laws–A Practical Engineer's Argument*, N.Y. TIMES, Feb. 15, 1876, at 1).

16. *Id.*

17. *Id.*

18. *See* U.S. Patent No. 5,837,492 (filed Apr. 29, 1996).

19. *See* U.S. Patent No. 5,960,411 (filed Sept. 12, 1997).

sive dominion over the notion of allowing an online shopper to purchase a product with a single click of a computer mouse? These firms couldn't possibly have made such tangible prototypes because the patents cited above cover nothing more than potentially useful knowledge, or what some patent watchers now resourcefully prefer to call "actionable knowledge."[20]

To best understand the distinction between patents on products and patents on actionable knowledge, let's invoke one more archetypal gadget. In addition to the toaster and the lightbulb, let's briefly consider the mousetrap. After all, as the expression goes, people are always seeking to design a better one; historically at least, our patent system was supposed to aid precisely this quest by offering a powerful incentive to inventors. Today's problem, however, was forcefully brought home to me a number of years ago by a software programmer named Wallace Judd, then president of the California-based Mentrix Corporation. As Judd put it, rather than encouraging people to design a better mousetrap, the current patent system is too often granting a monopoly *on the idea of trapping mice.*[21]

The more one thinks about Judd's distinction, the clearer and more profound it becomes. To the extent that the patent office can protect the design for a particular new mousetrap, it can theoretically foster innovation. The precise opposite outcome results, however, the moment the patent system begins to grant an exclusive, proprietary right over *the mousetrap concept*. In this latter case, the patent system awards to one party a twenty-year monopoly on a whole field of technological endeavor. In so doing, the system effectively *blocks* new innovators—the very ones it was intended to encourage.

Before looking more closely at the variables involved, suffice it to say for the moment that evidence of the patent-led stifling of innovation is mounting in a number of high-tech areas. Some economists have even gone so far as to heretically suggest that, taken as a whole, we might be better off economically and technologically without any patent system at all.[22] There are many examples of dysfunctional patenting, including a growing number of examples in the realm of human gene and tissue patents. But, instead, let's briefly consider the story of what happened not long ago in the strange

20. *See*, SHULMAN, *supra* note 3, at 6.

21. U.S. Patent & Trademark Office, Public Hearing on Use of the Patent System to Protect Software-Related Inventions: Before Bruce A. Lehman, Assistant Secretary of Commerce and Commissioner of Patents and Trademarks, Jan. 26–27, 1994, *available at* http://www.uspto.gov/web/offices/com/hearings/software/sanjose/sj_judd.html. (statement of Wallace Judd, Mentrix Corporation). *See also* SHULMAN, *supra* note 3, at 7.

22. *See* JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 27 (2008); *see also* Michael Fitzgerald, *A Patent is Worth Having, Right? Well, Maybe Not*, N.Y. TIMES, Jul. 15, 2007, §3, at 3 (discussing this argument).

case of patents on medical procedures.

Over the long history of the U.S. Patent system, concerns about public health tended to limit which health care-related inventions might be deemed patentable. But, in the early 1990s, doctors flocked to the patent office to take advantage of a seemingly new class of patents—those on medical procedures. Patents had, of course, been granted for some time on novel medical devices, but some case law and general laxity on the part of patent examiners seemed to have opened the door fully to a new type of patent. The change was subtle at first. No one could point to an overt decision by the U.S. Patent Office to allow patents on medical procedures; rather, it seems that, starting as early as the mid-1950s, the U.S. Patent Office's distinctions between medical treatments, devices, and procedures began to erode.[23] By the mid-1990s, however, according to one tally, the U.S. Patent Office was issuing more than 100 medical-procedure patents each month.[24]

One well-publicized lawsuit brought a good deal of public attention to the situation. In 1993, Jack Singer, an eye surgeon at the Lahey Hitchcock Medical Center and professor at Dartmouth Medical School, was sued by a colleague for performing and teaching a type of cataract surgery that allowed the eye to heal without stitches.[25] Singer's colleague, an Arizona-based eye surgeon named Samuel Pallin, had won a patent on the "stitchless" cataract procedure and was demanding that Singer purchase a license and pay a royalty to perform it. Pallin even demanded that, absent such a license, Singer, in his capacity as a medical school professor, could no longer teach the technique to a new generation of doctors as he had been doing for several years.

Outraged, Singer decided to fight back. *Pallin v. Singer* became something of a lightning rod for opinions on the topic from many quarters. Singer's legal challenge to Pallin's patent was even joined by the clout and resources of the American Medical Association (AMA).[26] After all, the doctor's lobby group recognized that the prospect of physicians suing one another over rights to health-giving procedures posed a threat to the profession, (and also no doubt worried about the bad publicity such lawsuits would engender). In his public remarks on the issue, then-AMA president

23. See Robert L. Lowes, *Are You Stealing from Other Doctors?*, MED. ECON., Mar. 11, 1996, at 195, 196.

24. *Id.*

25. *Pallin v. Singer*, Civ. No. 5:93-202, 1995 WL 608365 (D. Vt. May 1, 1995).

26. *See* SHULMAN, *supra* note 3, at 35–36. The AMA's stance on the issue was also endorsed by some 16 separate organizations of medical professionals. *Id.* at 34. *See also* AMA Council on Ethical & Jud. Aff., *Ethical Issues in the Patenting of Medical Procedures*, 53 FOOD & DRUG L.J. 341 (1998).

Robert McAfee stressed the longstanding humanitarian traditions of the medical profession. As he put it, the "history, excellence, and tradition of medicine has been that whenever a new procedure occurs and is proven effective, it is imperative to share that knowledge with the world at the earliest moment."[27]

Nonetheless, as *Pallin v. Singer* worked its way through the courts, the problem seemed to be mounting. Around this time, the journal *Medical Economics* pointed out in a cover story that, "Proliferating medical-procedure patents [had begun to] entangle not only surgeons, but a wide range of practitioners."[28] Even worse, according to the journal's assessment, many of the newly issued patents on medical procedures covered basic skills doctors were expected to learn during their medical residencies.[29]

There is no shortage of outrageous examples of medical-procedure patents. Perhaps most notable, among many remarkable candidates, is a patent issued to a radiologist named John D. Stephens conferring upon him proprietary rights over the medical procedure of using ultrasound to determine the gender of a fetus—a procedure that amounts to nothing more than looking at an ultrasound image of a fetus to see whether it has a penis or not.[30]

Notably, though, the prospect of a growing number of lawsuits between medical practitioners was so unpopular in the United States that, in 1996, Congress decided to step in. It was widely pointed out around this time that almost all industrialized nations of the world had already specifically outlawed patents on medical procedures because of the threat such patents posed to public health. Despite such a threat, though, U.S. legislators were loathe to exempt an entire category of subject matter from patentability. In the United States, Congress has never specifically exempted any subject matter from consideration at the patent office and has placed restrictions only upon inventions—such as those relating to nuclear weapons—that pose a clear potential threat to national security.[31] As a result, in an odd compromise, Congress passed and the President signed into law a measure that continues to allow medical-procedure patents to be granted but takes the teeth out of them by prohibiting medical practitioners from

27. Sally Squires, *AMA Condemns Patents for Medical Procedures*, WASH. POST, Jun. 20, 1995, at A01.

28. Lowes, *supra* note 23, at 195.

29. *Id.* at 196.

30. U.S. Patent No. 4,986,274 (filed Dec. 4, 1989).

31. *See* Invention Secrecy Act of 1951, 35 USC §§ 181–88 (2006); Atomic Energy Act of 1954, 42 USC §§ 2011–23 (2006).

suing one another.[32]

By almost all accounts, the 1996 congressional compromise has not been particularly effective. Medical-procedure patenting continues apace (with roughly 100 new patents on medical procedures still being issued monthly)[33] and, while so-called medical practitioners are not allowed to sue one another, enterprising lawyers have recognized that medical device makers and even research institutions can still be sued for "inducing infringement" of a medical procedure by a doctor.[34] A recent report on the growing number of such lawsuits quotes Aaron Kesselheim, a patent attorney and doctor who conducts health policy research at Brigham and Women's Hospital in Boston. As Kesselheim cautiously puts it, "It's not clear that providing a monopoly over a certain process promotes innovation in the field of patient care delivery."[35] Rather, he says, doctors may refrain from a procedure out of concern that someone will sue them. "[I]f that affects the care that they are trying to provide to the patients, then that's a negative," Kesselheim says.[36]

V.

Among the questions we might ask about medical procedure patents is this one: How did the situation ever occur? How did we get so far away from the original goals and conception of the patent system that the U.S. Patent Office would consider awarding a patent on reading an ultrasound image or, in another stupefying example, on a method for treating a bleeding nose?[37] The answer is important and relevant not only to medical procedures but also patents on genes, software, and business methods of all kinds. In each case, it is important to recognize that the current "anything

32. On September 30, 1996, President Clinton signed Public Law No. 104-208, 110 Stat. 3009-546. The Act denies patent owners the right to enforce patents covering medical or surgical procedures that do not involve patented drugs or devices. Patents on medical and surgical procedures performed on a human body, organ cadaver, or even on an animal used in medical research or instruction relating to the treatment of humans, are now unenforceable. *Id.* As discussed *infra* note 34, the law is not without significant loopholes, however.

33. Tresa Baldas, *As Medical Patents Surge, So Do Lawsuits*, NAT'L L.J., July 16, 2007, at 4.

34. *Id.* Baldas cites, for instance, a $1.35 billion settlement in such a case, namely Medtronic Sofamor Danek, Inc. v. Michelson, No. 01-2373 MLV, 03-2055 MLV, 2004 WL 2905403 (W.D. Tenn. May 20, 2004). It is also worth noting, as my legal colleagues have informed me, the current, congressionally-mandated exemption only covers licensed healthcare workers performing a narrowly-defined "medical activity," so researchers with doctoral degrees are not necessarily protected. In addition, the law is not retroactive, so patents issued before 1996 (including some of the examples listed) are still enforceable through lawsuits.

35. Baldas, *supra* note 33, at 4.

36. *Id.*

37. U.S. Patent No. 5,546,964, at [57] (filed Jan. 27, 1995).

goes" climate did not occur as a result of a conscious policy decision. Instead, in each case, the calamitous outcome was incremental, a kind of death by a thousand cuts. Patent policy, like many areas of the law, works by the accretion of precedent. But in the patent field, unlike other areas of the law, the pressures push almost entirely from one direction. Applications continually arrive at the U.S. Patent Office with claims as broad as savvy patent lawyers can think to write them. Court verdicts in patent disputes, often intending to resolve specific, circumscribed problems wind up opening the door ever wider to whole new categories of ownership rights. I will leave it for legal scholars to plumb these matters more fully, but let's take a moment to review just a few key milestones here.

Consider first, the story of patents on life forms. Several decades ago, no such patents were issued. But a key legal milestone was passed in 1980 in the landmark case *Diamond v. Chakrabarty.*[38] In this case, the U.S. Supreme Court ruled, in a split, five-to-four decision, that a live, genetically altered microorganism could be patented.[39] This ruling held that the issue of whether an invention is animate or inanimate should have no bearing on its patentability as long as the invention could be seen to meet the criteria of being a novel, useful product of human manufacture and not obvious to someone skilled in the particular field in which the patent is filed.[40] Ananda M. Chakrabarty, a microbiologist then at the General Electric Company, had used genetic engineering techniques to create an altered bacterium that had presumably never before existed in nature.[41] Because Chakrabarty's bacterium showed promise in breaking down crude oil, its lucrative potential for cleaning up oil spills arguably made his invention useful.[42] While specific plant varieties had long been protected through a more limited category of patent, Chakrabarty's successful claim for a so-called utility patent, indicated that a bacterium could be treated much like any useful machine or invention.[43] And so the door opened to a profusion of patents on living things of all kinds from human tissues to entire, genetically distinct strains of mice. Many of these subsequent patents involved significant expansions of their own; but *Chakrabarty* crossed the crucial threshold by first allowing a patent on a life form.

A strikingly similar thing happened with computer software. Back in

38. 447 U.S. 303 (1980).
39. *Id.* at 309.
40. *Id.*
41. *Id.* at 305.
42. *Id.*
43. *Id.* at 309. Diamond was Sidney A. Diamond, then commissioner of the U.S. Patent and Trademark Office, whose patent examiners had initially rejected Chakrabarty's patent application.

the 1970s, the U.S. Supreme Court had specifically held that software fell into the category of "mental processes," whose logical steps needed to be preserved in the public domain as "basic tools of scientific and technological work."[44] But then, in 1981, *Diamond v. Diehr*[45] came along. In the case, the patent holder, James Diehr, had sought a patent on a mechanical system for manufacturing rubber *that included a software program* to control the temperature throughout the process.[46] Once again, the Supreme Court ruled by a narrow margin that the inclusion of a software program in a patent application on a mechanical system ought not automatically disqualify it from consideration.[47] *Diamond v. Diehr* thus pushed the door to software patents slightly ajar. But the Patent Office's liberal interpretation of the ruling soon flung it open far wider. Before long, the patent office was awash in a flood of applications for stand-alone patents on software programs from the trivially small to the enormously complex.

More recently, a similar story occurred on the vexing topic of patents on so-called business methods, a category that includes everything from storing financial information to the medical procedures discussed above. Business methods, like living bacteria, and computer software, were once considered ineligible for patents. The line on what constituted a "business method" was sometimes hard to draw but, in general, when the subject reached the courts, such method patents were held to be invalid. But then, in 1998, a case involving two banks reached the Federal Circuit. The case was *State Street Bank & Trust Co. v. Signature Financial Group, Inc.*, and here again, the ruling opened the door to a whole new area: the prospect of patenting methods of doing business.[48]. In this case, the appeals court allowed Signature Financial Group to enforce its patent on a method widely used within the banking industry to electronically keep track of a client's multiple mutual funds on a single statement.[49] If anyone had stepped back to think about it, the so-called "hub and spoke" method of accounting for mutual funds would have seemed an awfully far cry from a light bulb or a mousetrap. But somehow, the "toaster model" of invention—however inapplicable and ill-suited—had won the day again. A conceptual, multifaceted tool—rather than a particular, innovative new *product* designed for the marketplace—was granted an exclusive, time-limited monopoly by the

44. Gottschalk v. Benson, 409 U.S. 63 (1972).
45. 450 U.S. 175 (1981).
46. *Id.* at 187.
47. *Id.* at 192–94.
48. 149 F.3d 1368 (Fed. Cir. 1998).
49. *Id.* at 1373.

U.S. Patent Office.[50]

These three legal rulings are just a few well-known examples of a whole cascade of decisions, in the courts and at the U.S. Patent and Trademark Office itself, that have incrementally but dramatically broadened and changed the notion of what a patent is. In each case the professionals involved have found it difficult to say "no" to a particular, new and incrementally broader claim. Often, peculiar aspects of these cases have obscured the larger issues at stake. But, in each case, the result has been to lead us ever closer to (forgive the awful-but-irresistible pun) a patently untenable situation.

VI.

Before moving on, it is worth some further discussion of the relation of patent rights to the marketplace because there is little question that confusion at the Patent Office is greatly compounded by the rhetoric of free enterprise. Proponents of the U.S. patent system like to assert that patents encourage technological development but this belief is too often conflated with a caricatured notion of an entrepreneurial free market. A good example can be seen in the National Inventors Expo, an event held regularly in Washington, D.C. and co-sponsored by the U.S. Patent and Trademark Office. The expo is a fascinating event with an atmosphere that falls somewhere between that of a high school science fair and a late night on the Home Shopping Network. Scores of independent inventors bring and hawk their inventions—everything from patented bookmarks, to bolts that change color when adequately tightened. The Inventors Expo—and many other events like it—resonate with a deep-seated tenet of American mythology: that entrepreneurial inventors built—and continue to drive—the country's free-market economy. But while we are frequently encouraged to think of patents as part of a dynamic free-market "knowledge bazaar," it is important to recognize that patents have, with their inviolable right to exclude others, always represented the perfect antithesis of the free market.

The evidence that patents represent a purposeful override of the free market is clear going back to the year 1421 when the first-known patent was granted to Fillippo Brunelleschi, the Florentine architect, engineer and inventor.[51] Brunelleschi had invented a barge with a hoist on it to carry marble from Italian quarries upstream along the Arno River to Florence. As

50. *Id.*

51. Steven Saas, *Brunelleschi's Bargain: Intellectual Property in Digital Space*, FED. RES. BANK OF BOSTON REGIONAL REV., Fall 1993, at 6, 6.

far as we know, his barge never worked very well. But, notably, Brunelleschi made a deal with the Florentine city-state to enforce his exclusive right to the barge technology for three years. There is no evidence of a discussion of promoting technology or the free market. On the contrary, this first patent seems to have been an utterly collusive deal. The state wanted Brunelleschi's technology and these were presumably the only terms under which he was willing to make it available—terms that were, of course, highly favorable to Brunelleschi in shutting down and preempting his competitors. The state has shown a keen interest in the power of granting the patent system's temporary monopolies ever since. As MIT economist Lester Thurow has noted, for instance, this is at least part of the reason that the patent system was written into the very first article of the U.S. Constitution. The founders sought to systematically disregard British patents. The aim was to allow U.S. patent protection on indigenous technological development (regardless of whether it had previously been patented in Britain) as a means to spur the domestic economy of the new nation.[52]

So, while patents necessarily limit rather than encourage free markets, they still can arguably spur innovation when used correctly. Some contemporary thinking on this topic has centered on the important rubric of how far "upstream" a conferred patent right stands from the marketplace. In this regard, one can think of ideas on a spectrum from basic research to actual products as further upstream or downstream respectively. The concept can be very useful. In their seminal paper on the topic, legal scholars Michael Heller and Rebecca Eisenberg explain that, "Policy-makers should seek to ensure coherent boundaries of upstream patents and to minimize restrictive licensing practices that interfere with downstream product development. *Otherwise, more upstream rights may lead paradoxically to fewer useful products for improving human health.*"[53]

Put another way, a patent on an "upstream" technology will turn into a kind of "tollbooth" along the road of technological innovation. As the *Economist* has cleverly put it, patents too far upstream become little more than a means to "charging rents on dreams."[54] Unfortunately, however, under the sway of the "toaster model" of invention, the U.S. Patent Office has erected a host of upstream tollbooths. And, perhaps worst of all, is how powerful such patents can potentially be. Continuing with the tollbooth analogy, patent holders today are not only being permitted to erect all man-

52. *See,* Lester C. Thurow, *Patents and Pirates*, BOSTON GLOBE, June 18, 1996, at 42.

53. Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCIENCE 698, 701 (1998) (emphasis added).

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

ner of tollbooths along the road to the marketplace, these tollbooths (in the form of patent licensing arrangements) can charge any fee, or even block technological travelers altogether. In the U.S. patent system, after all, there is no requirement that patent holders license their technology at all, turning tollbooths into potentially outright roadblocks.

Recently, there is some evidence that, at least in some high-tech areas researchers may be increasingly ignoring the tollbooths and zooming ahead anyway. Timothy Caulfield, for instance, has recently suggested that empirical data in the area of gene patenting indicates that upstream patents have not proven discernibly deleterious to innovation in the field.[55] The fact is that such effects are notoriously hard to measure. It seems most likely that what is showing up in such data is the reality, especially in the biomedical field, that so many conflicting patents have been issued that researchers are choosing to simply ignore them and plow ahead with their research nonetheless. If this is in fact the case, the patents that now appear toothless may still prove highly problematic; researchers ignore them at their peril. History teaches that such proprietary rights can bite even long after the fact of developments in a given field.[56]

VII.

While researchers like Caulfield rightly question the extent to which upstream patents are actually interfering with innovation, it bears noting that even Caulfield's findings acknowledge evidence of a number of related scourges, including: increased secrecy among researchers; skewed research direction; and erosion of public trust in the research endeavor.[57] Like Caulfield, a number of scientists at the nation's top university and research institutes have noted that collegial discourse has withered in the face of proprietary claims and secrecy among researchers.[58] Such findings allude to an all-too-frequently neglected piece of the overall picture: the extent to which proprietary rights such as patents can erode norms and pathways for sharing information among would-be innovators. This issue surfaced clearly, for instance, in the brief review above of the problems caused by medical-procedure patents. The medical profession recognized that doctors couldn't do their jobs effectively if proprietary claims interfered with doc-

55. Timothy Caulfield, *Human Gene Patents: Proof of Problems?*, 84 CHI-KENT L. REV. 133 (2009).

56. One of many good examples can be seen in George Selden's U.S. Patent No. 549,160, for a "Road Engine," which surfaced in an eight-year legal battle against the Ford Motor Company in 1903.

57. Caulfield, *supra* note 55, at 104.

58. *See,* Eric G. Campbell, et al., *Data Withholding in Academic Genetics: Evidence From a National Survey*, 287 JAMA 473, 478 (2002).

tors' ability to freely share information about new techniques with colleagues and medical students.

We can think of such shared pools of information and know-how as a kind of intellectual-property infrastructure, or what I like to call an "infostructure." In this conception, the "infostructure" can be seen as those seminal ideas, standards, languages, and tools that, much like an infrastructure, provide an underlying base or foundation for a given field of endeavor, organization, or system.

One can think of the growing body of knowledge and the system through which it is shared as a kind of platform or framework (not unlike the network of roads that makes up the infrastructure of a city). In this sense, some type of knowledge constitutes a shared "infostructure" that properly belongs to all who use it. It exists in a gray area between the marketplace and the public square, between the boardroom and the classroom. As we build a global economy for the 21st century, we need a new way to think about and value this conceptual information commons.[59]

As many are coming to realize, things work best in the knowledge-based economy when certain seminal information assets—particularly those needed by all players in a given high-tech sector to compete—are pooled and shared. In the biomedical field, shared use of genetic sequence information from the human genome is a good example, as is the know-how that allows different engineers to design distinct machines that can all plug into a single type of wall socket or software that, because of common protocols, can travel seamlessly over the Internet. Thus the task before us, in high-tech sectors from software design to genomics, is to proactively identify the infostructure: to define when shared interests should override private claims on the knowledge frontier.

Perhaps the first step is to cultivate a more enlightened, long-term view of the research endeavor. Universities and corporations alike must understand that the fruits of the proverbial research garden cannot be picked indefinitely without tending to the trees and broader ecosystem from which they derive. Much to his credit, Norbert Wiener, mathematician and father of cybernetic theory, expressed this clearly back in 1954. As Wiener put it in his classic work, *Invention: The Care and Feeding of Ideas*:

> [T]he value of a piece of scientific work only appears to the full with its further application by many minds and with its free communication to other minds. Here any secrecy or any rights of property possession will naturally have the effect of making people shy off from a preempted

59. For examples and analysis of the so-called "information commons," see, for example, the work of David Bollier, *available at* http://www.onthecommons.org.

field of work.[60]

Of course, the roots of Wiener's thinking can be seen to extend considerably further back to the ideals of the enlightenment. To enlist as many minds as possible to the problems of his day, John Adams, the second U.S. President, recognized in 1765 that "[t]he preservation of the means of knowledge among the lowest ranks is of more importance to the public than all the property of all the rich men in the country."[61]

A helpful example, here, can be seen in the story of the so-called Rosetta stone. Discovered in 1799, this stone, now residing at the British Museum, bears the same passage of text written in Egyptian hieroglyphics, more modern Egyptian writing and in Classical Greek.[62] The stone proved indispensable in helping to decipher ancient Egyptian hieroglyphics. But imagine how difficult that task would have been if pieces of the Rosetta stone's information had been separately and independently owned.

The analogy idea here is that rather than parceling out individual ownership rights over human genes, we should not underestimate the value that can come from having unfettered access to the genome in its entirety. That will be the best way to decipher its mystery. Like the Rosetta stone, scientists will return to it again and again for many decades to come.

VIII.

Today's privatization of knowledge assets—including genes and genetic information—threatens to choke productivity, magnify inequities, and erode our democratic institutions. And the problem seems to be getting worse, not better. How did we get here? At least in part, by misguidedly treating ideas exclusively as commodities. And by employing a patent system—designed to protect gadgets like toasters—to apportion rights to bits of useful knowledge increasingly "upstream" from the marketplace. To insure productivity, equity, and democracy in the realm of intellectual property, we need start by adopting some of the time-honored legal tools we use to control the excesses of private ownership in other realms.

This means injecting more commonsense into the patent system. We need to demand that our legislators ask questions about productivity: namely, "Is the system working as intended to spur innovation?" Is it finding the right balance between rewarding the thinkers and the doers? Are patent

60. NORBERT WEINER, INVENTION: THE CARE AND FEEDING OF IDEAS 153 (1993).

61. John Adams, *Dissertation on the Canon and the Feudal Law* (1765), *reprinted in* 3 THE WORKS OF JOHN ADAMS, SECOND PRESIDENT OF THE UNITED STATES 447, 457 (Charles F. Adams ed., Boston, Charles C. Little & James Brown 1851).

62. *See* E.A. WALLIS BUDGE, THE ROSETTA STONE (Dover Publications 1989) (1929).

rights being defined specifically enough to both protect patent owners and spur new innovation? We also need to ask questions about the system's equity: Is it as fair as it could be? For instance, a strong case can be made that we have unintentionally created a winner-take-all system in which incremental inventions are rewarded disproportionately, allowing a handful of individuals to disproportionately capture and leverage the $137 billion annual taxpayer investment into federal R&D made by U.S. taxpayers.[63] Finally, we need to question the extent to which the U.S. patent system reflects our democratic values in the extent to which it preserves access to shared intellectual resources.

Drawing sensible lines around intellectual property rights is not as hard as it may sound. We need a nuanced system, and the first place to look is the well-established legal framework governing tangible property ownership. As I have argued elsewhere, for instance, even a nation that reveres private land ownership can decide that some pieces of land are so spectacular or vital in some respect that they should be designated for shared use as part of a public trust. Along these lines, I have for several years now called for consideration of establishing the equivalent of National Parks for knowledge: Intellectual-Property-Free (or IP-Free) zones.[64] I have also suggested that the human genome is a prime candidate for the first such a designation. To at least some extent, with many researchers placing genetic sequence information online and in the public domain, this is already happening to some extent in a *de facto* fashion. Still, I believe the designation of an IP-Free zone still merits our consideration for the important and useful precedent it could set.

Another helpful conceptual tool that can be adapted from the realm of land ownership is the simple and practical notion of zoning. Zoning ordinances insure that, while an individual can buy land in a nice residential neighborhood, for instance, it doesn't mean that individual has the right to build a refinery there. In other words, one's ownership right is restricted depending on its context. Importantly, though, there is no similar concept today in the realm of intellectual property. The analogy here is clear as well. In some contexts, private patent claims should be similarly restricted. In certain contexts, for instance, perhaps patent holders should be required to license their technology, or should be unable to enforce their patents in certain upstream, nonprofit, research situations. The 1996 federal legisla-

63. AAAS, 2007 BUDGET PROPOSES GAINS IN DEFENSE, SPACE AND SOME PHYSICAL SCIENCES R&D, CUTS IN OTHER PROGRAMS: AAAS ANALYSIS OF R&D IN THE FY 2007 BUDGET (2006), *available at* http://www.aaas.org/spp/rd/prev07p.pdf.

64. *See* Seth Shulman, *We Need New Ways to Own and Share Knowledge*, CHRON. HIGHER EDUC. (Wash., D.C.), Feb. 19, 1999, at A64.

tion limiting the enforceability of medical procedure patents discussed above is an important (if imperfect) example.

As we address such broader social concerns about the effects of patenting, we need to bear in mind the comparatively narrowly construed roots of the U.S. Patent System, including its former model requirement. We need to remember that patents were always intended to reflect a balance between titleholders and the public, and are only fulfilling their stated purpose to the extent that they are, in fact, demonstrably promoting innovation. Finally, we would do well to remember the value of freely shared information, including the extent to which the "infostructure" operates much like a garden from which future intellectual property fruit can blossom and grow. As historian Gar Alperovitz has noted, "Seemingly contemporary transformations inevitably build on knowledge accumulated over generations." As he aptly puts it, "What we accomplish stands atop a Gibraltar of technological inheritance."[65]

65. Gar Alperovitz, *Distributing Our Technological Inheritance*, TECH. REV., Oct. 1994, at 30, 31–32.