Are university researchers at risk for patent infringement?

Amy Yancey & C Neal Stewart, Jr

Academic researchers have regularly ignored patents on key technologies as a strategy to maneuver around patent thickets and freedom-to-operate issues, but they may be more at risk than they realize.

In Aristotle's *Politics*[1], Hippodamus is credited with first suggesting that states should reward innovators for introducing useful products to society. The basic idea is grounded in the tenets of utilitarianism: "Reward the creator of a useful thing, and society will gain more useful things." But even Aristotle had reservations about the tension between serving public good and rewarding individuals. In the United States, patents have played an important part in innovation and science, but how could people in the eighteenth century have envisioned biotechnology and today's research climate?

The language in the US Patent Act has changed little since 1793: "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."[2] However, patent policy is still evolving through the interpretation of the courts and the United States Patent and Trademark Office (USPTO) and through legislation. Modern interpretations of the patent statute have changed to more precisely define utility, disclosure, enablement, novelty, nonobviousness and even the technical statutory bars, but the single most important change for biotechnology came from the landmark *Diamond v. Chakrabarty* decision on patentable subject matter, in which the Supreme Court said that Congress intended patentable subject matter to "include anything under the sun that is made by man"[3].

Chakrabarty has important implications for utility patents on plants and the evolution of agricultural biotechnology. Plants were originally only eligible for protection under the Plant Patent Act of 1930 or the Plant Variety Protection Act of 1970, but now utility patents are regularly granted on plants and plant-related processes. A cursory search of plant-related utility patents shows that patents filed under the USPTO's plant classification have increased steadily from five in 1981 to 777 in 2006. Anecdotally at least, this would seem to suggest that granting utility patents on plants has indeed spurred innovation in that field.

Amy Yancey and C. Neal Stewart, Jr. are in the Department of Plant Sciences at the University of Tennessee, Knoxville, Tennessee 37996, USA. e-mail: yancey@tennessee.edu, nealstewart@utk.edu

Golden Rice in the field. Developing the provitamin A–enhanced rice required access to more than 40 US patented technologies.

Promoting progress or encouraging infringement?

Despite the apparent increase in plant utility patents in the past 25 years, private agbiotech research and development seemed, unexpectedly, to peak in the mid- to late-1990s, measured by the number of firms engaged in field trials and petitioning for deregulation and the total number of transgenic field trial notifications and permits[4]. This apparent discrepancy results from a number of complex issues, including industry consolidation through the formation of life sciences conglomerates. It has been suggested[5–7] that one underlying cause seems to be patent thickets and anticommons effects that arise from the patenting of basic research processes in agbiotech—essentially creating a situation conducive to market failure where innovation is invariably blocked because of the cost of bringing downstream technologies to market. Although a recent report from the Science and Intellectual Property in the Public Interest (SIPPI) project concludes that innovation blockage is not occurring[8], the matter is far from settled in regard to the biotech sector. The survey relied on self-reporting by researchers, asking them how licensing of protected technologies was acquired and what effects intellectual property (IP) difficulties had on research in their laboratories. It does not measure any effect on downstream technologies. Furthermore, an earlier report to the National Academy of Sciences suggests that at least part of the reason university research has not been affected is because of regular infringement of patents by university researchers[9], which is neither a sustainable nor a desirable solution.

Patent thickets occur from the patenting of enabling or platform technologies in certain fields such as biotechnology, semiconductors and software, and result in difficulties in navigating the patent landscape[5]. Patents may be overly broad or blocking or be held by rival companies who wish to exclude competitors from the market. Also, although patents and patent applications are disclosed, license agreements are often not. Add to the mix defensive patenting, a complex and difficult USPTO classification system and a lack of information available on the license status of certain technologies, and it becomes difficult to know what privately developed technologies are available for use by researchers. Furthermore, because patents rights are negative rights, bestowing only the right and obligation to exclude others from making, using, selling or importing the invention, patent holders are not required to use the invention, only to defend it, potentially resulting in the underuse of important tools for addressing public welfare needs—an effect commonly referred to as the "tragedy of the anticommons"[6]. The anticommons effect is the result of too many firms having the right to exclude others from a scarce resource to the detriment of the public good (contrasted with the tragedy of the commons, where a common resource is overused). Essentially, scientific advance is blocked if the cost of licensing key enabling technologies exceeds the potential value of a product when public researchers are barred from accessing proprietary technologies. And because 76 percent of agbiotech patents are held by private companies[7], public researchers have been and will continue to be denied official access to important technologies. Worse, simply determining where a researcher has freedom to operate (FTO) is becoming more difficult—with important implications for infringement, particularly because patent infringement happens routinely at every university with biotech research.

Examples of thickets and anticommons at work in agbiotech include broad patents on the two most reliable and used plant transformation techniques. Monsanto's patent on the process of transforming plants through the use of *Agrobacterium tumefaciens* is claimed so broadly that it could exclude all plant transformation processes that use any engineered bacteria to transfer foreign DNA into plant genomes. The other method, biolistics-mediated transformation, was developed by Cornell University but licensed exclusively to DuPont, which has blocked commercial competitors from accessing the technology[7,10]. Similar issues for other enabling technologies exist. Monsanto also holds the patent on the neomycin phosphotransferase (*nptII*) gene, one of the most commonly used selectable markers, which confers antibiotic resistance in transformed plant material. The patent, though set to expire in 2008, has claims written so broadly as to cover all methods of conferring antibiotic resistance, even though recent discoveries[11] have produced less controversial methods that rely on plant rather than on bacterial mechanisms (the latter raise concerns among critics who fear exacerbation of antibiotic resistance issues).

> Could university professors performing basic research be successfully sued for infringing patents?

Another important example of thicket problems is illustrated in the much-cited Golden Rice project. The provitamin A–enhanced rice was developed for humanitarian purposes to combat blindness and malnutrition in developing nations. Developing the rice required access to over 40 US patented technologies[12]. Because there is no commercial value in creating humanitarian crops, it would have been economically infeasible to produce had companies not waived their license fees for the project.

Although it is disturbing to consider anticommons effects on agricultural research, the repercussions are equally distressing in biomedical research, where similar problems arise. For instance, the genes *BRCA1* and *BRCA2* have recently been associated with hereditary breast cancer. A diagnostic procedure for identifying the genes was licensed exclusively to Myriad Genetics, which went so far as to block testing by a University of Pennsylvania researcher[6,13]. The fast-paced software and semiconductor industries also face similar difficulties. Solutions in those arenas may prove helpful to addressing innovation-stifling problems in agbiotech.

Why should researchers care about patent policy?

On principle. In the United States, the land-grant university (LGU) system was established in 1862 through the Morrill Act and later expanded through several further acts to include mandates for research and cooperative extension. At the core of the values of the LGU system is the idea that public investment in education, research and outreach results in public benefits. Much of the basic research that has led to current patents on research tools were created by or in collaboration with publicly funded university research or, at the very least, on the shoulders of over 100 years of public investment and developmental policy in agricultural research. Anecdotal evidence demonstrates that patents on those tools can be and are being used to block further research on downstream technologies that could save lives and serve the public well-being.

Furthermore, important humanitarian and fair trade issues arise. Golden Rice is only one example of how patent thickets can pose difficulties in bringing improved nutrition to developing countries. In addition, numerous ethical concerns arise when private companies have the capacity to exploit traditional knowledge of peoples in the developing world for profit, especially if they exclude those peoples from a share of proceeds or from access to the benefits of additional discoveries derived from that knowledge.

Perhaps the most complex ethical consideration arises over the blurring of our definition of products of nature versus products of man. The Supreme Court's failure to grant certiorari in the recent *Metabolife* case, which grants a patent on a basic scientific relationship, seems to suggest that FTO issues will only become increasingly difficult for public researchers who seek to understand basic natural relationships for the public good[14].

Having our cake and patenting it, too. The Bayh-Dole Act of 1980 urges research institutions, including universities, to own inventions from federally supported research and to license those technologies to the private sector[15]. Institutions are required to adopt formal patent polices for employees, seek patent protection on new technologies and encourage the development of those new technologies[16]. Bayh-Dole adds layers of complexity to the problems posed for public university researchers. There have been several significant instances in which a technology developed at the university level was licensed exclusively to a private company to the exclusion even of the researchers who invented it. And as universities continue to encourage and sometimes push scientists to produce transferable technology and reap income from license agreements and start-up successes, it becomes arguably less defensible for those researchers to infringe with impunity. Furthermore, it is unclear whether or not public researchers are accountable for infringement even if they do not commercialize any technology as a result of research efforts. Could university professors performing basic research be successfully sued for infringing patents?

Many university scientists tend to ignore patents[9]. In today's climate, where technologies are at the crux of science, it is difficult to see how professors could successfully perform any meaningful research without infringing patents. But they do so at their own peril. Although the patent statute contains a clearly stated research exemption, the 2002 court decision in *Madey v. Duke* limits the scope of the research exemption to experiments done "solely for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry"[17]. Madey was not a company but a disgruntled ex-faculty member, but the case has important implications for universities and their researchers. The court found that the precedent did "not immunize any conduct that is in keeping with the alleged infringer's legitimate business, regardless of commercial implications." Essentially, major research universities often conduct research projects without commercial application, but that research still advances the institution's educational mission to "increase the status of the institution and lure lucrative research grants, students and faculty." It is hardly for amusement.

Future consequences?

For private universities, the answer is made clear by *Madey v. Duke*. They can be sued for making, using, selling or importing patented technologies, even if they have no intention of commercializing the fruits of the research. For public universities, Eleventh Amendment sovereign immunity rules apply in intellectual property cases, at least for now. The four dissenting Supreme Court justices in the narrowly decided *Florida Prepaid* case raised concerns over state institutions benefiting from intellectual property without being required to honor it[18]. This puts public universities in the proverbial tight spot between Bayh-Dole (on the Congressional side) and the potential loss of immunity (on the judicial side). At the time, the ruling in favor of immunity prompted Congress to propose new legislation to close what they saw as a loophole in IP protection[19]. For now, sovereign immunity stands.

Also yet to be decided is the question of whether or not individual university researchers can be held liable for infringement. There certainly exists no clear precedent suggesting that they cannot be. Let us consider here recent cases in which the music industry has pursued university students for downloading copyrighted material because they cannot pursue immune public universities for failing to curtail the downloading—this is contrasted with the now infamous Napster case in which the record industry effectively shut down Napster in 2001 instead of pursuing individual violators. Just because a researcher has not been sued does not mean he or she will not be in the near future. And if a researcher has a stake in a commercial start-up company that is spun out of university research, she or he may be in for a rude surprise. In fact, infringement need not be direct. Indirect infringement might be brought against a third party for helping Party A infringe Party B's patent. And willful infringement—usually avoided by private firms by conducting thorough FTO searches—can incur treble damages.

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Good for the goose…

When and where might industry nip? The May 2007 Iowa State University Research Foundation suit against Monsanto alleges that the company willfully infringed on the foundation's low-linolenic acid soybean and seeks treble damages[20]. Ultimately, as universities and researchers continue to actively pursue patent protection for inventions under Bayh-Dole, the line between business and public welfare becomes increasingly fuzzy and may in fact provide the impetus for private companies to aggressively protect their patents, especially as universities commercialize tools through license agreements or develop downstream products of commercial interest.

Emerging solutions

Although the public forum seems the obvious place for reform, important barriers exist that may make solutions slow in coming, if they come at all. Recent Federal Circuit Court decisions seem to suggest a trend toward stronger protection for patents and other IP. The World Trade Organization's Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement echoes the US emphasis on stronger IP protection for all member countries. Congress has been slow to reform, even on procedural issues such as implementing a US first-to-file system. The House passed major patent reform legislation in September 2007 addressing this and other issues, but the Senate version will likely be different. Much of the special-interest pressure comes from a private sector that, although not uniform in opinion on resolving patent problems, tends to lean toward stronger IP protection. On the regulatory side, the USPTO is understandably pro-patent. Still, recent innovations may help prevent overly broad or nonobvious patents from being issued, as the USPTO prepares to launch the first ever trial on a peer-to-patent process using a wiki where experts can comment on patent applications. It also remains to be seen what effect the unanimous April 2007 Supreme Court ruling on *KSR International, Co. vs. Teleflex, Inc.* will have in reducing the number of broad and obvious patents. The decision promises to allow more flexibility in applying the 'teaching, suggestion or motivation test' and consequently should allow examiners and courts more flexibility in determining that a patent is obvious to one skilled in the art[21,22].

The market is responding as well. Several private companies are providing services designed to help steer clients to information and access to patented technology, some of them for free. PatentMonkey (http://www.patentmonkey.com) offers free database searching and charges fees for more extensive services. LegalForce (http://www.legalforce.com) recently launched an online marketplace that may prove useful for licensing, buying, selling and trading patented technologies. Several nonprofits are also specializing in helping underserved communities in the developing world. Both Light Years IP (http://www.lightyearsip.net) and Public Interest Intellectual Property Advisors (http://www.piipa.org) offer volunteer expertise to help countries develop and protect IP. The Coalition for Patent Fairness (http://www.patentfairness.org) is an advocacy group working to reform innovation-stifling practices and address patent litigation issues.

The best solutions may be yet to come. One relatively recent but promising development is the formation of open-source movements to pool patents, provide improved databases and search capacities, and develop "workarounds." Inspired by the software open-source movement, it was begun by Richard Jefferson with the founding of CAMBIA (http://www.cambia.org). Although critics point out the obvious—that unlike software development, biotechnology is not likely to be practiced in the garage[23]—open source movements may be gaining ground. CAMBIA, which means 'change' in Spanish, has several initiatives for fostering open-source solutions for issues in food security, health and natural resource management in disadvantaged communities and developing countries. One of the organization's primary goals is to develop and encourage development of enabling technologies through BioForge, a portal giving scientists access to enabling technologies that are protected commons. Participants are free to use these technologies under open-license agreements that allow them to be used without fee so long as subsequent advances are made freely available. CAMBIA has already made strides toward producing efficient workarounds, including the Transbacter method for biological transformation of plants without the use of *Agrobacterium*. CAMBIA also has tools for enhancing open collaboration among scientists, including Patent Lens, which uses database capacities to make the patent landscape more transparent, and BiOS, a system designed to help foster collaboration by scientists in an open community.

The Public Intellectual Property Resource for Agriculture (http://www.pipra.org) is another organization taking cues from the open-source movement in the hope of improving access to agricultural intellectual property. PIPRA's goal is to "make agricultural technologies more easily available for development and distribution of subsistence crops for humanitarian purposes in the developing world and specialty crops in the developed world." PIPRA has worked to create special licensing language for humanitarian use and has also developed a searchable database of over 6,600 international agricultural patents. The group is working on a plant transformation vector with maximal FTO and has just released an IP handbook that should help public researchers navigate the rather murky waters of patent protection (http://www.iphandbook.com). Based in part on the work PIPRA has done, some major research institutions, such as the University of California, have moved to include exceptions for public research in their license agreements, and PIPRA member institutions are following suit.

Conclusions

The original proponents of patent protection could not have foreseen a world in which the very building blocks of life could be patented or farmers could be prevented from saving seeds from year to year, but our courts, regulators and political leaders are certainly aware of it now. Despite this fact, public policy solutions have been slow in materializing, and the problems may get worse before they improve. It may prove that no silver bullet exists, but with open-source solutions, pressure from open-science advocates like Richard Jefferson and open licensing from universities, anticommons effects can hopefully be avoided or minimized. In the interim, it seems prudent to conduct research on awareness of FTO issues among public university researchers, increase empirical evidence of the innovation-blocking effects of anticommons and patent thickets, evaluate the effectiveness of those organizations seeking to increase collaboration amount public institutions and create new workarounds.

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