

January 2011

The Researcher Rat's Culture and Ease of Access to the Publication Lever: Implications for the Patentability of University Scientific Research

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Recommended Citation

Joshua R. Nightingale, *The Researcher Rat's Culture and Ease of Access to the Publication Lever: Implications for the Patentability of University Scientific Research*, 113 W. Va. L. Rev. (2011).
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THE RESEARCHER RAT'S CULTURE AND EASE OF ACCESS TO THE PUBLICATION LEVER: IMPLICATIONS FOR THE PATENTABILITY OF UNIVERSITY SCIENTIFIC RESEARCH

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I. INTRODUCTION

Although science and engineering professors at research universities have a variety of different duties and responsibilities, participating in and overseeing novel scientific research generally trumps all others.¹ Long after the staff has gone home, professors toil into the evening hours, preparing research proposals for funding grants, working with graduate students, and independently researching topics and conducting experiments. The work can be tedious and complicated, and the experiments are often fraught with difficulties. Professors endure the tedium and difficulty in hopes of experiencing the elusive “*eureka*” moments when significant scientific advancements are made.

When these meaningful results are obtained, the professor has a number of possible options: publish the work in a scientific journal, prepare a patent application, or do both.² Based on numbers alone, it appears that publishing is the option more often chosen. Although prestigious professors may have authorship status on hundreds of peer-reviewed journal articles, many have no patents at all; one survey of scientists from the nation’s top 125 universities revealed that 90% of researchers held one or fewer patents.³

One reason for this may be the culture of academia. “Publish or perish” remains a prominent mantra among professors,⁴ and promotion and tenure are often closely tied to publication, but not with patenting.⁵ As one commentator stated, the need for publication in the academic world is approaching “a classic operant conditioning experiment: the researcher rat presses the publication lever

¹ See, e.g., Patricia Ann Mabrouk, *Promotion from Associate to Full Professor*, 388 ANALYTICAL & BIOANALYTICAL CHEMISTRY 987, 988 (2007). When seeking promotion or tenure, research is generally viewed as the single most important component of a professor’s promotion package, and professors generally tailor their time and efforts accordingly. *Id.*

² See generally Paula E. Stephan et al., *Who’s Patenting in the University? Evidence from the Survey of Doctorate Recipients*, 16 ECON. INNOVATION & NEW TECH. 71 (2007).

³ Press Release, University of Wisconsin-Madison, *Basic Research Robust in Face of More University Patenting* (Sept. 14, 2007), http://www.eurekaalert.org/pub_releases/2007-09/uow-br091407.php [hereinafter Press Release].

⁴ See, e.g., Mohamed Gad-el-Hak, *Publish or Perish—An Ailing Enterprise?*, 57 PHYSICS TODAY 61 (2004).

⁵ S. R. Searle, *On Publishing Extended Abstracts, and Reviews*, 27 AM. STATISTICIAN 155, 155 (1973).

as often as humanly possible, because he is periodically reinforced with a pellet of prestige or promotion.”⁶ Additionally, the scientific community has developed a culture of sharing knowledge and discoveries that also motivates professors to publish.⁷

Despite this pervasive culture, professors today have little reason not to consider patenting as a viable option alongside publishing. Laws enacted within the past three decades have dramatically changed the landscape of intellectual property control for universities. With the enactment of the Bayh-Dole Act in 1980,⁸ federally funded research universities can retain title to their inventions and other intellectual property,⁹ providing universities with a great incentive to produce patentable inventions.¹⁰ This act and subsequent legislation evince Congress’s desire to ultimately allow university research to be put into use in the private sector, rather than languishing in university and government archives.¹¹ In the wake of these statutes, most research universities now have robust technology transfer offices containing the personnel and knowledge to turn research innovations into potentially lucrative patents and licenses.¹²

With the Bayh-Dole Act and technology transfer offices making it easier than ever to “patent and prosper,”¹³ the staggering difference between the average professor’s number of publications and patents is puzzling. As noted above, one may publish and obtain a U.S. patent for the same work, provided that the patent application is filed within one year of publication.¹⁴ Furthermore, it would seem that publishable research and patentable research should largely

⁶ Robert Claiborne, *Operant Conditioning of POP*, 171 SCIENCE 751, 751 (1971).

⁷ See, e.g., Katherine L. Gross & Gary G. Mittelbach, *What Maintains the Integrity of Science: An Essay for Nonscientists*, 58 EMORY L.J. 341, 346 (2008).

⁸ Pub. L. No. 96-517, § 6(a), 94 Stat. 3018, 3019–27 (1980) (codified as amended at 35 U.S.C. §§ 200–211 (2006)).

⁹ *Id.*

¹⁰ See National Science Board, *Science & Engineering Indicators 2006*, <http://www.nsf.gov/statistics/seind06/c5/c5h.htm> (last visited Oct. 22, 2010). Between 1988 and 2003, the number of patents assigned to universities increased from 800 to 3,200. *Id.*

¹¹ Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663, 1663-64 (1996).

¹² Kristen Osenga, *Rembrandts in the Research Lab: Why Universities Should Take a Lesson from Big Business to Increase Innovation*, 59 ME. L. REV. 407, 418–19 (2007). Prior to the enactment of the Bayh-Dole Act in 1980, only twenty-five technology transfer offices were active within United States universities; by 2005, approximately 3300 such offices existed. *Id.* at 419.

¹³ Howard K. Schachman, *From “Publish or Perish” to “Patent and Prosper,”* 281 J. BIOLOGICAL CHEMISTRY 6889 (2006).

¹⁴ 35 U.S.C. § 102(b) (2006). Many foreign countries, however, follow the absolute novelty rule, and foreign patent rights may be lost if one publishes prior to patent filing in these countries. See, e.g., DANIEL C.K. CHOW & EDWARD LEE, INTERNATIONAL INTELLECTUAL PROPERTY: PROBLEMS, CASES, AND MATERIALS 330 (2006) (“Because European patent law currently lacks a grace period and requires absolute novelty, any form of publication, even by the inventor, will destroy novelty and no longer allows for an invention to be patented.”).

be one and the same: both regimes exist to promote disclosure of new and useful scientific advances, and both systems disfavor the promotion of trivial, cumulative, and obvious results.¹⁵ However, despite the systems' seeming similarities, major differences exist. As discussed within, these differences cause a great deal of publishable university research to be unpatentable.¹⁶

The conventional wisdom for the causes of most professors' lack of patents is varied.¹⁷ Some commentators focus on the culture of academia, as described above, which promotes the free sharing of knowledge and encourages professors to have their inventions enter the public domain.¹⁸ Other commentators focus on the patent system's substantive requirements: because some university research is grounded in "basic science" or useful only in the laboratory, professors may be precluded from patenting much of their work.¹⁹ Finally, others focus on the misalignment of incentives since the enactment of the Bayh-Dole Act. Although universities today encourage professors to pursue patents and patentable research, most institutions continue to not acknowledge patents, invention disclosures, and other commercialization efforts as criteria for tenure and promotion.²⁰ Instead, professors are incentivized to fulfill other duties that are required for their tenure and promotion, but have little to do with patenting.²¹ These "traditional" duties of professorship include publishing, graduating students, and presenting work at academic conferences, among others.²² Lacking time to do everything, professors may make the decision to ignore patenting.

All of these reasons are likely valid. However, this Note maintains that in addition to the aforementioned causes, disparities in the patenting and pub-

¹⁵ 35 U.S.C. §§ 101–103, respectively, make utility, novelty, and nonobviousness requirements for obtaining a patent.

¹⁶ As discussed *infra* Part II.A.ii, publishable university research may be unpatentable for a number of reasons: it may be basic scientific research lacking real-world usefulness at the time of patent filing; it may fall outside the bounds of the Patent Act's statutory patentable subject matter requirement; or, it may represent only an incremental advance that is obvious in light of the prior art, among other reasons.

¹⁷ In addition to this conventional wisdom, experts have suggested numerous other contributing factors: if the professor sees that he can obtain research funding in another area, he may discontinue work that could have lead to a patentable invention; most professors are not entrepreneurs and don't feel that they should be making money off science; if no startup capital exists to commercialize their inventions, professors may choose to not pursue them; and professors may simply grow bored with a research area and choose to switch to another area. Telephone Interview with Bruce Sparks, Director of Technology Transfer, West Virginia University Office of Technology Transfer (Feb. 5, 2010).

¹⁸ Aaron S. Kesselheim & Jerry Avorn, *Using Patent Data to Assess the Value of Pharmaceutical Innovation*, 37 J.L. MED. & ETHICS 176, 181–82 (2009).

¹⁹ See generally Timothy J. Balts, *Substantial Utility, Technology Transfer, and Research Utility: It's Time for a Change*, 52 SYRACUSE L. REV. 105, 107 (2002).

²⁰ Brett M. Frischmann, *The Pull of Patents*, 77 FORDHAM L. REV. 2143, 2162 (2009).

²¹ Searle, *supra* note 5, at 155.

²² *Id.*

lishing regimes also contribute to professors' lack of patents. This Note explores the fundamental question of whether publishable research is patentable research and maintains that the publication system promotes a great deal of research that is not similarly rewarded by the patent system. Because professors are highly motivated to publish in order to meet tenure and promotion requirements, much of their research efforts may be focused on work that is publishable, but not patentable. This Note further maintains that differences in the systems make it much easier for one to publish rather than patent. The relative ease with which one may publish a paper makes publication a more frequently used option that may be resorted to earlier in the research process. Frequent and early publication may also harm the professor's ability to patent.

Professors' lack of patents is problematic for a number of reasons. First, if patents are unavailable to professors or not pursued by them, professors miss out on the substantial incentives offered by the patent system, and certain scientific research and the advancement of useful knowledge may be discouraged.²³ Second, despite the "publish or perish" culture of academia, a lack of patenting ability may cause some professors to keep their discoveries secret while they pursue a patentable invention.²⁴ Finally, if professors fail to patent, the goals of the Bayh-Dole Act are undermined, and universities fail to reap the substantial economic benefits that intellectual property ("IP") licensing could provide. This Note maintains that the most viable solution for increasing professors' patents is to encourage universities to change their incentive systems: by acknowledging patents as an academic contribution for promotion and tenure purposes, universities would promote patenting and help steer professors toward patentable research.

II. THE CURRENT STATE OF THE FEDERAL PATENT SYSTEM AND PEER-REVIEWED PUBLICATION SYSTEM

A. *The Federal Patent System*

The U.S. Constitution authorizes Congress "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries"²⁵ The federal patent power stems from this provision,²⁶ which is commonly known as the intellectual property clause.²⁷ The U.S. Supreme Court has recognized that the "twin purposes" of the patent system are "encouraging new inven-

²³ Balts, *supra* note 19, at 130–31.

²⁴ *Id.* at 131–32.

²⁵ U.S. CONST. art. I, § 8, cl. 8.

²⁶ *Graham v. John Deere Co.*, 383 U.S. 1, 5 (1966).

²⁷ *See generally* Edward C. Walterscheid, *The Nature of the Intellectual Property Clause: A Study in Historical Perspective*, 83 J. PAT. & TRADEMARK OFF. SOC'Y 763 (2001).

tions” and “adding knowledge to the public domain;”²⁸ rewarding the inventor is generally seen as a secondary purpose.²⁹ The Court has stated that the patent system should be viewed as “a carefully crafted bargain that encourages both the creation and the public disclosure of new and useful advances in technology, in return for an exclusive right for a limited period of time.”³⁰ Another key purpose of the federal patent system is to “assure that ideas in the public domain remain there for the free use of the public.”³¹

In comparing the patenting and scientific publishing regimes, two key aspects critical to the determination of whether a patent or publication should be awarded are the procedures and substantive requirements used in each system.

i. Patenting Procedure

Patent applications are processed administratively by the U.S. Patent and Trademark Office (PTO) in a process known as “prosecution.”³² The PTO employs patent examiners whose work generally involves searching issued patents and scientific publications for prior art and determining if the application meets the statutory requirements for patentability.³³

Prosecution is an *ex parte* proceeding that has been described as a series of negotiations between the patent examiner and applicant: an examiner may issue an initial rejection, and the applicant may respond by submitting countervailing arguments to the examiner or by changing the invention she seeks to claim.³⁴ Final rejections by the patent examiner may be reviewed administratively by the Board of Patent Appeals and Interferences (Board).³⁵ If the Board affirms the examiner’s rejection, the applicant may seek judicial review in federal courts.³⁶ Issued patents may later be challenged as invalid in an infringement action brought by the patentee against an accused infringer or in a declaratory judgment action brought by an accused infringer against the patentee.³⁷

²⁸ *Eldred v. Ashcroft*, 537 U.S. 186, 226–27 (2003) (Stevens, J., dissenting).

²⁹ *See, e.g., Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 330–31 (1945) (“The primary purpose of our patent system is not reward of the individual but the advancement of the arts and sciences.”).

³⁰ *Pfaff v. Wells Elecs., Inc.*, 525 U.S. 55, 63 (1998).

³¹ *Aronson v. Quick Point Pencil Co.*, 440 U.S. 257, 262 (1979) (citing *Kewanee Oil Co. v. Bicron Corp.*, 416 U.S. 470, 480–81 (1974)).

³² JANICE M. MUELLER, *PATENT LAW* 42 (3d ed. 2009).

³³ *See id.* at 45.

³⁴ *Id.* at 45–47.

³⁵ *Id.* at 47.

³⁶ Disappointed applicants may seek judicial review in the Court of Appeals for the Federal Circuit or by commencing a civil action against the Director of the PTO in federal district court. 35 U.S.C. §§ 145–146 (2006).

³⁷ 35 U.S.C. § 282 (2006); *see also* Christopher R. Leslie, *The Anticompetitive Effects of Unenforced Invalid Patents*, 91 MINN. L. REV. 101, 140 (2006).

The average time required for patent issuance from the time of filing is approximately two to three years.³⁸ Examiners spend an average of eighteen hours actually reviewing the application.³⁹

ii. Patentability Requirements

The PTO reviews each patent application and issues a patent if the application meets five main statutory requirements: the invention must fall within one of the general categories of patentable subject matter;⁴⁰ it must be novel;⁴¹ it must be useful;⁴² it must be a nontrivial extension of what was known;⁴³ and it must be described and disclosed such that a person having ordinary skill in the art could make and use the invention.⁴⁴

The patentable subject matter requirement of the Patent Act, section 101, requires that the invention fit into one of four statutorily created categories: process, machine, manufacture, or composition of matter.⁴⁵ Case law has enumerated a number of areas that are outside the bounds of patentable subject matter, including “laws of nature, physical phenomena, and abstract ideas.”⁴⁶ As discussed below, university research focused on pioneering, “basic science,” rather than “applied science,” may be held unpatentable under this doctrine.⁴⁷

The novelty requirements of section 102 require that the invention has not been preceded in identical form in the public prior art.⁴⁸ Section 102 also encompasses the prohibition on derivation⁴⁹ and “statutory bars” to patenting.⁵⁰

³⁸ ROBERT P. MERGES ET AL., *INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE* 163 (rev. 4th ed. 2007).

³⁹ *Id.*

⁴⁰ 35 U.S.C. § 101 (2006) (the categories of patentable subject matter are processes, machines, manufactures, and compositions of matter).

⁴¹ *Id.* § 102 (“A person shall be entitled to a patent unless . . . the invention was known or used by others . . .”).

⁴² *Id.* § 101 (“Whoever invents or discovers any . . . useful process, machine, manufacture, or composition of matter . . . may obtain a patent therefor . . .”).

⁴³ *Id.* § 103 (“A patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made . . .”).

⁴⁴ *Id.* § 112 (“The specification shall contain a written description of the invention . . . as to enable any person skilled in the art to which it pertains . . . to make and use the same . . .”).

⁴⁵ *Id.* § 101.

⁴⁶ *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980); *see generally* *Bilski v. Kappos*, 130 S.Ct. 3218 (2010).

⁴⁷ *See generally* Emir Aly Crowne Mohammed, *What is an Invention? A Review of the Literature on Patentable Subject Matter*, 15 RICH. J.L. & TECH. 2 (2008).

⁴⁸ *See generally* Debra D. Peterson, *The Hydra of Identity Tolerance: Patent Law Heresies Involving 35 U.S.C. § 102*, 85 J. PAT. & TRADEMARK OFF. SOC'Y 639, 642 (2003).

⁴⁹ 35 U.S.C. § 102(f) (2006) (one shall be entitled to a patent unless “he did not himself invent the subject matter sought to be patented”). The derivation prohibition requires that the applicant

The statutory bar prohibitions have enormous implications in the world of university patenting; publications or conference presentations by professors prior to the section 102(b) critical date create the possibility that the disclosed research will be unpatentable or that an existing patent will be held invalid.⁵¹

The utility requirement of section 101 has “devolved over the years into a rather minimal obstacle to obtaining a patent.”⁵² Generally, the disclosed invention must simply *do something*.⁵³ Under the utility requirement, applicants must demonstrate that their discoveries have real-world, practical applications at the time of filing; thus, the doctrine discourages filing patent applications during the early stages of research. As discussed below, cases like *Brenner v. Manson*⁵⁴ and its progeny deal with the need for real-world utility in the context of pharmaceutical and chemical research, and these cases can have important implications for the patenting of university research. The need for real-world utility may also preclude “basic science” research from being patented, although courts frequently couch their rejections of such patents in terms of patentable subject matter, rather than utility.⁵⁵

The nonobviousness requirement of section 103 has been described as “the final gatekeeper of the patent system.”⁵⁶ Inventions deemed to be only trivial steps forward will not be granted a patent, despite the fact that they may be new and useful. While section 102’s novelty requirement requires that a single prior art reference disclose all elements of a claim, section 103’s nonobviousness inquiry looks at whether the invention is obvious in light of a combination of prior art references.⁵⁷ Because research proceeds in small, incremental steps, the nonobviousness requirement has important implications for university

himself have invented the disclosed invention, rather than derived it or appropriated it from someone else.

⁵⁰ *Id.* § 102(b). The statutory bars to patenting may be triggered by events that occur after the invention; if the invention was publicly used, on sale, described in a printed publication, or patented “more than one year prior to the date of the application for patent,” the applicant shall not receive a patent. *Id.*

⁵¹ See *In re Klopfenstein*, 380 F.3d 1345 (Fed. Cir. 2004); Sean B. Seymore, *The “Printed Publication” Bar After Klopfenstein: Has the Federal Circuit Changed the Way Professors Should Talk About Science?*, 40 AKRON L. REV. 493 (2007).

⁵² Robert P. Merges, *Commercial Success and Patent Standards: Economic Perspectives on Innovation*, 76 CAL. L. REV. 803, 811–12 (1988).

⁵³ *Id.* As the Federal Circuit recently indicated, “[t]he threshold of utility is not high: An invention is ‘useful’ under section 101 if it is capable of providing some identifiable benefit.” *Juicy Whip, Inc. v. Orange Bang, Inc.*, 185 F.3d 1364, 1366 (Fed. Cir. 1999).

⁵⁴ *Brenner v. Manson*, 383 U.S. 519 (1966).

⁵⁵ See Michael Risch, *Everything is Patentable*, 75 TENN. L. REV. 591, 591 (2007-2008) (arguing that courts’ “confused and inconsistent jurisprudence of patentable subject matter can be clarified by implementing a single rule: any invention that satisfies the Patent Act’s requirements of category, utility, novelty, nonobviousness, and specification is patentable”).

⁵⁶ Merges, *supra* note 52, at 812.

⁵⁷ 35 U.S.C. § 103 (2006).

patenting: depending on the state of the prior art, even key advances may be deemed obvious if they are not significant enough technical accomplishments.

The enablement requirement of section 112 requires that the inventor describe his invention such that “one of ordinary skill in the art” would be able to make and use the invention without undue experimentation.⁵⁸ Under section 112’s related “written description” requirement, the applicant must “convey with reasonable clarity to those skilled in the art that, as of the filing date sought, he or she was in possession of the invention.”⁵⁹ Under the written description doctrine, courts have held that enabling others to make and use the invention is not enough; written description “requires a precise definition, such as by structure, formula, chemical name, or physical properties” and not just a wish or plan for obtaining the invention.⁶⁰ Critics of a strong written description requirement have argued that the doctrine “prejudices university . . . inventors who do not have the expensive and time-consuming resources to process every new” invention fully.⁶¹

iii. Research Utility under *Brenner*

Although the utility requirement of section 101 is generally seen as a low hurdle, the Court’s decision in *Brenner v. Manson* created a new “substantial utility” requirement that has important implications for university patenting.⁶² Ultimately, *Brenner* turned on the question of whether a process that produced results useful only for purposes of research could be patentable.⁶³ In *Brenner*, the patent applicant claimed a process for synthesizing previously known steroids but was rejected by the PTO for a failure “to disclose any utility for” the steroid claimed.⁶⁴

⁵⁸ *Id.* § 112; *In re Wands*, 858 F.2d 731, 736–37 (Fed. Cir. 1988); see also *Consol. Elec. Light Co. v. McKeesport Light Co.*, 159 U.S. 465 (1895). The policy rationale underlying the enablement requirement is that it helps ensure that the public gains the benefit contemplated by the patent “bargain.” In exchange for the right to exclusively practice of the invention, the inventor must truly put the public in possession of the invention such that persons skilled in the art may study and understand the invention and be able to make the invention once the patent term ends. See, e.g., Dan L. Burk, *The Role of Patent Law in Knowledge Codification*, 23 BERKELEY TECH. L.J. 1009, 1010 (2008).

⁵⁹ *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563–64 (1991) (emphasis removed).

⁶⁰ *Fiers v. Revel*, 984 F.2d 1164, 1171 (Fed. Cir. 1993).

⁶¹ *Enzo Biochem, Inc. v. Gen-Probe Inc.*, 323 F.3d 956, 983 (Fed. Cir. 2002) (Rader, J., dissenting from denial of rehearing en banc). But see Michael Risch, *A Brief Defense of the Written Description Requirement*, 119 YALE L.J. ONLINE 127 (2010).

⁶² *Brenner v. Manson*, 383 U.S. 519, 534–35 (1966).

⁶³ *Id.* at 535 (discussing the “patentability of a process which either has no known use or is useful only in the sense that it may be an object of scientific research”).

⁶⁴ *Id.* at 520–22. Procedurally, the case involved a “patent race” with another group of inventors claiming the same process. *Id.* at 521–22. The PTO examiner and Board of Appeals dismissed the application and would not declare an interference due to the applicant’s failure “to disclose any utility for” the compound produced. *Id.* at 521. The Court of Customs and Patent

The applicant argued that his process was useful within the meaning of section 101 either “(1) because it works—*i.e.*, produces the intended product . . . or (2) because the compound yielded belongs to a class of compounds now the subject of serious scientific investigation.”⁶⁵ Turning to the purposes of the patent system, the Court first rejected the argument that the disclosure purpose of the patent system would be deterred by failing to grant patents in cases like these.⁶⁶ The Court noted the common practice of opaque claim drafting and stated that inventors lacking uses for their products will likely disclose their invention to others who could help find a use.⁶⁷ The Court determined that granting patents to processes whose products are useful only for research purposes and lacked real-world use would create “monopol[ies] of knowledge” with “metes and bounds . . . not capable of precise delineation.”⁶⁸ The Court further stated that such patents could inhibit scientific research without the receipt of any real benefit by the public.⁶⁹

The Court ultimately held that patentable inventions must have “substantial utility,” which requires that they present a specific benefit to the public in their currently available form.⁷⁰ Processes and products that are useful only in the research setting are not patentable under this utility standard, despite their “contributions to the fund of scientific information.”⁷¹ The importance of this decision for the patentability of university research is clear: a great deal of university research grounded in “basic science” or otherwise only having “research utility” within the laboratory is not patentable under the Court’s “substantial utility” requirement.

B. *The Peer-Reviewed Publication System*

Printed academic journals⁷² are the premier avenue through which scientists and researchers communicate their achievements and results, relay

Appeals reversed and held that the applicant was entitled to a declaration of interference, and the Supreme Court granted certiorari “to resolve this running dispute over what constitutes ‘utility’ in chemical process claims.” *Id.* at 522.

⁶⁵ *Brenner*, 383 U.S. at 532.

⁶⁶ *Id.* at 533–34.

⁶⁷ *Id.*

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ *Id.* at 534–35.

⁷¹ *Brenner*, 383 U.S. at 535. Later decisions by the Supreme Court and the Federal Circuit further elucidated the contours of the substantial utility requirement. For an overview of cases leading up to *Brenner* and those following it, see Timothy J. Balts, *Substantial Utility, Technology Transfer, and Research Utility: It's Time for a Change*, 52 SYRACUSE L. REV. 105, 107 (2002).

⁷² Examples of prominent scientific journals that are frequently used by university researchers include, but are not limited to, the following: *Applied Physics Letters*, *Nature*, *The Journal of*

opinions, and exchange observations.⁷³ Publication of research results in peer-reviewed, scholarly journals plays a critical role in the dissemination and legitimization of scientific advancements and knowledge, the advancement of authors' careers, the future directions of scientific research, and the prestige of the journals themselves.⁷⁴ Although publication may be critical in gaining tenure and advancing one's career, it offers no direct financial reward: scientific journals do not pay authors for publication of their submissions. Moreover, publishing an article gives the author and his institution no exclusive rights to the research described; others are expected to learn from and freely use the information contained in articles published.

Most scientific journals are peer-reviewed. "The phrase 'peer review' connotes the evaluation ('review') of scientific or other scholarly work by others presumed to have expertise in the relevant field ('peers')." ⁷⁵ Peer-reviewed journals make use of disinterested experts to review and scrutinize the scholarly and scientific reliability of the submitted work.⁷⁶ Peer review cannot ensure perfection of the published articles: "all peer review can reasonably do is detect major defects of originality and scientific credibility, together with commenting on important omissions, the rigor of the arguments, and defects in the writing style."⁷⁷

Although numerous criticisms have been leveled at the peer review system,⁷⁸ it is widely supported or at least accepted as better than the alternatives.⁷⁹

Organic Chemistry, The Journal of Biological Chemistry, and IEEE Transactions on Electron Devices.

⁷³ Juan Miguel Campanario, *Peer Review for Journals as It Stands Today – Part 1*, SCI. COMM., Dec. 1998, at 181.

⁷⁴ Steven N. Goodman et al., *Manuscript Quality before and after Peer Review and Editing at the Annals of Internal Medicine*, 121 ANNALS INTERNAL MED. 11, 11 (1994); see also Campanario, *supra* note 73, at 181 ("Scientific journals are . . . the means by which scholars compete as if in a mental Olympiad for prestige and recognition.")

⁷⁵ Susan Haack, *Peer Review and Publication: Lessons for Lawyers*, 36 STETSON L. REV. 789, 789 (2007).

⁷⁶ *Black's Law Dictionary* defines "peer-reviewed journal" as "[a] publication whose practice is to forward submitted articles to disinterested experts who screen them for scholarly or scientific reliability so that articles actually published have already withstood expert scrutiny and comment." BLACK'S LAW DICTIONARY 952 (Abridged 8th ed. 2005). Few historical accounts of the evolution of peer review exist, but it appears that the process began in the mid-seventeenth century as an informal method of seeking opinions from colleagues. John C. Burnham, *The Evolution of Editorial Peer Review*, 263 J. AM. MED. ASS'N 1323, 1323 (1990). The process became more common and institutionalized near the mid-20th century, likely in response to the burgeoning number of articles being submitted to journals and the growing need for expert authority and objectivity. *Id.*

⁷⁷ Stephen Lock, *Does Editorial Peer Review Work?*, 121 ANNALS INTERNAL MED. 60, 60 (1994).

⁷⁸ Commentators have criticized the system in a number of ways; despite the improvement of the quality of the work, the readability remains poor. John C. Roberts et al., *Effects of Peer Review and Editing on the Readability of Articles Published in Annals of Internal Medicine*, 272 J. AM. MED. ASS'N 119, 119 (1994). The system is subject to serious bias and preference on the part

Researchers generally agree that the peer review process improves the quality of the published work, reduces readers' time spent perusing redundant publications, and offers scientists the opportunity for recognition, encouragement, and support of their research.⁸⁰

i. Peer Review Procedure

Although the time between submission and publication for an accepted work is generally markedly less than the time required for a patent to be issued,⁸¹ “[t]he publication process of a scientific article . . . is a demanding and often lengthy process.”⁸² Most journals employ a review process that involves an editorial board and peer reviewers.⁸³ If the editorial board determines the manuscript to be of potential interest and suitable for the journal, the editor initiates external review.⁸⁴ Peer reviewers are responsible for performing the in-depth, technical review of the paper critical to the process.⁸⁵

of the reviewers. Ann M. Link, *US and Non-US Submissions: An Analysis of Reviewer Bias*, 280 J. AM. MED. ASS'N 246, 246 (1998). The system provides little prevention of fraudulent or embellished data. Christine Laine & Cynthia Mulrow, *Peer Review: Integral to Science and Indispensable to Annals*, 139 ANNALS INTERNAL MED. 1039, 1039 (2003). Dissemination of important work is delayed through the slow publication process, and numerous duplicate publications slip through the system. B. Gitanjali, *Peer Review – Process, Perspectives and the Path Ahead*, 47 J. POSTGRADUATE MED. 210, 211 (2001).

⁷⁹ Mark Ware, *Peer Review in Scholarly Journals: Perspective of the Scholarly Community – Results from an International Study*, 28 INFO. SERVICES & USE 109, 109 (2008). In one study conducted, 93% of all persons surveyed disagreed that peer review is unnecessary and 85% agreed that peer review improves scientific communication. *Id.*

⁸⁰ Gitanjali, *supra* note 78, at 211.

⁸¹ Under the American Inventors Protection Act of 1999, Pub. L. No. 106-113, 1999 U.S.C.A.N. (113 Stat. 1501A) 554, however, most U.S. patent applications that are also filed in foreign countries are now published eighteen months after filing. *See generally* Joseph M. Barich, *Pre-Issuance Publication of Pending Patent Applications: Not So Secret Any More*, 2001 U. ILL. J.L. TECH & POL'Y 415 (2001).

⁸² Gitanjali, *supra* note 78, at 210.

⁸³ *See generally* Elsevier, *The Peer Review Process*, http://www.elsevier.com/framework_reviewers/PPT/process.ppt (last visited Oct. 26, 2010). Editors are responsible for making the key decisions as to whether the work will be published and what revisions, if any, are required. Ann C. Weller, *Editorial Peer Review in U.S. Medical Journals*, 263 J. AM. MED. ASS'N 1344, 1345–46 (1990). To save time for authors and peer-reviewers, editors must make an initial judgment on whether the paper is likely to meet the journal's editorial criteria. *See, e.g.*, Nature Publ'g Grp., *Peer Review Policy: Authors & Referees*, http://www.nature.com/authors/editorial_policies/peer_review.html (last visited Oct. 26, 2010). If the editor determines that the submission is unsuitable for publication, she will promptly reject the paper without external review from peer-reviewers. *Id.*

⁸⁴ Nature Publ'g Grp., *Peer Review Policy: Authors & Referees*, http://www.nature.com/authors/editorial_policies/peer_review.html (last visited Oct. 26, 2010).

⁸⁵ *Id.* Peer review referees are “the linchpin about which the whole business of Science is pivoted.” JOHN M. ZIMAN, *PUBLIC KNOWLEDGE: AN ESSAY CONCERNING THE SOCIAL DIMENSION OF SCIENCE* 111 (Cambridge Univ. Press 1968). Peer reviewers are generally selected because

Reviewers are urged to provide arguments for and against publication, which helps the editors in making their final decision.⁸⁶ In certain cases, the editor may allow the author to revise his manuscript before a final decision is reached, and the process that ensues may be characterized as a “trilateral negotiation” between the author, editor, and reviewer.⁸⁷ After the author makes the revisions specified, the referees and editors will again assess the work; numerous iterations of this process may occur before a final decision is reached.⁸⁸

ii. Review Criteria

The substantive requirements for publication vary among journals, but a number of bedrock criteria and considerations exist. In general, reviewers’ ultimate goals include “screen[ing] for obvious errors in methodology and reasoning, and . . . ensur[ing] that the research is novel and ‘important.’”⁸⁹ Thus, four integral questions that reviewers seek to answer are as follows: “(i) Is the data valid? (ii) Are the conclusions reasonable? (iii) Is the material original? (iv) Is the information important?”⁹⁰

they are scientifically qualified, involved in scientific research that has resulted in the publication of original work, and willing to devote the time to critically review the manuscripts assigned to them. Gitanjali, *supra* note 78, at 210. One study concluded that the best peer reviewers “tended to be young, from strong academic institutions, well known to the editors, and blinded to the identity of the manuscript’s authors.” Arthur T. Evans et al., *The Characteristics of Peer Reviewers who Produce Good-Quality Reviews*, 8 J. GEN. INTERNAL MED. 422, 422 (1993).

⁸⁶ Nature Publ’g Grp., *supra* note 84. Using the reviewers’ advice and judgment on the merits of the manuscript, the editor must decide among several possibilities. *Id.* She may choose to accept the manuscript for publication, with or without editorial revisions. *Id.* Alternatively, she may allow the author to revise the manuscript to address reviewer concerns before a final decision is reached. *Id.* She may choose to reject but indicate that further work might justify a resubmission. *Id.* Finally, she may reject the manuscript outright. *Id.*

⁸⁷ DARYL E. CHUBIN & EDWARD J. HACKETT, PEERLESS SCIENCE: PEER REVIEW AND U.S. SCIENCE POLICY 88 (1990). This “negotiation” process finds a direct analogue in the patent system’s prosecution procedure, which has also been described as a series of negotiations. *Id.*

⁸⁸ *Id.*

⁸⁹ Brief of Amici Curiae Daryl E. Chubin et al. in Support of Petitioners at 2, *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1992) (No. 92-102) [hereinafter Chubin Amici Curiae Brief].

⁹⁰ Effie J. Chan, *The “Brave New World” of Daubert: True Peer Review, Editorial Peer Review, and Scientific Validity*, 70 N.Y.U. L. REV. 100, 119 (1995). See also Brief of [T]he New England Journal of Medicine et al. as Amici Curiae in Support of Respondent at 1a, *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993) (No. 92-102) [hereinafter New Eng. J. Med. Amici Curiae Brief]. While these are the most critical questions that reviewers seek to address, journals have identified a number of other important factors: data presentation and interpretation, appropriate statistical analysis, depth of the investigation, and a thorough and logical discussion of the results. See, e.g., Daryl Lund & David Min, *Effective Preparation of Scientific Manuscripts*, <http://www.ift.org/knowledge-center/read-ift-publications/journal-of-food-science/~media/Knowledge%20Center/Publications/ManuscriptPrepGuidance1009.ppt> (last visited Oct. 26, 2010). Aside from scientific considerations, manuscripts must meet readability requirements in order to be published: the writing must be clear and grammatically correct. *Id.*

In answering the question of whether the data is valid, the reviewer must seek to ensure that sound scientific methodology was used in producing the data presented.⁹¹ Thus, the author must show that the data presented was gathered through “scientifically legitimate experimental methodologies.”⁹² Authors are required to include an “experimental” section within their article, and reviewers must determine whether the experimental design and methods used were appropriate for the type of data to be collected and the type of research being conducted.⁹³ In the experimental section, recipes, materials, equipment used, and all other pertinent experimental conditions must be described in detail so that readers can repeat the experiment.

The second key issue that the reviewer seeks to address is the reasonableness of the conclusions drawn by the author. The author is expected to present his key analytical steps used in proceeding from the experimental results to his final conclusion; the referee must trace and assess the author’s analysis and determine whether the conclusions drawn are reasonable and plausible.⁹⁴ Part of this determination lies in defining the proper scope of the conclusion that can be drawn from the experimental results and subsequent analysis.⁹⁵ Thus, it is not uncommon for the author, editors, and referees to engage in “negotiation” over the proper scope of the conclusions drawn; the author may seek conclusions that indicate results of great magnitude and importance, while a cautious referee may seek to significantly narrow the scope of the conclusions.⁹⁶

The third key issue that the reviewer seeks to address is the originality of the submitted manuscript. Most journals’ standard publication criteria contains some type of blanket statement requiring that submissions must contain “new” or “original” results that have not been submitted elsewhere.⁹⁷ Reducing

⁹¹ See Brief of the Carnegie Commission on Science, Technology, & Government as Amicus Curiae in Support of Neither Party at 26, *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1992) (No. 92-102) (“[W]hen a study has been peer-reviewed, it has presumptively been conducted out in accordance with the dictates of scientific methodology”) [hereinafter *Carnegie Amicus Curiae Brief*].

⁹² Chan, *supra* note 90, at 120.

⁹³ *Id.* at 120. Because the reviewer cannot watch the experiments being performed and verify that all experimental methods were performed correctly, she must simply presume that the data gathered through appropriate experimental methodologies is valid. See Arnold S. Relman & Marcia Angell, *Editorial: How Good Is Peer Review?*, 321 *NEW ENGLAND J. MED.* 827, 828 (1989); Chan, *supra* note 90, at 120.

⁹⁴ See CHUBIN & HACKETT, *supra* note 87, at 2.

⁹⁵ *Id.* at 88.

⁹⁶ Chan, *supra* note 90, at 120; CHUBIN & HACKETT, *supra* note 87, at 88.

⁹⁷ See, e.g., Am. Inst. of Physics, *General Editorial Policies – Applied Physics Letters*, http://apl.aip.org/apl/authors/general_editorial_policies (last visited Oct. 26, 2010) (“Emphasizing rapid dissemination of key data and new physical insights, APL only publishes papers containing new results that have not been submitted elsewhere.”).

readers' time spent reading redundant publications is a goal of the peer review system.⁹⁸

Finally, the fourth key issue that the reviewer seeks to address is the importance of the submitted manuscript. For example, in its criteria for publication, the American Institute of Physics states the following in regard to its *Applied Physics Letters* journal:

[W]e are no longer able to consider for publication every submission that is merely free from error. We aim at publishing papers that represent substantial advancement of established knowledge or that report significant novel development in applied physics. Manuscripts that . . . fall short of this standard will not be accepted.⁹⁹

Thus, this requires a determination of the impact that the manuscript will have on the relevant field of science; consequently, even a manuscript that is technically proficient, produced using a sound scientific methodology, and the result of logical reasoning may not warrant publication.¹⁰⁰

iii. Variability Between Journals

Unlike the regimented procedures employed by each PTO examiner in determining the validity of a patent application, the peer review process varies widely between journals.¹⁰¹ The average amount of time that a referee devotes to each review is one such area in which journals vary.¹⁰² The number of reviewers assigned to each article also differs between journals; although most journals employ two or more referees to review submissions, some journals

⁹⁸ Gitanjali, *supra* note 78, at 211.

⁹⁹ Am. Inst. of Physics, *supra* note 97.

¹⁰⁰ Chan, *supra* note 90, at 120–21; Joint App. at 185aa, *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, (1993) (No. 92-102) (deposition of Jay H. Glasser, Professor of Epidemiology, University of Texas).

¹⁰¹ Ware, *supra* note 79, at 109 (noting that peer review has been criticized as “unstandardised and idiosyncratic”); see also Lowell Hargens, *Variation in Journal Peer Review Systems: Possible Causes and Consequences*, 263 J. AM. MED. ASS'N 1348, 1348 (1990).

¹⁰² Various studies conducted have indicated mean review times of 5.4 hours and 3.5 hours, respectively, for two different journals, while another survey suggested that reviewers spend only two to three hours on a single review. Campanario, *supra* note 73, at 189; Nick Black et al., *What Makes a Good Reviewer and a Good Review for a General Medical Journal*, 280 J. AM. MED. ASS'N 231 (1998).

have resorted to a single referee system to expedite the process.¹⁰³ The average qualifications of reviewers also vary greatly among journals.¹⁰⁴

Predictably, not all journals enjoy equal prominence, and this reality has significant consequences on the question of whether a submission is publishable within a given journal.¹⁰⁵ “The Impact Factor is a number that judges the importance of a scientific/engineering journal.”¹⁰⁶ The impact factor is determined primarily by looking at the number of citations in later publications to articles published within a journal in a given year.¹⁰⁷ Prominent journals with high impact factors place a higher premium on submissions with great significance and magnitude of scope. Because high impact factor journals receive so many submissions, editors at these journals simply must impose higher standards in determining what is publishable.¹⁰⁸ Thus, a significant number of manuscripts received at high impact factor journals will be rejected upon the initial screening provided by the editor; if this practice was not employed, editors would often have to engage in the time-intensive formal review process, which would result in even longer delay times between submission and publication.¹⁰⁹ Thus, the rate of acceptance also varies widely between journals.¹¹⁰

¹⁰³ Campanario, *supra* note 73, at 184. Even journals that use multiple reviewers may differ in their systems employed. See *id.* for a review of various referee systems being employed: the single referee system, “refereeing in series,” and “refereeing in parallel.”

¹⁰⁴ See K. Schulman et al., *Ethics, Economics and the Publication Policies of Major Medical Journals*, 272 J. AM. MED. ASS’N 154 (1994). As an illustrative example, one survey of *Physiologia Plantarum* reviewers indicated that 83% of the reviewers were in senior university positions, 57% had their Ph.D. degrees at least fifteen years prior to the date of the survey, and 60% had published six or more papers in the last three years. T. M. Murphy & J. M. Utts, *A Retrospective Analysis of Peer Review at Physiologia Plantarum*, 92 PHYSIOLOGIA PLANTARUM 535 (1994). These impressive qualifications can be compared to the results of a survey conducted of *American Journal of Public Health* reviewers, which indicated that 31% of them had not been listed as an author of a publication in the 1987 Science Citation Index, and 15% had never before been cited. Alfred Yankauer, *Who are the Peer Reviewers and How Much Do They Review?*, 263 J. AM. MED. ASS’N 1338 (1990). While these studies surveyed different measures, the journal described in the former study at least appears to employ reviewers of a significantly higher caliber than the latter.

¹⁰⁵ David P. Hamilton, *Publishing by – and for? – the Numbers*, 250 SCIENCE 1331, 1331 (1990) (“The conventional wisdom in the field is that 10% of the journals get 90% of the citations These are the journals that get read, cited, and have an impact.”) (citations omitted).

¹⁰⁶ Randy L. Haupt, *The Impact of the Impact Factor*, IEEE ANTENNAS & PROPAGATION MAG., Oct. 2005, at 180.

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

¹⁰⁹ Richard Monastersky, *The Number that’s Devouring Science*, 52 CHRON. HIGHER EDUC. 12, 15 (2005). The journal *Nature* rejects approximately half of the manuscripts it receives without sending them out for review. *Id.*

¹¹⁰ See Chubin Amici Curiae Brief, *supra* note 89, at 19 n.18. “In fields like physics, which have acceptance rates of 80%, the rule of thumb . . . is, ‘When in doubt, accept.’ . . . In fields like psychology, which have acceptance rates of about 20%, the number of papers submitted far exceeds the number of pages available.” *Id.*

Being rejected at one journal does not foreclose an author from resubmitting his work to other journals for publication. An author will often initially submit his paper to a high impact factor journal, and, if not accepted, he will resubmit to lesser journals.¹¹¹ This process may continue until the work is finally accepted; in extreme cases, an author may have been rejected by ten to twenty other journals prior to finding one that will publish his work.¹¹² Although no hard numbers exist to show what percentage of submitted works ultimately get published, perhaps, after multiple rejections,¹¹³ it is likely safe to say that most works that make any appreciable contribution to the store of scientific knowledge should be publishable *somewhere*. In their amicus brief to the U.S. Supreme Court for the *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,¹¹⁴ case, noted scholars and experts in the peer review system Daryl E. Chubin and Edward J. Hackett stated the following: “[W]ith the proliferation of peer review journals, it is axiomatic that getting a paper published somewhere, at some time, is a virtual certainty, if only one is willing to persevere.”¹¹⁵

III. THE BAYH-DOLE ACT

A. *The Statute and its Effects*

The Bayh-Dole Act¹¹⁶ was enacted in 1980 to allow university research results to be put into use in the private sector and ultimately for the benefit of the public.¹¹⁷ Prior to the Bayh-Dole Act, a select few university research advances were patented, and the rest were largely ignored by private industry.¹¹⁸ In enacting the Bayh-Dole Act, Congress aimed to use the patent system to achieve a number of goals: “to promote the utilization of inventions arising from federally supported research or development; to encourage maximum participation of small business firms in federally supported research and development efforts; [and] to promote collaboration between commercial concerns and non-profit organizations, including universities[.]”¹¹⁹ The Act allows universities to retain title to their IP and enter into licensing agreements to collect royalties

¹¹¹ Haupt, *supra* note 106, at 180.

¹¹² See Chubin Amici Curiae Brief, *supra* note 89, at 21.

¹¹³ *Id.* at 21 n.19 (“Unfortunately, there are few hard numbers on these questions. Although the overall acceptance/rejection rates for journals may be known, individual authors are understandably reluctant to disclose how many times their articles were rejected.”).

¹¹⁴ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993).

¹¹⁵ Chubin Amici Curiae Brief, *supra* note 89, at 21.

¹¹⁶ 35 U.S.C. §§ 200–211 (2006).

¹¹⁷ Eisenberg, *supra* note 11, at 1663–64.

¹¹⁸ Thomas J. Siepmann, *The Global Exportation of the U.S. Bayh-Dole Act*, 30 U. DAYTON L. REV. 209, 210 (2004).

¹¹⁹ 35 U.S.C. § 200.

from the use of their inventions in the private sector.¹²⁰ Prior to the Bayh-Dole Act, legislation had typically required that title to federally-funded research vest in the government or be put into the public domain through dedication.

The Bayh-Dole Act resulted in large increases in university patenting.¹²¹ The Association of University Technology Managers (AUTM) reports that 3800 U.S. patents were issued in 2004 to universities; in contrast, the AUTM reports that less than 250 patents were issued to universities in 1980.¹²² Proponents of the Bayh-Dole Act tout government statistics and survey results that indicate the positive effects of university technology transfer on academic research, economic development, and the public-at-large.¹²³

However, the Bayh-Dole Act is not without its critics, and a number of cogent arguments have been lodged against it. Critics have focused on the fact that the public is seemingly required to pay twice for the same invention: first, through government research grants consisting of public funding and, second, through higher prices on goods and services to private companies seeking to recover money lost on royalties paid to university patent holders.¹²⁴ Others have argued that the Bayh-Dole Act actually deters innovation: “A proliferation of intellectual property rights upstream may be stifling life-saving innovations further downstream in the course of research and product development.”¹²⁵

¹²⁰ Eisenberg, *supra* note 11, at 1665; 35 U.S.C. § 202 (“Each nonprofit organization or small business firm may . . . elect to retain title to any subject invention . . .”).

¹²¹ ASS’N OF UNIV. TECH. MANAGERS, AUTM U.S. LICENSING SURVEY: FY 2004 (2005), http://www.immagic.com/eLibrary/ARCHIVES/GENERAL/AUTM_US/A051216S.pdf (last visited Oct. 26, 2010) [hereinafter 2004 Licensing Survey].

¹²² *Id.* at “A Message from the President.” Because data from this survey reflects patent filings from 2001-2002 and earlier, filings in 2004 and later are likely even higher.

¹²³ *Id.* For example, the AUTM has cited a 1968 study, which “found that no drug to which the government held title had ever been commercially developed and become available to the public;” in contrast, the AUTM states that today, “more than 300 biotech drug products and vaccines targeting more than 200 diseases . . . are in clinical trials[.]” *Id.*

¹²⁴ A number of other arguments against the Bayh-Dole Act have been made. “Second, by calling for exclusive rights in inventions that have already been made through public funding (and thus, presumably, without the need for a profit incentive), it contravenes the conventional wisdom that patent rights on existing inventions result in a net social loss *ex post*, a loss that we endure only to preserve *ex ante* incentives to make future patentable inventions. Third, by promoting the private appropriation of federally-sponsored research discoveries as a matter of routine, it calls into question the public goods rationale for public funding of research.” Eisenberg, *supra* note 11, at 1666-67.

¹²⁵ Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698, 698 (1998).

B. Technology Transfer in Universities and Incentives to Patent

The method by which universities allocate rights in their research discoveries is through a “technology transfer” process.¹²⁶ “These agreements are the roadmap of how the discovery gets from the lab to the market.”¹²⁷ University technology transfer offices are now commonplace and exist to pursue, manage, protect, and license intellectual property created at the university.¹²⁸ The Bayh-Dole Act requires that the university’s royalties be shared with the individual inventors, but universities are left to determine exactly what percentage inventors receive.¹²⁹

The Bayh-Dole Act and its promise of licensing revenues for commercially viable research provides a major incentive for universities to pursue private IP.¹³⁰ Whether professors are equally incentivized to do so is less clear, however. One study of 1800 life science professors indicated that 25% of the professors surveyed held at least one patent and that 12% of those surveyed held two or more patents.¹³¹ Of the 25% surveyed who held at least one patent, only 33% of these researchers had received any licensing revenues.¹³² Thus, only 8% of the 1800 professors surveyed had received licensing revenues.¹³³

Importantly, the study’s results showed that patent royalties were highly concentrated in a small number of patents, leaving most patent-holding professors with only very small royalties.¹³⁴ In this study, 96% of the patent license revenues were concentrated in three (3) patents out of 1200, with 90% of the

¹²⁶ Ned T. Himmelrich & Jonathan M. Holda, *Technology Transfer Agreements: Don't be an Amateur*, MD. B.J., Nov.–Dec., at 30, 31 (2001).

¹²⁷ *Id.*

¹²⁸ See Osenga, *supra* note 12, at 418–21.

¹²⁹ 35 U.S.C. § 202(c)(7). West Virginia University, for example, disperses the revenue balance after expenses as follows: 40% to the inventors, 10% to the inventor's department, 10% to the inventor's particular college or school within the university, and 40% to the West Virginia University Research Corporation. W. VA. UNIV. OFF. OF TECH., *Intellectual Property Policy*, <http://www.wvu.edu/~research/techtransfer/policy/> (last visited Oct. 26, 2010). The West Virginia University Research Corporation serves to “foster and support research at West Virginia University, and provide evaluation, development, patenting, management, and marketing services for inventions of the faculty, staff and students of the University.” W. VA UNIV. RES. CORP., *About*, http://researchoffice.wvu.edu/about/wvu_research_corporation (last visited Oct. 26, 2010).

¹³⁰ The Act requires that the remaining revenue balance after patenting, licensing, and other related expenditures “be utilized for the support of scientific research or education” within the university. 35 U.S.C. § 202(c)(7).

¹³¹ Bradford L. Barham & Jeremy D. Foltz, *Patenting, Commercialization, and US Academic Research in the 21st Century: The Resilience of Basic, Federally-Funded Open Science* 16 (Univ. of Wisconsin-Madison, Dept. of Agric. & Applied Econ., Staff Paper No. 513, 2007), available at <http://www.aae.wisc.edu/pubs/sps/pdf/stpap513.pdf>.

¹³² *Id.*

¹³³ *Id.*

¹³⁴ *Id.* at 17.

revenues being captured in one single patent.¹³⁵ Though “a total of \$27 million in licensing revenues was generated” by the 1200 patents in question, the median royalty payment for those receiving any licensing revenue was only \$5,000, a very small payoff.¹³⁶ The “very low probability and extreme concentration of patent royalties” caused the study’s authors to characterize the system as a “lottery” for these professors; “even those securing a ticket are very unlikely to get any payoff and if they do it is likely a minor benefit.”¹³⁷ While universities with numerous patent holders see IP commercialization efforts as a relatively steady source of income, most individual professors will fail to be one of the lucky “lottery” winners and, thus, have little incentive to enthusiastically pursue patenting.¹³⁸

IV. ANALYSIS

Most professors today do not have patents. In addition to the causes put forth by conventional wisdom,¹³⁹ this Note maintains that disparities in the patenting and publishing regimes also contribute to professors’ lack of patents by encouraging publication at the expense of patenting. Below, the fundamental question of whether publishable research is patentable research is considered by investigating the differences in both the substantive requirements and procedures for the regimes.

By exploring these differences, this Note maintains that the publication system rewards and promotes early, pioneering research and also small, incremental advances, both of which are largely unrewarded by the patent system. In many cases, this difference makes the level of scientific advancement required to publish lower than that needed to obtain a valid patent. The relative ease with which one may publish a paper makes publication a more frequently used option that may be resorted to earlier in the research process, and this frequent and early publication may harm the professor’s ability to patent later.

A. *How the Substantive Requirements Vary Between Patenting and Publishing*

To begin the comparison between the patent law system and the peer review publication system, it is worthwhile to consider each of the five main requirements of patentability—patentable subject matter, novelty, utility, obviousness, and enablement—and determine whether a close analogue exists

¹³⁵ *Id.*

¹³⁶ *Id.* at 16–17.

¹³⁷ Barham & Foltz, *supra* note 131, at 17.

¹³⁸ *Id.*

¹³⁹ See *supra* notes 17–22 and accompanying text.

within the peer-reviewed publication system. If such an analogue exists, it must be determined how the requirements vary between the two systems.

On first glance, it would seem that scientific journals' requirements are similar to those of the patent system. Both systems require new and important results that are described such that one skilled in the field could repeat the experiments and results. However, on closer inspection, it becomes clear that much publishable research is not patentable. While the novelty and enablement requirements are nominally similar between the two systems, aspects of the remaining requirements create important differences between the two systems.

i. Novelty

Ignoring some of the more technical aspects of section 102, both the patent system and peer review publication system have a bedrock requirement that the research be "new."¹⁴⁰ A patent applicant fails to meet section 102's novelty requirement when a single prior art reference discloses "each and every element of the claimed invention;" promoting the publication system's goal of eliminating time spent reading redundant journal articles requires the same determination to be made.¹⁴¹ Thus, both systems have novelty requirements that are essentially "strict identity" inquiries.¹⁴²

Along with its novelty requirements, the patent system's closely related requirement that the applicant has not derived or stolen his invention from another¹⁴³ finds a close analogue in the peer review system: all journals require that authors meet the basic standards of professional ethics, including its prohibitions on plagiarism.¹⁴⁴

ii. Enablement

Patent law's enablement requirement finds a close analogue in the peer review system's goal of determining the validity of data and conclusions presented. Although the systems' requirements are couched in different language—patent law's enablement seeks to address whether a person having ordinary skill in the art could make and use the invention without undue experimentation, and the peer review system's inquiry ostensibly focuses on assuring the validity of data and conclusions presented—at the heart of both is the goal of fulfilling the quid pro quo bargain inherent in each system. In exchange for the

¹⁴⁰ 35 U.S.C. § 102.

¹⁴¹ *Structural Rubber Prods. Co. v. Park Rubber Co.*, 749 F.2d 707, 715 (Fed. Cir. 1984).

¹⁴² 1 DONALD S. CHISUM, *CHISUM ON PATENTS* § 3.02 (2003).

¹⁴³ 35 U.S.C. § 102(f) ("[H]e did not himself invent the subject matter sought to be patented.").

¹⁴⁴ See Robert C. Kennicutt, Jr. et al., *Professional and Ethical Standards for the AAS Journals*, 167 *ASTROPHYSICAL J. SUPPLEMENT SERIES* 101, 101 (2006) ("As implicit conditions for publishing . . . authors are expected to adhere to basic standards of professional ethics and conduct that are common across all areas of scholarly publishing.").

patent rights or publication privilege, each system requires that the scientist explain his scientific achievement so that others can study, understand, and recreate the research. Indeed, the overarching goal of the peer review publication system is the dissemination of scientific knowledge, and a key part of this dissemination lies not only in the ultimate conclusions drawn, but also in the experimental techniques, methodologies, and conditions used to gather the data. “Science is built by many people contributing incrementally,”¹⁴⁵ and journal articles that did not allow for scientists to recreate and build on previous experiments would be of little value to the scientific world.¹⁴⁶

The enablement requirement shared by the two systems may be the single area in which the publication system has more stringent requirements than the patent system. “Unlike the rules for scientific publications, which require actual performance of every experimental detail, patent law and practice are directed to teaching the invention so that it can be practiced.”¹⁴⁷ An enabling patent application is a constructive reduction to practice that acts as a substitute for an actual reduction to practice, but the publication system generally requires that the author has performed the experiment used to gather the data presented.¹⁴⁸

Also similar between the two systems is the requirement that the enablement be commensurate with the scope of the conclusions drawn. In patents, this means that the scope of the legal protection embodied in the patent’s claims can extend no further than that which was enabled by the specification. In peer-reviewed journal articles, a peer reviewer should not allow an author to espouse conclusions that cannot be rationally drawn from the experimental results and subsequent analysis.

¹⁴⁵ Yochai Benkler, *Freedom in the Commons: Towards a Political Economy of Information*, 52 DUKE L.J. 1245, 1256 (2003).

¹⁴⁶ As the Federal Circuit explained in *In re Wands*, 858 F.2d 731 (Fed. Cir. 1988), a patent application need not disclose what is well known in the art. *Id.* at 737. Similarly, the highly specialized scientific journals in which most research is published also assume a basic level of knowledge on the part of its readership of common methods used in the field. See, e.g., John W. Little & Roy Parker, *How to Read a Scientific Paper*, <http://www.biochem.arizona.edu/classes/bioc568/papers.htm> (last visited Dec. 22, 2010) (“[T]he authors usually assume that the reader has a general knowledge of common methods in the field.”). Thus, neither patents nor journal articles are meant to provide manufacturing specifications.

¹⁴⁷ *Hoffmann-La Roche, Inc. v. Promega Corp.*, 323 F.3d 1354, 1377 (Fed. Cir. 2003).

¹⁴⁸ *But see Fiers v. Revel*, 984 F.2d 1164, 1171 (Fed. Cir. 1993) (Written description “requires a precise definition, such as by structure, formula, chemical name, or physical properties” and not just a wish or plan for obtaining the invention). Courts promoting a strong written description requirement seem to require that the inventor carry out all of the experimental details to obtain the invention.

iii. Utility

While the novelty and enablement requirements are nominally similar between the two systems, some divergence begins to creep in with regard to patent law's utility requirement. Notwithstanding section 101's seemingly low hurdle, the Supreme Court's holding in *Brenner* that products useful only in the research setting are not patentable may produce a marked difference in the patenting and publishing regimes for university research.¹⁴⁹ Although the *Brenner* court's "real-world" utility requirement is not generally an issue in obtaining patents for most mechanical and electrical research,¹⁵⁰ it may preclude patenting of certain chemical and biotechnological research.¹⁵¹ Similarly, basic scientific research, in contradistinction to applied scientific research, may be useful in the laboratory but lack practical utility under *Brenner*. On the other hand, assuming that the submitted manuscript met the other requirements for publication, it is not likely that chemical and biotechnological advances or basic scientific research held to lack substantial utility under *Brenner* would be denied publication in appropriate scientific journals.¹⁵²

This is because journal editors are keenly aware of the importance of advancements having only research utility and would likely agree with Justice Harlan's dissenting opinion in *Brenner* that biotechnology and "[c]hemistry [are] . . . highly interrelated field[s] and a tangible benefit for society may be the outcome of a number of different discoveries, one discovery building upon the next."¹⁵³ Simply put, scientific advancements that are only useful in the laboratory are par-for-the-course in scientific journal articles. The publication system and academia thus reward early, pioneering work that has not yet found usefulness outside the laboratory.

Furthermore, even a cursory investigation into published scientific articles reveals that research advances held to be unpatentable as lacking substantial utility are the subject of numerous published journal articles. For example,

¹⁴⁹ In 1960, the Court of Customs and Patent Appeals conveyed an argument counter to that later espoused by the Supreme Court in *Brenner*. *In re Nelson*, 280 F.2d 172 (C.C.P.A. 1960).

Surely a new group of steroid intermediates is *useful to chemists doing research* on steroids, and in a 'practical' sense too. Such intermediates are 'useful' under section 101. . . . Refusal to protect them at this stage would inhibit their wide dissemination, together with the knowledge of them which a patent disclosure conveys, which disclosure the potential protection encourages. This would tend to retard rather than promote progress.

Id. at 180–81.

¹⁵⁰ MUELLER, *supra* note 32, at 236.

¹⁵¹ Balts, *supra* note 19, at 107.

¹⁵² Indeed, one commentator criticizing the *Brenner* Court's substantial utility requirement stated, "The concern . . . is . . . that [the researcher] will not publish his discoveries in scientific journals until a specific utility for the product is discovered." *Id.* at 131–32.

¹⁵³ *Brenner v. Manson*, 383 U.S. 519, 539 (1966) (Harlan, J., dissenting).

in 2005, the U.S. Court of Appeals for the Federal Circuit (“Federal Circuit”) held that expressed sequence tags (ESTs), which are nucleic acids used to locate genes, do not meet section 101’s utility requirements under *Brenner* when the function of the underlying gene is unknown.¹⁵⁴ Research on ESTs is certainly publishable; a seminal EST paper published in the journal *Science*¹⁵⁵ has been cited over 1600 times since 1991,¹⁵⁶ indicating the huge research and publishing interest that surrounds these sometimes unpatentable discoveries.

iv. Patentable Subject Matter

The patentable subject matter doctrine of section 101 and cases like *Chakrabarty* create areas of research that are publishable but have questionable patentability. For example, specialized software-related journals make software research publishable, but the patentability of this research is far from certain under the amorphous test enunciated in the Supreme Court’s *Bilski v. Kappos* decision.¹⁵⁷ Similarly, areas of “basic science” research may be publishable but barred from patentability by the *Chakrabarty* Court’s “laws of nature, physical phenomena, and abstract ideas” prohibition.¹⁵⁸ Thus, the patentable subject matter doctrine, like *Brenner*’s practical utility requirement, creates areas where the publishable research is not patentable.

v. Nonobviousness

The patent system’s nonobviousness requirement has an analogue in what many journals refer to as their “importance” requirement. The requirement ultimately has a similar effect in both systems: just as a patent application for a new, useful, and enabled invention may fail for nonobviousness, a submitted manuscript that is free from errors and presents new and interesting results may not be publishable because it fails to make a significant impact on the relevant field of science.

Despite the seeming similarities, patent law’s nonobviousness bar is likely set much higher than that of the peer review system’s importance requirement. An example illustrating the great disparity in the systems’ nonob-

¹⁵⁴ *In re Fisher*, 421 F.3d 1365 (Fed. Cir. 2005).

¹⁵⁵ Mark D. Adams et al., *Complementary DNA Sequencing: Expressed Sequence Tags and Human Genome Project*, 252 SCI. 1651 (1991).

¹⁵⁶ This large number of citations is as reported by the Google Scholar database in December 2009 and indicates the multitude of subsequent articles also dealing with ESTs. It is safe to assume that many of these articles fail to identify the function of the ESTs’ underlying genes; for example, some focus solely on the physical experiments and processes used to perform DNA sequencing and generate ESTs. See, e.g., Thomas J. Albert et al., *Direct Selection of Human Genomic Loci by Microarray Hybridization*, 4 NATURE METHODS 903 (2007) (describing a new technique to allow fast and accurate DNA sequencing).

¹⁵⁷ See generally *Bilski v. Kappos*, 130 S.Ct. 3218 (2010).

¹⁵⁸ *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980).

viousness requirements is the difference in how the systems treat substitutions of materials. In *Hotchkiss v. Greenwood*, the Court addressed the issue of whether the substitution of porcelain or clay for wood or metal in the construction of a doorknob was a patentable invention.¹⁵⁹ Despite the fact that the resulting doorknob may have been better and cheaper than prior knobs, the Court held that the invention was unpatentable.¹⁶⁰ In contrast, scientific literature is rife with papers performing a common experiment but substituting the specific materials used to accomplish the result. In fact, journals often publish “review papers” that gather and summarize results from numerous other primary articles, and the research presented often differs only by the materials used.¹⁶¹ If judged by the patent system’s nonobviousness standard, it is likely that much of the research contained in these papers would be unpatentable because most would likely be seen as merely arrangements of old elements performing expected functions and yielding expected results.¹⁶²

Patent law’s nonobviousness requirement is not uncontroversial, as it is well established that technical advances often proceed in small, incremental steps. As described below, the publication system has no problem publishing small, incremental, unpatentable advances because the publication system seeks to disseminate knowledge and lacks the ability to confer unwarranted monopoly rights. Certainly, journals seek to attract readers and increase subscriptions by publishing articles of significant impact, but the danger inherent in giving monopolies where they are not deserved does not exist.

B. The Publication System Rewards Early, Pioneering Work and Small, Incremental Advances, but the Patent System Does Not

In comparing the substantive requirements between the patenting and publication regimes, a common thread becomes evident: the publication system rewards early, pioneering research and also small, incremental advances, both of which are largely unrewarded by the patent system. Research deemed to be lacking in real-world utility, focused on basic, abstract science, or only an obvious, incremental advance are all generally publishable but not patentable.

The differences in the systems’ requirements spring largely from the monopoly rights conferred by the patent system. “Traditionally, courts and

¹⁵⁹ *Hotchkiss v. Greenwood*, 52 U.S. 248, 262 (1850) (“claim does not rise to the dignity of an invention or discovery, but is a mere substitution of one material in place of another, for making the same common article”).

¹⁶⁰ *Id.* at 267. In the Patent Act of 1952, Congress added the nonobviousness requirement, which was meant to codify the judicial precedents first announced in *Hotchkiss*. *Graham v. John Deere Co.*, 383 U.S. 1, 3–4 (1966).

¹⁶¹ See, e.g., Jacob I. Mackenzie, *Dielectric Solid-State Planar Waveguide Lasers: A Review*, 13 IEEE J. SELECTED TOPICS IN QUANTUM ELECTRONICS 626 (2007). This review paper collects results from other published sources and compares laser action for “several hosts doped with different active ions.” *Id.* at 630.

¹⁶² *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 282 (1976).

commentators have justified the nonobviousness requirement on the ground that patents are monopoly rights, presumptively undesirable, and so require ‘drawing a line between the things which are worth to the public the embarrassment of an exclusive patent, and those which are not.’¹⁶³ The same can be said for the *Brenner* court’s substantial utility requirement and the patentable subject matter requirement: monopoly rights are not to be awarded lightly, and public policy plays an important role in making this determination. Scientific journals, on the other hand, confer no monopoly rights to the authors of published articles. Rather, scientific journals seek to disseminate and further scientific knowledge, and it is specifically contemplated that readers will practice the published work and go on to further advance the technology through their own contributions.¹⁶⁴ In publishing, the serious danger inherent in giving monopolies where they are not deserved does not exist, and early and incremental advancements that may have only research utility are readily published.

Differences in the systems also affect the timing of when one may submit an article for publication and file a patent application. The early, pioneering research and small, incremental advances described above as unpatentable may be developed into patentable inventions with further work. For example, further research and effort on an invention having only research utility can enable it to have the practical utility required for patenting. But, because such research may be publishable in its current state, professors are encouraged to publish early in the research process, perhaps long before they have an invention that is patentable. As described below, this early and frequent publishing ultimately makes it more difficult for universities to eventually obtain patents on their patentable inventions and undermines the goals of the Bayh-Dole Act.

C. *Procedural Variation Between the Patent System and Peer Review System*

Looking beyond the disparities in the systems’ substantive requirements, procedural variations also make it easier for professors to publish frequently and early in the research process. The sheer number of journals and variability that exists among them significantly improves one’s chances of being published. As detailed above, journals vary in the qualifications held by their peer reviewers, number of reviewers that evaluate each article, and amount of time spent on each article. Presumably, journals that subject submissions to the heightened scrutiny of multiple highly qualified and sophisticated reviewers and time-intensive evaluations will present a higher hurdle than their less discerning counterparts. More prestigious journals with higher impact factors also present a higher hurdle for authors; as detailed above, the large number of submissions

¹⁶³ Glynn S. Lunney, Jr., *E-Obviousness*, 7 MICH. TELECOMM. & TECH. L. REV. 363, 366 (2001) (quoting *Graham v. John Deere Co.*, 383 U.S. 1, 9 (1966) (quoting Letter of Thomas Jefferson to Isaac McPherson (Aug. 13, 1813), VI WRITINGS OF THOMAS JEFFERSON 181 (Washington ed.))).

¹⁶⁴ Goodman et al., *supra* note 74, at 11.

made to these journals requires that work of only the highest quality and impact be accepted.

All of these factors are reflected in journals' widely-varying rates of acceptance and show that some journals simply require a higher caliber of work. As described above, it is not uncommon for authors to first attempt to publish their work in the most prestigious journal within their discipline; if rejected, the author may then submit to the second best journal, and so on.¹⁶⁵ Ultimately, this makes publishing a paper easier: authors have many avenues for publishing their works, and even less important works can likely find a home at a less prestigious journal.¹⁶⁶ As described above, with perseverance, even articles that make only small scientific advances should be publishable *somewhere*.

The PTO, in contrast, presents the sole path to obtaining a U.S. patent. Though one may obtain administrative and judicial review of an examiner's rejection, a patent will be granted only if it ultimately meets the statutory requirements for patentability. There are not multiple venues of varying requirements in which one may shop his patent application.¹⁶⁷

Numerous other procedural differences make scientific publishing easier than patenting. Prosecuting and maintaining a patent generally costs thousands of dollars;¹⁶⁸ publishing essentially costs nothing. Although a published paper may be the subject of later criticism and scholarly discourse, it can never be "unpublished:" in contrast, an issued patent's validity may be later challenged by a third party and held to be invalid.¹⁶⁹

D. Culture Surrounding Publication and Patenting

As detailed above, the patent and scientific publishing systems' substantive requirements and procedures make it easier for professors to publish fre-

¹⁶⁵ Monastersky, *supra* note 109, at 15 ("Researchers go to great lengths to place their papers in high-impact journals. They will often flip a manuscript from one publication to the next, dropping reluctantly down the impact ladder until they find one that will accept their work.").

¹⁶⁶ This notion is counteracted only by the fact that publishing in higher impact journals is becoming more and more important in academia and some authors may simply forego publishing until their work is ready for a more prominent journal. *Id.* at 12. Publishing in high impact factor journals is increasingly "play[ing] a crucial role in hiring, tenure decisions, and the awarding of grants." *Id.* See also Fabio Rojas, *Let's Talk about Third Tier Journals*, ORGTHEORY.NET (Jan. 26, 2009), <http://orgtheory.wordpress.com/2009/01/26/lets-talk-about-third-tier-journals/> ("Publication in a third tier journal is usually seen as a clear signal that the research is weak. Basically, 'third tier publication' = failed research article.").

¹⁶⁷ On the other hand, the patent examiner has the burden of proving why a patent should not be granted. 35 U.S.C. § 102 ("A person shall be entitled to a patent unless . . ."). The more amorphous and less standardized substantive requirements employed by journals suggest that peer reviewers and editors can reject articles out of hand or due to some unreasonable bias towards the author or subject matter.

¹⁶⁸ Corey B. Blake, *Ghost of the Past: Does the USPTO's Scientific and Technical Background Requirement Still Make Sense?*, 82 TEX. L. REV. 735, 746 (2004).

¹⁶⁹ 35 U.S.C. § 282 (2006).

quently and early in the research process. Thus, one reason for the disparity in most professors' number of journal articles and patents is that not all publishable research is patentable research, and the relative ease with which one may publish a paper encourages professors to publish earlier in the research process and more often. However, another key consideration is the culture of academia. Professors accustomed to sharing knowledge through publication and eager for their "pellet of prestige or promotion"¹⁷⁰ are apt to publish at earlier stages in their research when they may have publishable, yet not patentable, results.

i. Knowledge-sharing Culture of Academia and Preference for Publication

The traditional culture of academia and science is one that favors the free sharing of knowledge. "To publish, to present, to collaborate—these activities dominate an academic's life, determining his stature and contribution to scientific advancement."¹⁷¹ Although patenting and commercialization are undoubtedly becoming more important in academia since the enactment of the Bayh-Dole Act, publication and the free sharing of knowledge remain venerable traditions.

Professors may prefer publishing versus patenting for a variety of other reasons. One engineering professor made the following comments:

I don't care too much for patents. Most of [my patented inventions] were patented by scientists from Japanese firms who were visiting my lab That's why I am listed as a coinventor. . . . I certainly haven't received a penny from any of these patents. . . . You can't just look at the patents. Many people don't even care about patents. The patent system is too slow for them.¹⁷²

This quotation likely summarizes the feelings of a great many professors. Many professors simply "don't care" about patents and do not see them as accurate measures of their research activities. Some professors find the patent system to be too slow and instead prefer the faster turnaround time of publishing. Finally, as described above, most professors likely fail to make much money, if any at all, through patenting.

¹⁷⁰ Claiborne, *supra* note 6, at 751.

¹⁷¹ Lisa Bergson, *Why Academia and Business Don't Always Mix*, BUSINESSWEEK, <http://www.businessweek.com/smallbiz/0006/fd000630.htm> (last visited Jan. 6, 2010).

¹⁷² Ajay Agrwal & Rebecca Henderson, *Putting Patents in Context: Exploring Knowledge Transfer from MIT*, 48 MGMT. SCI. 44, 49–50 (2002).

ii. “Publish or Perish” Culture

Graduate student researchers and professors alike are well-aware of the venerable “publish or perish” tradition of academia. “There is . . . evidence of increasing pressure, especially on younger scientists, to ‘get something published’ in order to satisfy some nebulous, usually ill-defined, criteria for gaining tenure, salary raises, or other form of professional stature.”¹⁷³ The upside of this tradition has been the issuance of scientific publications. The downside of “publish or perish” is the possible encouragement of spurious and low-quality publication.¹⁷⁴

iii. “Patent and Profit” Culture

Despite the fact that the “publish or perish” credo appears to be alive and well in most university research settings, other facts indicate that a sea change towards a new “patent and profit” research environment may be underway.¹⁷⁵ One need only refer to the AUTM’s data showing great increases in patenting since the Bayh-Dole Act’s 1980 enactment to be convinced of this.¹⁷⁶ Commentators have suggested that university researchers’ perspectives on commercializing their research have shifted dramatically in the past few decades.¹⁷⁷ Decreased research funding, pressure to expand departmental budgets, and the competitive nature of the grant funding process have all led universities to explore commercial exploitation of their research.¹⁷⁸

The increased ability for universities to patent and license their inventions has introduced new players into the academic culture; universities now seek to patent their inventions, attract venture capital, and form companies to further commercialize their research advancements.¹⁷⁹ The arrival of private capital to the world of academics has produced the biotech industry, numerous jobs, and life-saving medicines and devices.¹⁸⁰

These positive effects have no doubt come at an expense. Indeed, “the advance of scientific knowledge in return for glory—what most of us would consider pure science—is no longer the only incentive. Researchers can opt for rapid commercialization, in which case they may wish to keep some data under

¹⁷³ Searle, *supra* note 5, at 155.

¹⁷⁴ Hamilton, *supra* note 105, at 1332.

¹⁷⁵ Tom Abate, *Scientists’ ‘Publish or Perish’ Credo Now ‘Patent and Profit’*, S.F. CHRON., Aug. 13, 2001, at D1; *see also* Schachman, *supra* note 13, at 6889.

¹⁷⁶ *See generally* 2004 Licensing Survey, *supra* note 121.

¹⁷⁷ Himmelrich & Holda, *supra* note 126, at 33.

¹⁷⁸ *Id.*

¹⁷⁹ Abate, *supra* note 175.

¹⁸⁰ *Id.*

wraps.”¹⁸¹ Thus, researchers’ great focus on commercialization may mean that they will withhold disclosing their discoveries until they have developed a patentable, commercial invention.¹⁸² Commercial considerations within the sphere of academic research may create a number of other issues. For example, if patenting and commercialization assume a position of importance above publishing, researchers may be drawn to research that has the potential for commercial viability, rather than basic research.¹⁸³ Other critics fear that commercial considerations may give researchers an incentive to present their research in a way that favors their corporate sponsors.¹⁸⁴

E. *Implications for the Patentability of University Research*

Most professors today have one or fewer patents. As discussed above, conventional wisdom attributes this to the knowledge-sharing culture of academia, the lack of real-world usefulness inherent in much university research, and the “publish or perish” culture in which professors work. All of these reasons are likely valid; however, some previously overlooked reasons for this phenomenon may also stem from the marked differences in the patenting and publishing regimes.

i. *Academia’s Focus on Publication Causes Professors to Focus on Early, Pioneering Work and Small, Incremental Advances at the Sake of Research that is Patentable*

The conflicting “publish or perish” and “patent and profit” mantras have created an atmosphere of tension and confusion for professors today. “Researchers . . . are faced with a dilemma: publish and lose possible patent rights or keep the discovery secret until a substantial utility is found, but risk tenure and job security.”¹⁸⁵ One commentator framed the issue as “whether a paradigm based on academic freedom, collaboration, and a gift economy can be reconciled with an industrial culture and marketplace that reward the hoarding of ideas.”¹⁸⁶

As described above, the publication system rewards early, pioneering research and also small, incremental advances, both of which are largely unrewarded by the patent system. Because tenure and promotion are tied to publication, academia also rewards such pioneering and incremental advances. Thus,

¹⁸¹ *Id.*

¹⁸² Himmelrich & Holda, *supra* note 126, at 33.

¹⁸³ *Id.* (noting that some feel that “corporate funds would ‘sully’ the hands of the institution”).

¹⁸⁴ *Id.*

¹⁸⁵ Balts, *supra* note 19, at 128.

¹⁸⁶ James Stuart, *The Academic-Industrial Complex: A Warning to Universities*, 75 U. COLO. L. REV. 1011, 1012 (2004) (citation omitted).

academia's traditional incentive structure may encourage professors to pursue a great deal of research that is publishable, but not patentable. Although universities today also encourage professors to pursue patents and patentable research, these institutions manifest a "split personality."¹⁸⁷ patenting efforts are encouraged and ostensible economic incentives are offered to professors, but most universities continue to not acknowledge patents, invention disclosures, and other commercialization efforts as criteria for tenure and promotion. These mixed messages to professors are creating a classic case of misaligned incentives. Universities seek IP licensing revenues, but are not properly incentivizing professors to patent.

Professors caught in the center of this conflict must make a choice, and many may choose to focus on publishing and research that facilitates publishing, rather than patenting. As described above, the revenue-sharing provisions of the Bayh-Dole Act likely fail to provide much appreciable income for most professors, which causes the Act's revenue-sharing incentives to fail. "Despite an explosion in academic patenting in recent years, most life science professors still do research the 'old-fashioned' way, . . . [which is] by winning federal grants, publishing results in scientific journals, and graduating Ph.D. students."¹⁸⁸ The continuing deluge of papers submitted to journals indicates that "publish or perish" is indeed alive and well today.¹⁸⁹

ii. Early and Frequent Publication Expands the Prior Art and Makes Subsequent Inventions Obvious and Unpatentable

As described above, differences in the patent and publication systems enable professors to publish early in the research process, perhaps long before they have an invention that is patentable. Section 102(b) statutory bars are the most obvious patentability problems created when one may publish early and easily. An article published more than one year before the date of patent filing creates a section 102(b) statutory bar if the publication provides an enabling disclosure that includes all claimed elements. However, this is not likely the main patentability problem created by earlier and easier scientific publishing. Sophisticated professors are likely becoming more and more aware that section 102(b) statutory bars may cause a loss of patent rights if a patent application is not filed soon enough after publishing. University technology transfer offices warn strongly against the creation of such statutory bars, and some even require that a patent application be filed prior to publication in order to help ensure foreign patentability.

¹⁸⁷ Elliott C. Kulakowski, *Is the New University Mantra "Publish, Patent or Perish"?*, IPADVOCATE.ORG, available at <http://www.ipadvocate.org/forum/topic.cfm?TopicID=134> (last visited Jan. 7, 2010).

¹⁸⁸ Press Release, *supra* note 3.

¹⁸⁹ Hamilton, *supra* note 105, at 1332 (noting that the pressure to publish in quantity shows that "the publish or perish syndrome is still operating in force").

Rather, patentability problems are more likely to occur during the course of long-term research projects. Although the ultimate result of the project may be a patentable invention, there may be a number of incremental results which are meaningful enough to be published, yet not significant enough or lacking the practical utility required to be patentable. If professors opt to pull the publication lever on these incremental achievements, the patentability of important, downstream research results may be compromised by the professors' own doing. While amendments to the Patent Act preclude an inventor from creating sections 102(e), (f), and (g) prior art against himself,¹⁹⁰ the publication of a scientific article representing an incremental advancement leading up to a later, patentable invention creates section 102(a) prior art that can be used to help defeat a patent application under section 103's nonobviousness requirement. In publishing her incremental advances, the researcher may unwittingly be expanding the prior art and necessitating that her ultimate invention be "that much better" before it will represent a significant enough advance to be patentable. Thus, it is not likely that one single published article will render the invention anticipated under section 102, but more likely that the trail of published research leading up to the final invention will render the final invention obvious under section 103.

An example may further illustrate the concept. A graduate student seeking a Ph.D. may spend five or more years researching a single topic. It is not uncommon for the Ph.D. student to publish scientific articles throughout the tenure of his academic career. The student and his professor choose to publish at discrete points in which it appears that the student has created a significant scientific advancement worth disseminating. Although the published paper may represent a meaningful scientific advancement worth publishing, it may ultimately only be an incremental, unpatentable step towards a larger, downstream goal. Each paper published becomes prior art that may make obtaining a patent difficult. The professor, in fulfilling his duty to the scientific community and ensuring that he does not "perish" for lack of publishing, may render his own invention obvious and, thus, preclude its patentability. The more lenient substantive requirements and procedures of publishing exacerbate this effect.

A similar, analogous concept is the well-documented practice of preemptive publishing and targeted disclosures.¹⁹¹ Outside the world of academic research, research firms in patent races may submit information to the patent office through targeted disclosures for defensive purposes: the disclosures become prior art that may be used to prevent rivals from obtaining patents.¹⁹² Firms can also accomplish this result by publishing their research or submitting

¹⁹⁰ 35 U.S.C. § 103(c)(1) (2006).

¹⁹¹ See generally Scott Baker & Claudio Mezzetti, *Disclosure as a Strategy in the Patent Race*, 48 J.L. & ECON. 173 (2005); Rebecca S. Eisenberg, *The Promise and Perils of Strategic Publication to Create Prior Art: A Response to Professor Parchomovsky*, 98 MICH. L. REV. 2358 (2000); Gideon Parchomovsky, *Publish or Perish*, 98 MICH. L. REV. 926 (2000).

¹⁹² Baker & Mezzetti, *supra* note 191, at 173.

it to companies like IP.com and Research Disclosure, Inc., which publish nonpatented information and make it easily available to the PTO.¹⁹³ Either way, the result is the same: “[i]f an invention of a certain quality would have been sufficient to qualify for patent protection before the disclosure, after the disclosure any invention must be that much better before it will represent a sufficient advance over the now-expanded prior art.”¹⁹⁴ Trailing firms can use this technique to “catch up” in the race, and even leading firms may find it advantageous to increase the costs of racing and discourage the trailing firm from an aggressive race.¹⁹⁵

iii. Professors’ Lack of Patents is Problematic and Changes Should be Pursued

Professors’ lack of patenting ability or failure to patent is problematic for a number of reasons: lacking the substantial incentives of the patent system, certain research and scientific advancements may be discouraged; some research may be kept secret longer; and universities may fail to reap the substantial benefits that the Bayh-Dole Act could provide. Changes should be pursued that would help tip the scales back towards patenting and away from publishing. Certain commentators have focused on the controversial substantial utility requirement and argued that a “research utility” exception should be created, which would allow professors to obtain patents on inventions useful only for research.¹⁹⁶ Although making more of professors’ current work patentable would help encourage patenting, the culture of academia would still loom heavily and continue to encourage publication.

Perhaps the most viable solution is to encourage universities to change their incentive structures. Notwithstanding a few forward-thinking institutions,¹⁹⁷ most universities do not consider patenting and commercialization in the tenure and promotion process. Changes in university policy that would allow the university to “[r]ecognize the issue of a patent on an invention as an academic contribution similar to the publication of a refereed journal article for promotion and tenure purposes”¹⁹⁸ would likely do a great deal to promote patenting. By untethering the promotion system from publication, some research

¹⁹³ *Id.* at 173–74.

¹⁹⁴ *Id.* at 173.

¹⁹⁵ *Id.* at 177.

¹⁹⁶ Balts, *supra* note 19, at 136–38.

¹⁹⁷ See, e.g., Sara Lipka, *Texas A&M Will Allow Consideration of Faculty Members’ Patents in Tenure Process*, CHRON. HIGHER EDUC. (May 30, 2006), available at <http://www.utsystem.edu/news/clips/dailyclips/2006/0528-0603/HigherEd-CHE-Tenure-053006.pdf>.

¹⁹⁸ W. Ronnie Coffman et al., *Commercialization and the Scientific Research Process: The Example of Plant Breeding*, in SCI. & THE UNIV. 94, 102 (Paula E. Stephan & Ronald G. Ehrenberg eds., 2007).

will be diverted away from the types of small, incremental advances that are rewarded only in publishing; professors will subsequently focus more on patentable research. Universities are already encouraging professors to patent, and it is time that they properly incentivized them to do so.

V. CONCLUSIONS

The Bayh-Dole Act allows federally-funded research universities to retain title to their inventions and other intellectual property, providing universities with a great incentive to produce patentable inventions. Despite the Act, most professors still do not have patents. A previously overlooked reason for this may be the differences in the publishing and patenting regimes. The publication system rewards early, pioneering work and small, incremental advances, but the patent system does not. Because most institutions currently look to publication and not patenting when making decisions about tenure and promotion, many professors may be encouraged to pursue such publishable pioneering and incremental work at the expense of research that is patentable. Furthermore, because the substantive requirements and procedures make it easier for one to publish than to patent, professors may publish frequently and earlier in the research process, possibly making it harder for them to obtain patents later.

To increase professor patenting, a simple change that is already being implemented in a small number of universities should be pursued by more universities. Universities should acknowledge patents as an academic contribution for promotion and tenure purposes, alongside publication. By doing so, professors would be properly incentivized to patent, and universities could better reap the benefits of the licensing revenues they are already pursuing.

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