BARRIERS TO INNOVATION: INTELLECTUAL PROPERTY TRANSACTION COSTS IN SCIENTIFIC COLLABORATION

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ABSTRACT

The institution of university science research has evolved over the past century, from one of open science and free information to one of competition and jealously guarded intellectual property rights. This iBrief analyzes the background factors driving the evolution of the institution of science, evaluates the net effects on the progress of science, and considers potential short-term solutions to alleviate the legal transaction costs necessary for scientific collaboration.

INTRODUCTION

¶1 Negotiation, contracts, licensing, and lawyers in general only cause headaches for most university scientists. Time spent doing paperwork or dealing with legal issues only serves to detract from time scientists would otherwise spend on valuable research. Unfortunately for scientists, intellectual property law and policy changes over the course of the 20th Century, and particularly the last several decades, have produced a steady increase in transaction costs necessary to facilitate scientific inquiry. These intellectual property transaction costs increase the expense of performing research and slow the pace of scientific progress. This iBrief examines the legal and policy shifts impacting science, analyzes the resulting impact on the scientific endeavor, and advocates for one organization's efforts to minimize the transaction costs embedded in scientific collaboration.

I. PARADIGM SHIFTS IN UNIVERSITY SCIENCE RESEARCH

¶2 Thomas Kuhn, in *The Structure of Scientific Revolutions*, famously constructs the concept of a paradigm shift to explain the process of scientific change.[2] Kuhn describes the cyclic emergence of scientific novelties or discoveries which "subvert the existing tradition of scientific

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[2] THOMAS S. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS 6 (3d ed. 1996) (1962).

practice."[3] The cycle begins with an initial set of beliefs through which "normal science" is conducted – for example, the Ptolemeic view of the earth-centered universe or the 18th Century Newtonian paradigm that light was made up of particles. Upon discovering seemingly anomalous information that cannot be reconciled with the current paradigm, scientists are forced to reject previous assumptions and tightly held beliefs. "A scientist's world is qualitatively transformed [and] quantitatively enriched by fundamental novelties of either fact or theory."[4] The result of this shift, after the dust settles, is an entirely new paradigm.[5]

¶3 Kuhn recognizes that social and cultural context may contribute to the success or failure of existing scientific paradigms.[6] More than mere contribution, however, law and policy in the 20th century constructed and safeguarded a paradigm of open science[7] through which university science research thrived. Open science, as explained by sociologist Robert Merton, involves four behavioral norms which together fostered a collaborative scientific environment throughout much of the 20th Century.[8] First, "universalism" means that the scientific enterprise should be open to all interested participants.[9] Second, "communalism" means that ideas should be owned by no one and shared with all.[10] Third, "disinterestedness" requires that the scientist should rise above his or her individual subjectivity.[11] Finally, "organized skepticism" mandates that discoveries be subject to peer review.[12]

¶4 As with every preceding scientific paradigm, however, open science is now under increased pressure to change in the wave of intellectual property law and policy developments of the past century. In the emerging paradigm, science research is increasingly commercial instead of open, and increasingly proprietary instead of public. While commercializing science has lowered some barriers, such as commercial access to medicine, it has raised others.

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[3] *Id.*
[4] *Id.* at 7.
[5] *Id. at* 7.
[6] *Id.* at 69.
[7] *See* ROBERT K. MERTON, SOCIAL THEORY AND SOCIAL STRUCTURE 268-69 (1996).
[8] James Stewart, Comment, *The Academic-Industrial Complex: A Warning to Universities*, 75 U. COLO. L. REV. 1011, 1026-30 (2004).
[9] *Id.*
[10] *Id.*
[11] *Id.*
[12] *Id.*

A. Erosion of Subject Matter Boundaries in Intellectual Property

¶5 Both patent and copyright doctrines deny protection to certain types of raw information. A "universally understood" tenet of U.S. copyright law is that "facts are not copyrightable."[13] Analogously, "[p]henomena of nature, . . . mental processes, and abstract intellectual concepts" are not patentable."[14] These doctrines reveal a common understanding that certain types of information should not be owned by individuals but should instead remain universally accessible in the public domain. The public domain provides a foundation of shared knowledge that is freely accessible to all and includes facts, abstract ideas, other unprotectable information, and all information for which the intellectual property protection has lapsed.[15]

¶6 The longstanding policy supporting the public domain in U.S. intellectual property law is rooted in the Constitution. The Constitution limits Congress' power to grant creators "exclusive Right[s]" to their creations: works must be "Writings [or] Discoveries" and the right must last *only for* "limited Times."[16] Thus, facts or abstract ideas do not qualify as "Writings [or] Discoveries." Furthermore, the "limited Times" requirement ensures that once a creator reaps sufficient rewards from a work, the work will enter and enrich the public domain.[17]

¶7 Some forms of information, however, only exist in the public domain and are never exclusive. Subject matter restrictions ensure that intellectual property protection applies only to "Writings and Discoveries,"[18] not raw information. In the copyright realm, "facts do not owe their origin to any individual" and thus "are part of the public domain available to every person."[19] Similarly, "[a]n idea itself is not patentable."[20]

¶8 The understanding that basic facts, natural phenomena, and other abstractions are not protectable forms of information has eroded significantly over the course of the 20th Century. Before *Parke-Davis & Co. v. H.K. Mulford Co.*,[21] patents for naturally occurring substances were

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[13] Feist Publ'ns, Inc. v. Rural Tel. Serv. Co., Inc., 499 U.S. 340, 344 (1991).
[14] Gottschalk v. Benson, 409 U.S. 63, 67 (1972).
[15] James Boyle, *The Second Enclosure Movement and the Construction of the Public Domain*, 66 DUKE J. L & CONTEMP. PROBS. 33, 58-59 (2003).
[16] U.S. CONST. art. I, § 8, cl. 8.
[17] Eldred v. Ashcroft, 537 U.S. 186, 223-24 (2003).
[18] *Id.*
[19] Miller v. Universal City Studios, Inc., 650 F.2d 1365, 1369 (5th Cir. 1981).
[20] Rubber-Tip Pencil Co. v. Howard, 87 U.S. 498, 507 (1874).
[21] Parke-Davis & Co. v. H.K. Mulford Co., 189 F. 95 (S.D.N.Y. 1911).

uniformly rejected.[22] *Parke-Davis* altered this trend by upholding a patent granted for a purified naturally occurring substance, calling it "a new thing commercially and therapeutically."[23] This holding opened the door for patent coverage for isolated gene fragments.[24] Next, *Diamond v. Chakrabarty* established that living organisms could constitute patentable subject matter.[25] Finally, mathematical formulas and algorithms contained in otherwise patentable machines and processes now constitute patentable subject matter,[26] even when the result of the process is as abstract and intangible as a number.[27]

¶9 As in patent doctrine, the borders of copyright protection have also been stretched. Although the inability to copyright facts has not been questioned,[28] the copyrightability of compilations of facts, in the form of scientific databases for example, is a current matter of contention. Under the 1976 Copyright Act, a compilation includes "a work formed by the collection and assembling of . . . data that are selected, coordinated, or arranged in such a way that the resulting work as a whole constitutes an original work of authorship."[29] The underlying facts, however, remain free and unprotected.

¶10 In contrast, the European Parliament and the Council of the European Union issued Directive 96/9/EC on the legal protection of databases, which established *sui generis* protection for the factual *contents* of databases, thus extending protection from mere compilations of facts to individual facts themselves.[30] On several fronts, U.S. law is approaching a similar result. First, several bills have proposed some form of database protection.[31] Second, databases and their contents may already be guarded

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[22] *See, e.g.*, American Wood-Paper Co. v. Fibre Disintegrating Co., 90 U.S. 566, 593-94 (1874) ("[T]he extract. . . . cannot be called a new manufacture.").
[23] *Parke-Davis*, 189 F. at 103.
[24] *See* John M. Golden, *Biotechnology, Technology Policy, and Patentability: Natural Products and Invention in the American System*, 50 EMORY L.J. 101, 105 (2001).
[25] Diamond v. Chakrabarty, 447 U.S. 303, 310 (1980).
[26] Diamond v. Diehr, 450 U.S. 175, 192 (1981).
[27] State St. Bank & Trust Co. v. Signature Fin. Group, Inc., 149 F.3d 1368, 1375 (Fed. Cir. 1998).
[28] Feist Publ'ns, Inc. v. Rural Tel. Serv. Co., Inc., 499 U.S. 340, 344 (1991).
[29] 17 U.S.C. § 101 (2000).
[30] *Directive 96/9/EC of the European Parliament and of the Council,* Mar. 11, 1996, 1996 O.J. (L 78) 20, *available at* http://europa.eu.int/ISPO/infosoc/legreg/docs/969ec.html (last visited Oct. 4, 2005).
[31] *See, e.g.*, H.R. 3531, 104th Cong. (1996); H.R. 2652, 105th Cong. (1996); H.R. 354, 106th Cong. (1999).

under alternate legal theories including unfair competition, contractual reach-through agreements, and trade secrets.[32]

¶11 By gradually increasing the domain of intellectual property protection to include previously unprotectable information, the potential economic value of raw scientific "building blocks" has dramatically increased. The incentive to seek patents for substantially factual material, algorithmic processes, gene sequences, and other previously unprotectable subject matter has altered the incentive structure in scientific research. While "open science" inventors contented themselves with non-economic rewards of paper publication credit, esteem, self-gratification, and a certain degree of fame, today's scientists must also seek patents to be successful. Patents represent economic value and may eventually benefit the public, but they also increase competitiveness among scientists and cause major reluctance to collaborate.

B. Erosion of Government Commitment to the Public Domain

¶12 To complement the constitutional commitment to enriching the public domain, long-term policy decisions have encouraged public availability of government resources. By statute, all potentially copyrightable government-created works fall immediately into the public domain.[33] Similarly, the government may only grant exclusive licenses to its own inventions when "the public will be served by the granting of the license,"[34] preventing public resources from being used for exclusively private gain.

¶13 Departing significantly from the expectation that government works should be available to the public for the common good, the 1980 Bayh-Dole Act[35] ushered in a new era of privatized science. The Act "codified" existing U.S. policy allowing scientists to patent their inventions, even when their research was government funded.[36] The act sought to "promote widespread utilization of federally-sponsored inventions" and to "motivate private investors to pick up where government sponsors left off and transform new discoveries into commercial products."[37]

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[32] Amar Hasan, *Sweating in Europe: The European Database Directive*, 9 COMP. L. REV. & TECH. J. 479, 481-82 (2005).
[33] 17 U.S.C. § 105 (2000).
[34] 35 U.S.C. § 209(a)(2) (2000).
[35] Act of Dec. 12, 1980, Pub. L. No. 96-517, § 6(a), 94 Stat. 3015, 3019-28 (1980) (codified as amended at 35 U.S.C. §§ 200-212 (1994)).
[36] Arti K. Rai & Rebecca S. Eisenberg, *Bayh-Dole Reform and the Progress of Biomedicine*, 66 DUKE J. L. & CONTEMP. PROBS. 289, 290 (2003).
[37] *Id.*

¶14 Bayh-Dole presents a strong individual incentive to take all forms of scientific research to the stage of economic viability in the market by granting patent rights to inventors instead of to the government funding agency and allowing exclusive licensing for commercial development. For federally funded research that is relatively "downstream," the act encourages scientists to take the final step in creating publicly marketable and beneficial products.[38] For research in only the initial phases of basic science, through which fundamental research tools are explored and developed, the act provides a somewhat perverse incentive to privatize at a very early stage of research:

> Universities have taken the opportunity to file patent applications on basic research discoveries, such as new DNA sequences, protein structures, and disease pathways, that are primarily valuable as inputs into further research, thereby accelerating the encroachment of the patent system into what was formerly the domain of open science. Even when they do not seek patents, universities often seek to preserve their expectations for profitable payoffs by imposing restrictions on the dissemination of research materials and reagents that might generate commercial value in subsequent research.[39]

¶15 Although the act provides incentives for commercialization and public distribution of useful scientific developments, the resulting extreme privatization and "deterioration in the culture of upstream research"[40] lessens the outright success of the legislation.

¶16 There is, however, a counter-movement recognizing that publicly financed research results should be made available to everyone. In September of 2004, The National Institutes of Health ("NIH") proposed a policy that would require all "scientific information arising from NIH-funded research [to be] available in a timely fashion to other scientists, health care providers, students, teachers, and the many millions of Americans searching the web to obtain credible health-related information."[41]

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[38] *Id.*
[39] *Id.* at 291.
[40] Michael Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCIENCE 698, 698 (1998).
[41] Press Release, National Institutes of Health, Enhanced Public Access to NIH Research Information (Sept. 3, 2004), *available at* http://grants.nih.gov/grants/guide/notice-files/NOT-OD-04-064.html.

¶17 This proposition has not been adopted, due at least in part to "a quick and panicked response from scientific publishers"[42] who would undoubtedly lose their significant market advantage if information was open to the public instead of restricted to subscription services.[43] The U.S. House of Representatives Appropriations Committee, however, supported the proposed policy. The Committee expressed strong concern that "there is insufficient public access to reports and data resulting from NIH-funded research" and that the situation, "which has been exacerbated by the dramatic rise in scientific journal subscription prices, is contrary to the best interests of the U.S. taxpayers who paid for this research."[44] Despite the public concern regarding the availability of scientific research, Bayh-Dole remains the controlling policy determining the allowable uses of the fruits of publicly funded research.

II. BARRIERS TO SCIENTIFIC PROGRESS

¶18 The increasing expansion of protectable subject matter from algorithms to gene fragments, combined with the vast increase of commercialization at all stages of research, has significantly increased both the economic incentive to participate in scientific research and the legal savvy needed to compete successfully in the market. In effect, the scientific institution has shifted from one of collaborative development to one of competition and secrecy.

A. Increased Transaction Costs in Conducting Science Research

¶19 One highly notable consequence of the shifts in law and policy over the 20th century is the intellectual property protection available to biomedical research tools developed far upstream in the scientific pipeline. Before Bayh-Dole and the push to commercialize, "[u]npatented biomedical discoveries were freely incorporated in 'downstream' products for diagnosing and treating disease."[45] Today, a gene sequence may be patented at the first moment of isolation, even without knowledge of the specific role it will play in a commercial product.[46]

¶20 While this development is undoubtedly of economic benefit to certain scientists, upstream protection of basic research tools vastly increases downstream costs to incorporate projects involving diverse and

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[42] Rick Weiss, *NIH Proposes Free Access For Public to Research Data*, THE WASHINGTON POST, Sept. 6, 2004, at A21, *available at* http://www.washingtonpost.com/wp-dyn/articles/A64389-2004Sep5.html.
[43] *Id.*
[44] H.R. REP. NO. 108-636, at 104 (2004).
[45] Heller & Eisenberg, *supra* note 40, at 698.
[46] Molly A. Holman & Stephen R. Munzer, *Intellectual Property Rights in Genes and Gene Fragments*, 85 IOWA L. REV. 735, 739 (2000).

possibly conflicting sets of rights.[47] Upstream patents over gene sequences, for example, require complex transactional agreements at each subsequent stage of research. Subsequent protectable inventions could include (1) an organism designed to host the patentable gene, (2) a protein produced by the host organism, (3) research databases, and (4) a marketable drug. In effect, "[e]ach upstream patent allows its owner to set up another tollbooth on the road to product development, adding to the cost and slowing the pace of downstream biomedical innovation."[48] The cost of a downstream product compounds with each toll. The increased price the public pays outweighs the initial gain to the few upstream scientists.

¶21 Furthermore, these "concurrent fragments" create what Heller and Eisenberg call a "tragedy of the anticommons" when "multiple owners each have a right to exclude others from a scarce resource and no one has an effective privilege of use."[49] In an atmosphere of competition and secrecy, granting exclusive rights over upstream products will more likely lead to market shortages than to productive bargaining.[50]

¶22 Universities, federal laboratories, hospitals, and private research institutions often wish to use materials developed elsewhere.[51] The institutional and legal mechanism developed to cope with the potential tangle of intellectual property rights over research tools – including genes, cell lines, and other biological products – is a type of contractual arrangement known as materials transfer agreements ("MTAs").[52] MTAs are binding contracts that provide a common understanding of how the materials may be used by the parties.[53]

¶23 MTAs define the "material" in question and may include a broad range of terms and restrictions. These may stipulate allowable uses of the material, define allowable uses and ownership of derivative materials, require assignment or compulsory licensing of downstream intellectual property, limit academic credit derived from the material, control future transfer of the material, and a host of other restrictions.[54]

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[47] Heller & Eisenberg, *supra* note 40, at 699.
[48] *Id.* at 699.
[49] *Id.*
[50] Heller & Eisenberg, *supra* note 40, at 701.
[51] *See, e.g.*, University of California Office of Technology Transfer Council on Government Regulations, *Materials Transfer in Academia* (2001), http://www.ucop.edu/ott/overacad.html.
[52] *Id.*
[53] *Id.*
[54] *Id.*

B. Result of Heightened Transaction Costs

¶24 Negotiating an MTA is a time consuming and costly procedure, even between collegial and friendly parties.[55] Although "many transfers within academia are still informal . . . use of an MTA is recommended so that disputes about use do not arise."[56] Even if a material is offered for free, universities warn scientists that "informal transfers done without MTAs confer little protection on either the provider or the recipient."[57] In the worst situations, an unwilling or hostile party can delay a transfer or require unreasonable terms. Such delays may cost scientists research windows, grant opportunities, and generally delay the progress of research.[58]

¶25 All time spent negotiating MTAs detracts from time spent performing valuable research and slows the flow of information between scientists. Various empirical studies confirm the prevalence of the problem. For instance, Eric Campbell's study on data withholding among academic geneticists in the Journal of the American Medical Association found that forty-seven percent of academic geneticists surveyed who had asked "other faculty for additional information, data, or materials regarding published research reported that at least one of their requests had been denied in the preceding 3 years."[59] Because of the transaction overhead, scientists simply choose not to share materials.[60]

¶26 Whether a scientist chooses to collaborate using an MTA or refuses to put in the time and effort to do so, the progress of science suffers. Using an MTA delays real science by imposing legal transaction costs. Refusing to transfer materials to avoid such transaction costs slows the progress of science by denying others the use of valuable scientific resources. Under imposing pressures to develop marketable and profitable inventions, the institutional and legal barriers to the flow of scientific information only serve to increase the barriers to scientific innovation.

III. TOWARDS EFFICIENCY THROUGH STANDARD LICENSING

¶27 The tangle of downstream intellectual property rights created by "concurrent fragments" and "tollbooth[s] on the road to product

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[55] *Id.*
[56] *Id.*
[57] *Id.*
[58] Wendy D. Streitz & Alan B Bennet, *Material Transfer Agreements: A University Perspective*, 13 PLANT PHYSIOLOGY 10, 10 (Sept. 2003), *available at* http://www.plantphysiol.org/cgi/content/full/133/1/10.
[59] Eric Campbell et al., *Data Withholding in Academic Genetics,* 287 JAMA 473, 473 (2002) *available at* http://jama.ama-assn.org/cgi/content/abstract/287/4/473.
[60] *Id.*

development" will not become untangled without significant legislative reform. Rather, immediate efforts to alleviate the high transaction costs of collaboration in science research must focus on simplifying the process of sharing. If scientists could use an MTA to share valuable materials without significant effort or expense, they would have much greater incentive to do so.

A. Existing MTA Simplification Efforts

¶28 The most significant effort to simplify MTAs has been the creation of the Uniform Biological Material Transfer Agreement ("UBMTA"). The U.S. Public Health Service and representatives from academia and industry created the UBMTA "to address concerns about contractual obligations imposed by some MTAs and to simplify the process of sharing proprietary materials among public and nonprofit organizations."[61] The ideal result of a UBMTA would be to "reduce the administrative burden of sharing materials as investigators come to rely on common acceptance of its terms by cooperating organizations."[62] Since 1995, over 250 institutions have undertaken efforts to adopt the UBMTA into use.[63]

¶29 Despite the numerous signatories pledging to use the standard agreement, the UBMTA has delivered only "limited success."[64] Instead of adhering to a standard agreement, many institutions have merely "substituted their own form agreement for the UBMTA," adding "more restrictive" terms.[65] Critics see these deviations as "unsurprising" because "university technology transfer officials . . . tend to see their primary job as bringing licensing revenue into the university,"[66] not lowering the transaction costs of collaboration. Furthermore, even the creators of the UBMTA realize that it "may not be appropriate for every material transfer,"[67] conceding the potential need for contractual customization.

¶30 Customization of the UBMTA for unique materials, particular parties, or for more restrictive terms undermines the entire purpose of a

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[61] Uniform Biological Material Transfer Agreement: Discussion of Public Comments Received: Publication of the Final Format of the Agreement, 60 Fed. Reg. 12771, 12771 (Mar. 8, 1995).
[62] *Id.*
[63] Association of University Technology Managers, Signatories to the March 8, 1995, Master UBMTA Agreement, (Mar. 8, 1995), *available at* http://www.autm.net/aboutTT/aboutTT_umbtaSigs.cfm.
[64] Rai & Eisenberg, *supra* note 36, at 290.
[65] *Id.* at 306.
[66] *Id.*
[67] Press Release, National Institutes of Health, Uniform Biological Material Transfer Agreement: Request for Comments (Sept. 23, 1994), *available at* http://grants.nih.gov/grants/guide/notice-files/not94-204.html.

standard contract. Customization requires negotiations, new understanding of the changes, bulky bureaucratic involvement, and results in many of the original problems introduced by MTAs.

B. The Science Commons Approach: Configurable Digital Licensing

¶31 Creative Commons, a non-profit organization that provides standard, digital licenses for online copyrightable media, recognizes both the challenges inherent in standardizing MTAs and the potential economic and social benefits of doing so successfully.[68] Creative Commons offers a free, online content licensing service to allow internet users to share photos, writing, music, and the like.[69] The licenses alter the standard contours of copyright law to allow sharing of a work under certain conditions – such as for non-commercial use only or requiring proper attribution credit – while allowing the creator to retain a "some rights reserved" version of copyright.[70]

¶32 The two most unique components of Creative Commons licensing are two features lacking in the UBMTA efforts. First, the license is configurable for different situations. Without sacrificing license compatibility and interoperability, a user may choose from a range of restrictions such as creation of derivative works, use for non-commercial purposes only, and subsequent distribution restrictions.[71] Second, Creative Commons publishes the license in a digital format, by which search engines like Yahoo and others may locate material offered under a Creative Commons license.[72]

¶33 Science Commons, one of Creative Commons' newest and most innovative projects recognizes that "a standard, open framework for managing material transfer can catalyze innovation."[73] Science Commons seeks to apply the Creative Commons licensing model to the creation of a new version of a uniform MTA.[74]

¶34 A Science Commons MTA must include sufficiently standard terms to decrease the transaction costs of collaboration while maintaining an array of configurable terms diverse enough to avoid the splintering effect

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[68] Creative Commons, http://www.creativecommons.com/about/licenses (last visited Oct. 1, 2005).
[69] *Id.*
[70] *Id.*
[71] *Id.*
[72] *See, e.g.*, Yahoo! Creative Commons Search, http://search.yahoo.com/cc (last visited Oct. 1, 2005).
[73] Science Commons Licensing, http://www.sciencecommons.org/licensing (last visited Oct. 1, 2005).
[74] *Id.*

experienced by the UBMTA. Like the suite of Creative Commons licenses, a Science Commons MTA must define the material in question and allow investigators and technology managers to select more or less restrictive terms of use, downstream requirements for derivative works, and attribution requirements. The range of configurable options must derive from the existing range of MTAs used by scientists and universities today. Also like the Creative Commons licenses, a Science Commons MTA would function most efficiently in a digital format. If scientists could license materials to colleagues or search for materials from others with no more effort than several clicks of a mouse, they would be less likely to withhold the "information, data, and materials . . . vital . . . to the efficient advancement of science."[75]

¶35 While the Creative Commons licensing system has achieved major recognition and use,[76] application of the Creative Commons licensing model to scientific transactions will present major challenges. Most fundamentally, the Creative Commons license involves copyrighted works while a Science Commons license would involve a transfer of physical goods or information not subject to copyright. This difference, at the very least, will require significant re-tooling of the Creative Commons licensing machinery. Furthermore, Creative Commons licensing involves only the simple case of an individual licensing creative works for use on the Internet. Science Commons, in contrast, involves significantly more complex and sophisticated parties. As large institutions, universities are subject to laws, rules, policies, and practices that make even the smallest of changes difficult and time consuming. Even more restricting to universities are economic considerations. Technology transfer offices, already concerned with the proverbial bottom line, will avoid changes that present even the appearance of endangering the university's revenue stream. Finally, while Creative Commons had no competing licenses to consider, Science Commons is entering a domain occupied by existing licensing procedures.

¶36 Science Commons must harness these institutional challenges to its advantage. With many existing relationships with universities and their technology transfer offices, Science Commons must continue to facilitate dialogue about transactional barriers to science. Instead of fighting the existing licensing systems, Science Commons should use existing university technology transfer infrastructure as a starting point for launching efficient digital licenses. Like any development of a community standard, adoption of new licensing standards must be a community effort.

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[75] Campbell, *supra* note 59, at 473.

[76] As of November 2005, a generic web search for "Creative Commons" yields almost 60 million websites, many of which are Creative Commons licensed works.

¶37 When digital licensing of scientific tools and information can accommodate a wide range of contractual possibility while still maintaining compatibility and interoperability, scientists will hopefully chose to collaborate in the spirit of open science while still preserving their intellectual property rights crucial to competing in the modern scientific paradigm. Like any paradigm shift, the transition from open science to intellectual property science involves an inevitable degree of chaos and experimentation. Although the success of Science Commons is yet to be determined, it must be applauded for fostering dialogue focusing on minimizing the problematic aspects of the new paradigm.

CONCLUSION

¶38 The broad expansion of protectable intellectual property subject matter and the commercialization of science may be inevitable characteristics of modern science. Unreasonably high barriers to research collaboration and the scientific progress, however, are not inevitable factors to be taken lightly. If nothing else, the UBMTA effort has highlighted the common frustrations caused by the complicated and expensive process of materials transfer and the community support available to standardization efforts. Of the modern efforts to standardize, Science Commons approach to licensing, combining standardized digital licensing with fluid and customizable terms of agreement, has the best chance of success. When implemented, a Science Commons license could remove barriers to collaboration and increase the general pace of scientific collaboration and progress.