Commons, Anticommons, and Community in Biotechnological Assets

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I argue for three theses: T1 — Access to scientific knowledge can be used to reinforce existing scientific communities and sometimes generate new ones. T2 — Community can be used to generate scientific knowledge, patent reform, scientific research, medical diagnostics, and trade secrets and occasionally patents. T3 — On the spectrum from commons to semicommons to private property to anticommons, an anticommons can arise if a biotechnological asset is fuzzily defined. I defend these propositions against objection and establish the fertility of my account by considering intellectual property issues relating to synthetic biology. Along the way I present a new understanding of the public domain. I also pursue several projects that are interwoven throughout the Article. The analytic project shows how careful definitions yield a useful taxonomy of biotechnological

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* Professor of Law, UCLA School of Law. My thanks go to James Patrick Allen, Preston Ascherin, Assaf Jacob, Doug Lichtman, Brett McDonald, Gideon Parchomovsky, David Schorr, and Mark Woodhead. Comments from colleagues, seminar students, participants in the Community and Property conference, and members of the Law and Philosophy Discussion Group in Los Angeles led to improvements in this Article. I am grateful to Beth Noveck for sending me the Peer-to-Patent first anniversary report on the very day it was published, just before this Article went to press.

My approach to this topic was inductive in the following way. I thought about areas of biotechnology and intellectual property that were somewhat familiar to me, formulated hypotheses, tested the hypotheses against the literature, discarded hypotheses that proved false or unsupported, and restated the surviving hypotheses as theses. I then assessed the fertility of the theses and the materials for establishing them by considering an area of biotechnology, namely synthetic biology, with which I was less familiar. The structure of this Article is not a mirror image of my inductive approach.

assets and their holders. The normative project explains why we should endorse intellectual property rights in some biotechnological assets but not others. Finally, the thematic project establishes larger contrasts between different forms of community on the one hand and individualism on the other, and reveals how my understanding of the public domain yields a surer grasp of these contrasts and their roles in institutions of property.

I. PROSPECTUS

This Article advances three theses with respect to biotechnological assets. The term "biotechnological asset" has two uses. In its descriptive use, it applies to biochemicals, tissues, and members of plant and animal species that someone physically possesses or controls. In its normative use, it applies to legal rights with respect to biochemicals, tissues, and members of plant and animal species. I concentrate on property rights but also touch on contract rights. Examples of descriptive biotechnological assets include DNA sequences, blood samples, body parts, and genetically modified organisms and chimeric animals. Examples of normative biotechnological assets include trade secrets in annotated databases containing information on expressed sequence tags (ESTs), gene patents, rights asserted by tissue providers, and patents on genetically modified soybeans and human-nonhuman chimeras. I discuss some examples from each set.

The three theses I defend interrelate commons and anticommons, communities and individuals, and different sorts of private property. The theses will not be wholly clear without further definition, argument, and illustration, but I state them as follows:

T1. Access to scientific knowledge can be used to reinforce existing scientific communities and sometimes generate new ones.

T2. Community can be used to generate scientific knowledge, patent reform, scientific research, medical diagnostics, and trade secrets and occasionally patents.

T3. On the spectrum from commons to semicommons to private property to anticommons, an anticommons can arise if a biotechnological asset is fuzzily defined.

There are good reasons for caring whether these theses are correct. Neither TI nor T2 assumes that community is intrinsically good or that it is otherwise non-instrumentally desirable. So to advocate T1 there has to be something good or desirable about new and existing scientific communities, or at least some of them. If, as seems plausible, many such scientific

communities are good or desirable, and if access to scientific knowledge is good or desirable, that would make T1 important. As to T2, the ends are desirable or justifiable. If community is a sensible means, and especially if it is a particularly effective or the only means, to these ends, that would make community instrumentally desirable. The importance of T3 lies not mainly in the delights of intellectual rigor but in avoiding the increased information costs in ascertaining the scope of fuzzily-defined biotechnological assets or contracting for them and the cost of purchasing unneeded licenses to use these assets.

This Article has the following structure. In Part II I shall provide cases or examples that form the "data" on which the theses rest and argue for each thesis. In Part III I shall reply to objections, and in Part IV I shall show the intellectual fertility of this account. I then conclude.

To forestall misunderstanding I define some terms that appear in my theses or in my analysis of examples. A "commons" is an asset which all have liberty-rights to use, from which no person has a legal power to exclude others, and which no person has a legal duty to refrain from exploiting. In some cases, such as a community swimming pool in a condominium, "all" must be read as "all relevant persons" (condominium owners and their guests) with adjustments *mutatis mutandis* in reading "no one." A commons as thus defined includes both common property and open-access resources.[1] In the case of common property, the members of the group individually have rights of entry and withdrawal and collectively have rights to manage or sell the resource and to exclude nonmembers. In the case of open-access resources, such as a fishery, anyone may come in and take out units of the resource, but no person has an exclusive right to sell or manage the resource. A "semicommons" is a mix of common and private rights in which each set of rights has a significant impact on the other.[2] An anticommons is an asset from which each person has a legal power to exclude others and which no one has a liberty-right to use without the permission of others. In most cases, "each person" does not mean every person in the world, and "others" requires a corresponding restriction. As much is evident in Heller's treatment of the anticommons.[3] For purposes of this Article, a "community" is a group

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1 Thráinn Eggertsson, *Open Access Versus Common Property*, *in* PROPERTY RIGHTS: COOPERATION, CONFLICT, AND LAW 73, 74 (Terry L. Anderson & Fred S. McChesney eds., 2003), explains the distinction.

2 Henry E. Smith, *Semicommon Property Rights and Scattering in the Open Fields*, 29 J.L. & ECON. 131 (2000).

3 Michael A. Heller, *The Tragedy of the Anticommons: Property in Transition from Marx to Markets*, 111 HARV. L. REV. 621 (1998).

of people who have shared interests and who work toward shared goals. I do not assume that members of a community share either all interests or all goals, only that the interests and goals are to some significant extent shared.

The "public domain" is a normative status that confers a presumptive liberty-right and power to appropriate information that relates to existing works of art and literature, inventions, and understanding or skill pertaining to plants, animals, technologies, and cultural expressions. The foregoing presumptions relating to a liberty-right and a power are first-order presumptions. The presumption that something belongs in the public domain is a second-order presumption, for it rests on a normative status that involves first-order presumptions. This second-order presumption applies to all information concerning all normative biotechnological assets. It can be rebutted in either of two ways: (i) by the exercise of a liberty-right and power of someone who currently possesses the information to keep it secret or disclose it to others only under mutually agreed upon terms, or (ii) by correctly invoking a constitutional, statutory, or judicial legal rule.[4] In short, one can rebut the presumption that certain information belongs in the public domain by appropriately keeping it secret or not letting others share one's knowledge of it save on mutually agreed terms, or by invoking the law to prevent others from using the information even if they gain access to it.

The public domain thus defined is not identical with either common property or open-access resources. Unlike common property, the public domain applies only to informational resources in normative biotechnological assets (not human tissue jointly owned by a dozen different research institutes, for example), has no collective rights of management, sale or exclusion, and delineates ways to rebut a presumptive liberty-right and power to appropriate information. Unlike open-access resources, the public domain applies only to informational resources in normative biotechnological assets (not, for example, fisheries), delineates ways to rebut a presumptive liberty-right and power to appropriate information, and in the absence of rebuttal is silent on rules pertaining to entry, withdrawal, exclusion, sale, or management with respect to the information. The concepts of common property and open-access resources occupy the same theoretical plane because assorted non-presumptive rights, powers, liberties, and duties govern entry, withdrawal, exclusion, sale, and management. The concept of the public domain, as articulated here, occupies a different theoretical

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4 *Cf.* Pamela A. Samuelson, *Enriching Discourse on Public Domains*, 55 DUKE L.J. 783, 792-94, 799-802 (2006) (defining public domain conceptions PD3 and PD6). Clause (i) relates roughly to PD6. Clause (ii) includes but is not exhausted by PD3.

plane, for its presumptive nature makes it a site for continuing argument and debate.[5]

It would be foolish to claim that other understandings of the public domain are wrong or misguided, but it is important to explain why I introduce this new understanding. We have many terms — "common property," "open-access resources," "unowned things" — that do useful work in certain contexts, but none of them demarcates the sphere of argument and debate as does my use of the term "public domain." I do not need to, and here will not, specify all or only those arguments and forms of debate that relate to the public domain. I will say that my understanding is capacious. It includes new variations on existing arguments, such as Field's giving the common property flip side of Demsetz's account of the development of private property.[6] It includes different paradigms of argument as they emerged historically, such as Locke's justifications for private property, Hume's early utilitarianism, Hegel's dialectical treatment of property and Marx's critique of it, Rawls's early Kantian liberalism and his later avowedly political liberalism, and Habermas's depiction of the public sphere as a locus of conversation and contestation. It includes, too, the places where argument and debate take place — in cities and towns, in nation-states and across countries, in business and trade negotiations, in law courts, in academic seminars and writings, in politics, and in many other locations.

Embedded in the examples, distinctions, theses, and arguments are three larger projects that are interwoven throughout this Article. One project is analytic: to show how careful definition and conceptual clarification yield a useful taxonomy of sundry biotechnological assets and their holders. Another project is normative: to indicate why we should endorse intellectual

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5 I would accept other definitions of "public domain" for use in other contexts. As Samuelson remarks, "Accepting the existence of multiple public domains offers several benefits." *Id.* at 823. Among them are avoiding needless and possibly fruitless debates over which definition is "true" or "correct"; achieving greater awareness of different public domains and the values attached to them; enabling context-sensitive uses of the term to develop; facilitating more nuanced response to issues raised in the literature; and gaining deeper understanding of public domain values by considering them from different viewpoints. *See id.* at 823-27.

6 Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347 (1967); Barry C. Field, *The Evolution of Property Rights*, 42 KYKLOS 319 (1989). Abraham Bell & Gideon Parchomovsky, *The Evolution of Private and Open Access Property*, 10 THEORETICAL INQUIRIES L. 77 (2009), play off both Demsetz and Field in discussing the reconfiguration of assets, though their intellectual property examples are limited to copyright (such as unbundling music through iTunes to reduce illegal sharing of entire compact discs).

property (IP) rights in some biotechnological assets but not in others. A final project is thematic: to establish larger contrasts between different forms of community on the one hand and individualism on the other, and to display how my understanding of the public domain yields a surer grasp of these contrasts and their role in institutions of property.

II. EVIDENCE AND ARGUMENT

A. An Argument for T1

T1 states that access to scientific knowledge can be used to reinforce existing scientific communities and sometimes generate new ones. T1 is, then, an instrumental proposition concerning one way of generating and reinforcing community. For the sake of illustration, consider Community Patent Review. Often called "peer-to-patent review"[7] or P2P, I refer to it, not entirely in jest, as CPR. The U.S. Patent and Trademark Office began using this form of review in spring 2007 in the initial phase of a pilot project. The chief purposes of CPR are, primarily, to increase patent quality, and, secondarily, to accelerate the evaluation of patent applications.

Stripped to its essentials, CPR works like this.[8] A patent applicant, after filing and before examination begins, asks for CPR. The USPTO puts the application on a "p2patent" web site and allows four months for open comment by peer reviewers. These reviewers then invite other expert reviewers to participate. Each reviewer can submit examples of prior art, comment on the application and prior art submissions, and rate claims, prior art, prior art submissions, and other peer reviewers. Next, the patent examiner receives the results of this prior art search, and mulls them over in deciding whether the claimed invention is to receive a patent. In due time, the CPR system identifies and ranks peer reviewers on the basis of their work. Prior art submissions appear in a database to increase the knowledge of the USPTO. Throughout, all CPR documents are open to the public. At root, CPR separates scientific decision-making on whether prior art anticipates the claimed invention, which falls mainly to peer reviewers (though the patent

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7 *See* Beth Simone Noveck, *"Peer to Patent": Collective Intelligence, Open Review, and Patent Reform*, 20 HARV. J.L. & TECH. 123 (2006); INST. FOR INFO. L. & POL'Y, N.Y. LAW SCH., COMMUNITY PATENT REVIEW PROJECT SUMMARY (Feb. 2007), *available at* http://dotank.nyls.edu/communitypatent/p2p_exec_sum_feb_07.pdf [hereinafter CPR SUMMARY].

8 *See* CPR SUMMARY, *supra* note 7, at 8-13.

examiner makes an independent judgment), from legal decision-making on whether an application meets the criteria for a patent, which falls to the patent examiner.[9]

Key points of interest are these. First, CPR requires no government intervention or substantive change in patent law. Funds for the program come from several nonprofit groups and fewer than ten large corporations. The USPTO had only to allow the project as a pilot program in which patent applicants do not need to opt out but are free to opt in. The only legal change, for those who opt in, lies in administrative law. Administratively, the USPTO puts P2P applications on a website for scientific and technical comment by peer reviewers rather than assigning them immediately to particular patent examiners for assessment of the scientific, technical and legal merits. Applicants who opt for peer-to-patent review rather than the usual process might do so for various reasons. Among them are beliefs that patent examiners are often insufficiently competent on scientific and technical matters and that variation in such competence among examiners makes approval a crapshoot.

Second, increasing patent quality is a vital part of patent reform. Under CPR this increase would stem from nonlegal means: time volunteered by scientists and engineers, and money donated by corporations and nonprofit organizations. If the time and money are used well, they should add to the store of scientific knowledge. Increased knowledge should in turn raise patent quality.

Third, although the peer reviewers count as a "community" as defined earlier, they form, at least initially, a highly dispersed group whose members, even in the same area of innovation, might not know each other well, if at all. Over time, those peer reviewers recognized for their expertise and judgment may become a sub-community of elite reviewers who are known to each other and to other peer reviewers. The members of both communities share an interest in raising patent quality, which is among their shared goals in participating in CPR. Given human nature, tangible economic incentives could also be at work. For instance, some reviewers might volunteer their time in the hope that they will be recognized as elite reviewers, which could lead to remunerative consulting work. I have no position on whether CPR will draw enough highly able reviewers to make the system work on a large scale. But if CPR takes hold, there may eventually arise groups of funding corporations and nonprofit organizations. These groups are not communities as defined, because they are not persons. The groups in this example are

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9 *See* Noveck, *supra* note 7, at 123-30.

nonetheless analogous to communities in that their members have shared interests and goals.

Thus, CPR provides access to the scientific knowledge contained in patent applications not only to patent examiners but also to peer reviewers. Initially, peer reviewers are a somewhat formless community of experts willing to devote their time to CPR. The process of reviewing applications reinforces this large community. It also reinforces and sometimes generates smaller communities of reviewers who tackle applications in particular fields of invention. Over time, those peer reviewers recognized for expertise and judgment emerge as a sub-community of elite reviewers who are known to each other and to other peer reviewers. Therefore, access to the scientific knowledge contained in patent applications can be used to reinforce existing scientific communities and sometimes generate new ones. The interests of these communities seem unlikely to lead to regulatory capture or other undesirable effects.

CPR was launched on June 15, 2007, and a progress report appeared a year later based on data up to April 2008.[10] Inventors or assignees submitted 40 applications. Twenty of these involved databases, data transfer, document processing, and closely related inventions.[11] Thirty-seven of the 40 applications came from ten companies, led by IBM (9) and General Electric (7).[12] The USPTO completed the review of 23 applications by April 2008; in 9 of these cases, it "relied directly on submission by eight public members of the Peer-to-Patent project to issue final or non-final rejections of the applications."[13] The reactions of patent examiners to CPR were mainly positive. Just over a fifth of them stated that prior art suggested by peer reviewers "was inaccessible through the USPTO"[14] because, for example, the sources came from firm databases. Over 60 percent of the peer reviewers who responded to the P2P survey were computer professionals, engineers, or research scientists.[15]

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10 CTR. FOR PATENT INNOVATIONS, N.Y. LAW SCH., PEER TO PATENT: FIRST ANNIVERSARY REPORT 6, 11 (June 2008), *available at* http://dotank.nyls.edu/communitypatent/P2Panniversaryreport.pdf [hereinafter P2P REPORT].

11 *Id.* at 12.

12 *Id.*

13 *Id.* at 13.

14 *Id.* at 14 (boldface type omitted).

15 *Id.* at 19 (graph of reviewer professional roles). P2P "is neither a blog nor a wiki. It does not solicit any and all commentary." *Id.* at 5.

B. An Argument for T2

T2 states that community can be used to generate scientific knowledge, patent reform, scientific research, medical diagnostics, and trade secrets and occasionally patents. The following argument unfolds in three stages.

1. From Community to Scientific Knowledge and Patent Reform. To some it might seem the easiest thing in the world to establish the first stage of T2 by employing CPR as an example. CPR uses a community of peer reviewers and eventually a sub-community of elite reviewers, which increases scientific knowledge, for surely at least some of their examples of prior art, comments on the application and prior art submissions, and ratings claims will add to the stock of justified true statements on scientific matters. Scientific knowledge includes such statements. Indeed, some might say that this part of T2 is not merely possible but highly likely. Additional scientific knowledge seems equally likely to elevate patent quality, which is one component of patent reform.

As in the argument for T1, I cannot guarantee that CPR will take hold or operate as Professor Noveck intends.[16] Perhaps some scientists and engineers who take part will not prove to be highly competent or might try to use the CPR work to increase their prominence. Perhaps commercial agents who are in competition with applicants who opt for CPR will hire scientists and engineers to pen unfavorable reviews and thus use CPR opportunistically to damage their competitors' prospects for receiving a patent. In the worst-case scenario CPR could cause patent quality to deteriorate. Nevertheless, the P2P progress report of June 2008 undercuts such worries. The peer reviewers as a whole were quite competent, though 37 percent of those who responded to a survey had only a bachelors degree.[17] There was no reported evidence of opportunistic behavior, though the Peer to Patent Reviewer Survey allowed for the anonymous disclosure of bias or a dishonorable motivation.[18]

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16 *See* CPR SUMMARY, *supra* note 7, *passim.*

17 P2P REPORT, *supra* note 10, at 20 (graph of highest degree earned by reviewer). Thirty-one percent of responding reviewers had a masters degree and 21 percent had a doctorate. *Id.* At least for the 40 applications examined in the P2P pilot program, enough qualified experts volunteered to discharge the specific tasks assigned to them. *Id.* at 15-16.

18 *Id.* at 50 (Question 27). Question: "Why did you participate in Peer-to-Patent?" Among the 12 answers that could be checked (including "Other") were "Interest in (positive or negative) a particular patentee/assignee," "Desire to weaken a patent by finding prior art to narrow its claims or defeat the patent," and "Desire to strengthen a patent by finding prior art to hone its claims." *Id.* Query whether even anonymous respondents to the survey could be counted on to acknowledge bias or dishonorable motives.

And yet, caution is advised. CPR requires a good supply of highly qualified reviewers. Such reviewers already tend to be extremely busy. The task of knocking out weak applications might not appeal to all of them. The potential reputational gains to elite reviewers might not be sufficient incentive for many highly qualified scientists and engineers to volunteer for CPR duty. As of June 2008 we lack decisive evidence from this recently-introduced pilot program, for the P2P first anniversary report covered a mere 40 applications. So it is premature to say that peer-to-patent review will advance scientific knowledge and elevate patent quality on a grand scale. It is likewise premature to say that CPR will do neither. The program is, however, well-enough designed, and the results thus far are sufficiently encouraging, to say that communities made up of peer reviewers and elite reviewers can be used to generate scientific knowledge and patent reform.

2. Tissue Contributions, Communities, and the Promotion of Scientific Research and Medical Diagnostics. Disease-defined communities have played a role in generating scientific research and medical diagnostics. Members of such communities include those with the relevant disease and sometimes family members as well. They share an interest in the disease and their common goals are better diagnosis and treatment. Tissue providers from these communities have occasionally contributed to patentable inventions. At least if a disease is rare or unusual, members of the community can advance shared interests and goals by insisting that tissue providers retain some property or contract rights in inventions. Otherwise, tissue providers might be subject to a default rule that leaves them with no such rights concerning inventions derived in part from their tissues.

Consider three examples. As virtually every first-year U.S. law student knows, John Moore, an individual with hairy cell leukemia from whose tissues his treating physician developed a patented cell line, was held not to have a property interest in those tissues sufficient to sustain a claim of conversion.[19] Less well known is the case of *Greenberg v. Miami Children's Hospital Research Institute, Inc.*,[20] in which parents of children who had a fatal genetic disorder known as Canavan disease sued a medical researcher and his employer. The plaintiffs made available to the researcher, Dr. Reuben Matalon, blood and autopsy samples from Canavan patients to aid him in a search for the genetic cause or causes of the disease. He isolated and sequenced

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19 Moore v. Regents of the Univ. of Cal., 793 P.2d 479 (Cal. 1990). Moore managed to survive a demurrer by his physician, who did not disclose his financial interest and thus deprived Moore of informed consent. *Id.* at 483-85.

20 264 F. Supp. 2d 1064 (S.D. Fla. 2003).

the wayward gene and assigned the patent on a Canavan diagnostic test to his employer. The court ruled for the defendants on a key issue: property rights in a tissue sample "evaporate[] once the sample is voluntarily given to a third party."[21] Even if one takes *Moore* and *Greenberg* to be "the law," neither case stands for the proposition that tissue providers legally *cannot* sell their own tissues.

Tissue providers got the message in an IP-related context involving a genetic disorder known as pseudoxanthoma elasticum (PXE). Both contract and patent law came to the rescue of the PXE community. In 2001, PXE International, Inc., an advocacy group representing PXE patients, struck a deal with researchers: patients would provide tissue samples in return for an equal share of any patent royalties and for control over licensing decisions. Basically, the group secured financial and other benefits partly by contract.[22] In part as a result of the donated tissue, scientific research on the disease increased and a diagnostic test was developed. Thus, a community helped to generate scientific research and a medical diagnostic. Just because tissue-donation led to this result in the cases of PXE and Canavan disease, it does not follow that the same result will occur for all diseases or even all genetic diseases. Further, the use of targeted incentives by disease-defined communities need hardly be the *best* way to spur research or the invention of medical diagnostics or to bring them to market. The point of the argument is only to establish that it is *a* way that such communities can do so.

So contract represents one way that disease-centered communities can secure some property rights relating to tissue contributions. A second way would be to amend section 116 of the Patent Act, which deals with joint invention. The amendment would have to allow one or more tissue contributors to qualify as "inventors." At present, tissue contributors are most definitely not joint inventors, and to list them as such would count as misjoinder and have to be corrected.[23] It seems highly doubtful that Congress would so amend the Patent Act. However, PXE International found a way around this problem. Sharon Terry, its executive director and mother of two children with PXE, helped a team of four scientists from the University of Hawaii not only by getting tissue samples and family data. She also "extracted

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21 *Id.* at 1067. The doctrine of informed consent came to the plaintiffs' rescue. *See id.* at 1069.

22 *See* Donna M. Gitter, *Ownership of Human Tissue: A Proposal for Federal Recognition of Human Research Participants' Property Rights in their Biological Material*, 61 WASH. & LEE L. REV. 257, 315-19 (2004) (recounting the efforts of PXE International).

23 *See* 35 U.S.C. §§ 116, 256 (2002).

DNA, ran gels, read the gels, and helped write the paper"[24] identifying the gene that causes PXE. The research led to a patent. Terry and the scientists were listed as inventors; together they assigned the patent to PXE International and the University of Hawaii.[25]

Some might object that the PXE community improved its position merely in point of the allocation of resources, but did not create additional resources needed to invent a diagnostic test. I disagree. Resources can be non-monetary as well as monetary. PXE International provided additional resources in the form of tissue samples and information about family history. The devotion of increased resources to PXE was precisely the factor that led to the diagnostic test.

I make no claim that this part of T2 works equally well for all disease-related communities or promotes the optimal creation of intellectual property rights. The most visible examples here are uncommon genetic diseases, such as Canavan's and PXE, which might otherwise elicit meager research funding. T2 does not explain funding for diseases which afflict many people, such as heart disease or cancer, unless one concentrates on comparatively unusual sub-diseases, such as hairy cell leukemia. Furthermore, one could argue that the influence of disease-defined communities distorts an otherwise optimal source of research funding and IP creation. Sub-optimality is hardly limited to niche genetic diseases. For instance, some might argue that research on breast cancer is overfunded and research on kidney disease is underfunded, or vice versa, compared to optimal funding. In any event, we are so far from knowing what is an optimal allocation of research funds for different diseases that it would be hard to show that any minor effect created by PXE International is distorting or undesirable.

3. From Community to Intellectual Property. It is necessary to draw on a different example to demonstrate the possibility of using community to generate intellectual property other than patents. Let us use ESTs in the wake of *In re Fisher*[26] to illustrate the argument in the case of trade secrets.

An expressed sequence tag is a complementary DNA sequence of approximately 400 to 500 bases that is almost always only a partial sequence of a gene being expressed at the time a specific tissue is sampled. One can

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24 Eliot Marshall, *Patient Advocate Named Co-Inventor on Patent for the PXE Disease Gene*, 305 SCIENCE 1226 (2004).

25 *Id.*; Methods for Diagnosing *Pseudoxanthoma Elasticum*, U.S. Patent No. 6,780,587 (filed Feb. 23, 2001) (issued Aug. 24, 2004). On the PXE group as a model, see Sharon F. Terry et al., *Advocacy Groups as Research Organizations: The PXE International Example*, 8 NATURE REVIEWS GENETICS 157 (2007).

26 421 F.3d 1365 (Fed. Cir. 2005).

convert the sequence to base pairs through second-strand synthesis. It is theoretically possible for an EST to be a gene, which encodes a protein, but it is not very probable because most genes are between 2,000 and 25,000 base pairs in length. ESTs, then, are always or virtually always gene fragments. They have limited, intermediate uses: to isolate genes, locate coding regions on genomic DNA, identify patterns of expression in tissues other than the tissue of origin of the EST, and so on. ESTs rarely have any end-use utility.[27]

The history of the patentability of ESTs unfolded in the following way. In the early 1990s, the National Institutes of Health (NIH) filed patent applications on roughly 2,700 ESTs and the genes containing them, but withdrew the applications under public pressure. Biotechnology and pharmaceutical firms filed several millions of EST patent applications. The USPTO acted on very few of these, and by 1998 had issued only three EST patents.[28] Heller and Eisenberg argued that EST patents could well lead to an anticommons.[29] Their article elicited some analytical and empirical reservations. Analytically, the central criticism was that they did not distinguish with sufficient care between a patent on an EST alone and a patent on an EST whose scope embraced the gene containing it as well. The latter might well result in an anticommons, but the former, depending on the circumstances, might not.[30] Empirically, the foremost complaint was that Heller and Eisenberg provided almost no evidence to back up their concern about either ESTs or a biotechnological anticommons.[31] Later, Murray and Stern found empirical evidence for nothing more than a "modest" anticommons effect.[32] Their study, however, dealt not with ESTs in particular but with the free flow of scientific knowledge generally. As to legal policy, a proposed registration system for ESTs went unheeded. It would have

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27 *See* Molly A. Holman & Stephen R. Munzer, *Intellectual Property Rights in Genes and Gene Fragments: A Registration Solution for Expressed Sequence Tags*, 85 IOWA L. REV. 735, 748-50 (2000).

28 *See id.* at 738 n.6, 770-73.

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

30 *See* Holman & Munzer, *supra* note 27, at 802-04 (suggesting that the collective-action difficulties are sometimes solvable, but maintaining that ESTs should rarely be patentable).

31 *See id.* at 803.

32 Fiona Murray & Scott Stern, *Do Formal Intellectual Property Rights Hinder the Free Flow of Knowledge? An Empirical Test of the Anti-Commons Hypothesis*, 63 J. ECON. BEHAV. & ORG. 648, 651, 673 (2007).

allowed a much weaker sort of IP right than a patent in ESTs.[33] On the legal front, the USPTO tightened its examination guidelines to require a "specific," "substantial," and "real world" utility.[34] *In re Fisher* found the guidelines to be consistent with the Patent Act, and held that certain ESTs for identifying nucleic acid sequences in maize genes lacked specific and substantial utility.[35] At this writing, the chances that many ESTs will be patented in the United States seem small to the point of vanishing altogether.

Should we care about this tempest in a Perkin-Elmer DNA sequencer? We should, because the intellectual property law focus has moved from patents to trade secrets. The databases maintained by Incyte Pharmaceuticals, Human Genome Sciences, Merck & Co., and other firms are valuable. These firms protect their information under the rules of trade-secret law. Because many other firms have difficulty independently discovering or reverse-engineering this information at an acceptable cost, they need to negotiate with database owners and arrange licenses for access.[36] Thus, the relevant property regime has changed from patent to trade secret, and the relevant asset is no longer a patent on individual ESTs but secret information in databases about numerous ESTs. Although the relevant non-property regime is still mainly the law of contract, the subject of licensing contracts is not access to ESTs but access to databases with information about ESTs.

In addition, these legal changes occurred partly through community pressure. A substantial community of research scientists as well as a community of legal scholars thought that EST patents were a spectacularly bad idea. Their articles and other forms of protest turned around the NIH and pushed the USPTO to come up with more stringent utility examination guidelines, effectively limiting the number of EST patents to a very few. Once it became clear that extremely few patents would ever be issued on ESTs, their real value lay not in the sequences themselves but in the heavily annotated databases in which information about ESTs was kept. These annotated databases contain trade secrets. Thus, two communities — one of scientists and another of legal scholars — generated change in the USPTO, which limited the number of patented ESTs and made plain that

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33 *See* Holman & Munzer, *supra* note 27, at 813-25 (explaining the registration system and defending its superiority over alternatives).

34 *See* Utility Examination Guidelines, 66 Fed. Reg. 1092 (Jan. 5, 2001), *incorporated into* U.S. PAT. & TRADEMARK OFF., MANUAL OF PATENTING EXAMINING PROCEDURE § 2107 (8th ed. 2001, rev. Sept. 2007).

35 421 F.3d 1365, 1378, 1379 (Fed. Cir. 2005) (2-1 decision). The court also held that the EST application failed for want of enablement. *Id.* at 1378-79.

36 *See* Holman & Munzer, *supra* note 27, at 820-21.

the most valuable aspects of ESTs were trade secrets in annotated databases. Consequently, community sometimes can be used to generate trade secrets or, more precisely, generate a realization that trade secrets are sometimes the more valuable aspects of their scientific knowledge. To what extent this diffuse pressure affected the courts is hard to say, but *In re Fisher* endorses the stronger stand on utility taken by the USPTO.

4. Therefore, community can be used to generate scientific knowledge, patent reform, scientific research, medical diagnostics, and trade secrets and occasionally patents.

C. An Argument for T3

T3 states that, on the spectrum from commons to semicommons to private property to anticommons, an anticommons can arise if a biotechnological asset is fuzzily defined. Observe that T3 involves a class of atypical examples of anticommons. The typical examples, which are plentiful in theory but hard to find in the real world, involve cases where many separate entities own indispensable, overlapping rights to an asset. In one set of cases, the rights are clear but, clearly, overlap. In another set, the rights are extremely narrow, but no one can do anything with the asset unless most or maybe all of the narrow rights in it can be bundled. In still another set, the rights are quite broad and, because of their breadth, overlap.

T3 asserts that an (atypical) anticommons can arise if a biotechnological asset is fuzzily defined. Fuzziness differs from clarity, narrowness, and breadth. Yet fuzziness can come into play when it either conduces to breadth or the appearance of breadth, or produces uncertainty as to which rights overlap (which in turn leads to identifying a large number of rights, whether narrow or broad, as possibly necessary for the use of the asset), or both. The broad-to-narrow spectrum differs from the clear-to-fuzzy spectrum, and each differs from the commons-to-anticommons spectrum.

A good illustration of T3 involves changes in gene theory and a possible normative biotechnological anticommons. Gene patents are a biotechnological asset. The governing principle of traditional gene theory has been "one gene, one protein." Genes so understood operate independently of each other. When a gene is switched on, it codes for a protein product. Different genes could, technically, code for the same protein. But as a practical matter and in a given species, for any protein there is just one gene that encodes it. U.S. patent law follows this principle. The USPTO allows

gene patents provided that the full and exact nucleotide sequence is given and this ordered sequence encodes a specific functional product.[37]

Traditional gene theory has been under assault for at least 10 to 15 years. A June 2007 report of the ENCODE Project Consortium, which consists of some 35 groups from 80 organizations in many different countries, gives a snapshot of where the assault currently stands.[38] The traditional gene — sometimes called the "industrial" gene — is an individual unit that codes for a single protein, is locally transcribed into RNA, which then mechanistically splices out non-coding regions ("introns") and is translated into the relevant protein. Genomics has transformed the understanding of genes by showing how they function in a complex network. The network gene — sometimes called the "genomic" gene — can code for alternative proteins. The genome of which it is a part is "pervasively transcribed" and can have different "transcription start sites."[39]Transcription is more complicated than previously thought. A "given gene may both encode multiple protein products and produce other transcripts that include sequences from both strands and from neighboring loci."[40] There are non-protein-coding RNAs, and the regulation of transcription "involves the interplay of multiple components."[41] As to replication, new data and analysis suggest "that larger-scale chromosomal architecture may be more important than the activity of specific genes."[42] Genes and genomes are less mechanistic than previously thought.[43] The ENCODE report concludes that "the simple view of the genome as having a defined set of loci transcribed independently does not seem to be accurate."[44]

Should the network model of genes win the day, the implications for gene patents are serious. One implication is that more than one gene could play a role in producing each of an unknown number of proteins. The network model raises grave questions for gene patents, including whether infringement claims should be subject to dispute when another

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37 Regents of the Univ. of Calif. v. Eli Lilly & Co., 119 F.3d 1559, 1566-69 (Fed. Cir. 1997).

38 The ENCODE Project Consortium, *Identification and Analysis of Functional Elements in 1% of the Human Genome by the ENCODE Pilot Project*, 447 NATURE 799 (2007). The term "ENCODE" is an acronym for the Encyclopedia of DNA Elements. *Id.*

39 *Id.*

40 *Id.* at 802.

41 *Id.* at 804.

42 *Id.* at 807 (citation omitted).

43 *See id.* at 812-13.

44 *Id.* at 812.

crucial component of the network is claimed by someone else.[45] Because of this question and others like it that may arise, the metes and bounds of gene patents can be uncertain. Because of this uncertainty, what is covered by gene patents — namely, the biotechnological assets — are fuzzily defined. And because these existing gene patents are fuzzily defined, with their accompanying power to exclude others they could result in an anticommons. In light of the collective-action problems of anticommons, any given gene subject to network interactions could result in less than optimal consumption of that genetic asset, even though private parties holding patents relating to such a gene might create intermediaries or specialized licenses to reduce anticommons effects. If there are many such genes, the metes and bounds of patent rights in them will be uncertain, which could reduce the capital flowing into an important area of biotechnological research. There are, moreover, related reasons for believing that the number of gene patents is declining and will continue to decline.[46]

Hence, on the spectrum from commons to semicommons to private property to anticommons, an anticommons can arise if a biotechnological asset is fuzzily defined. We cannot, however, validly infer that this path is the most likely way for an anticommons to arise, for we have not shown that all other possible paths are less likely to result in an anticommons.

T3 requires a clarification: If an anticommons relating to a bio technological asset arises out of fuzziness, the very fact that the rights to that asset are fuzzily defined might reduce the severity of the anticommons problem. The holder of a fuzzily-defined right who is aware of its fuzziness is less likely to hold out than the holder of a clearly-defined right. The former is likelier than the latter to worry that, once litigation clarifies the rights involved, he or she might not have the right he or she wants or needs. In consequence, the former is likelier than the latter to adopt a softer position in negotiation, litigation, and settlement talks. So the adverse impact of a fuzziness-generated anticommons could be less severe than that of other sorts of anticommons.[47] And yet, if the

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45 Denise Caruso, *A Challenge to Gene Theory, A Tougher Look at Biotech*, N.Y. TIMES, July 1, 2007, § 4 (Week in Review), at 3.

46 *See* Michael M. Hopkins et al., *DNA Patenting: The End of an Era?*, 25 NATURE BIOTECH. 185 (2007) (citing the impact of the Human Genome Project, more stringent criteria of patentability, fewer patent grants and applications, and increased interest in patenting splice variants and single nucleotide polymorphisms).

47 *Cf.* Ian Ayres & Paul Klemperer, *Limiting Patentees' Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-Injunctive Remedies*, 97 MICH. L. REV. 985 (1999) (arguing that uncertainty in patent litigation holds down patent monopoly costs).

holder of a fuzzily-defined right is unaware of its fuzziness, and if the holder believes that the right is clearer, broader or stronger than litigation eventually shows it to be, he or she might take a harder position in negotiation, litigation, and settlement talks than he or she otherwise would and thereby increase the severity of the anticommons problem.

Despite the preceding qualification, prevailing economic wisdom is that fuzzily-defined rights — and indeed rights-uncertainty of all kinds — lead to unnecessary patent licensing.[48] Patent infringement litigation is quite costly, and potential infringers are averse to the very real risks of supracompensatory damages and injunctions. They will therefore frequently buy licenses to avoid these risks. Excessive patent licensing is not identical with an anticommons. But it can be a manifestation or a result of an anticommons. Excessive licensing is more likely to occur in fields where patents are both numerous and fuzzily defined. To put the matter broadly, if the fear of litigation shifts the biotechnology industry in the direction of excessive licensing, the higher costs will not yield equally high offsetting gains. This sort of inefficiency is likely to boost prices for consumers and hinder biotechnological research.

III. OBJECTIONS AND REPLIES

1. *Objection*: The understanding of community is defective, for shared interests and working toward shared goals do not a community make.

Reply: My understanding of community is admittedly broad but not for that reason defective, because its breadth in no way impairs its suitability for my purposes. Furthermore, in some contexts one can define community more narrowly. For instance, one could also require that members have mutual knowledge[49] that each member has shared interests and goals. Differently, one could analyze community in terms of a network of social and sociolinguistic modules.[50] Differently again, one could require that the members *intend* to work toward the same goals *because* they share the same interests.[51]

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48 *See* James Gibson, *Risk Aversion and Rights Accretion in Intellectual Property Law*, 116 YALE L.J. 882, 927-31 (2007).

49 *See* DAVID K. LEWIS, CONVENTION: A PHILOSOPHICAL STUDY 52-60 (1969) (defining the equivalent term "common knowledge" at 56); STEPHEN R. SCHIFFER, MEANING 30-36 (1972) (defining mutual knowledge at 30-31).

50 *See* Henry E. Smith, *Community and Custom in Property*, 10 THEORETICAL INQUIRIES L. 5, 18-19 (2009).

51 Groups of peer reviewers under CPR are examples of narrow communities. P2P REPORT, *supra* note 10, at 3. These communities ranged in size from two to 42

2. *Objection*: TI, T2, and T3 are neither separately nor together very interesting or powerful claims. T1 and T2 both say only that certain things "can be used," and T3 that something "can arise." But lots of things "can be used" or "can arise."

Reply: The objection has much less force than initially appears, for at least two reasons. First, the interest of each thesis lies in the connections and results identified rather than the frequency with which they occur. After all, each thesis picks out a mechanism for producing ostensibly desirable results or risking an undesirable result. Second, we can learn from positive and negative outcomes. As an analogy, consider the proposition that alternative fuel technologies can be used to reduce emissions and increase gas mileage. When we succeed, we gain information on related situations where we might also succeed. When we fail, we can often figure out why we might also fail in kindred cases. The same point holds, *mutatis mutandis*, for T1, T2 and T3. But I won't be coy: If I knew when, where, and why one could be sure of establishing the connections in T1 and T2 and of avoiding an anticommons that can result under T3, I would say so at once.

IV. FECUNDITY

If the foregoing account — consisting of theses, definitions and clarifications, the examples discussed, arguments for the theses, and replies to objections — is sound, then it will be intellectually fertile only in the event that it throws light on various types of biotechnological assets. The emerging discipline of synthetic biology is a good test case.

Synthetic biology is a modular enterprise that tries to build more complicated biological structures out of basic biological bits. In ascending levels of complexity, DNA sequences are the basic bits, parts consist of DNA sequences, devices are composed of parts, and systems are built out of devices. The Massachusetts Institute of Technology maintains a "Registry of Standard Biological Parts," which advances the aims of synthetic biology "by recording and indexing biological parts that are currently

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members. For any given patent application, there were about seven active participants on average. *Id.* at 18.

> Substantial effort went into designing a system that creates a sense of cohesive group participation and helps the community visualize its own efforts. "Sparkline" and "treemap" graphics provide users with an immediate, visual overview of community membership and activity.

Id. at 9.

being built and offering synthesis and assembly services to construct new parts, devices, and systems."[52] A notable feat in synthetic biology was the assembly, in 2008, of the entire genome of a bacterium consisting of nearly 583,000 base pairs.[53] The MIT Registry now contains DNA sequences. These sequences are, in my lexicon, descriptive biotechnological assets. Eventually, the Registry may contain, for the most part, information about DNA, parts, devices, and systems.[54] Information of this sort would not itself be a descriptive biotechnological asset. However, if this information were protected by patent or trade secret law, it would qualify as a normative biotechnological asset.

A thoughtful article by Kumar and Rai,[55] which builds on an earlier article by Rai and Boyle,[56] introduces legal readers and intellectual property scholars to three central issues concerning synthetic biology. The issues are: (1) How do we resolve a tension in synthetic biology between different methods of creating "openness"? (2) How do we avoid the undesirable consequences — especially patent thickets and anticommons — that problematic foundational patents in synthetic biology might create? (3) Is there a symbiotic relationship between open and proprietary models of innovation in synthetic biology, and if such a symbiosis exists, is it beneficial from the standpoint of social welfare?[57] Kumar and Rai do not claim to resolve these issues, but they suggest some ways of thinking about them. My task is to see whether the account offered here improves on their suggestions.

To prevent misunderstanding, I underscore how much everyone who works in the area of intellectual property and biotechnology owes to Kumar and Rai. It is rare for the first substantial article in a law review to get a new, exciting scientific discipline right and to ask deeply searching IP questions about it. Kumar and Rai have done that. If at times my examination seems stringent or even undiplomatic, its sole aim is nevertheless to push us closer to the truth on the issues they raise.

The first issue, suggest Kumar and Rai, can be resolved either by having

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52 Help: About the Registry, http://partsregistry.org/wiki/index.php/Help:About_the_Registry (last visited June 12, 2008).

53 Daniel G. Gibson et al., *Complete Chemical Synthesis, Assembly, and Cloning of a* Mycoplasma genitalium *Genome*, 319 SCIENCE 1215 (2008).

54 *See* David Baker et al., *Engineering Life: Building a Fab for Biology*, SCI. AM. 44, 46 (June 2006).

55 Sapna Kumar & Arti Rai, *Synthetic Biology: The Intellectual Property Puzzle*, 85 TEX. L. REV. 1745 (2007).

56 Arti Rai & James Boyle, *Synthetic Biology: Caught Between Property Rights, the Public Domain, and the Commons*, 5 PLOS BIOLOGY 389 (2007).

57 I have changed the ordering of these issues and crafted them more clearly than in Kumar & Rai, *supra* note 55, at 1747-48.

the structures of synthetic biology reside in the "public domain" or by using intellectual property rights to create a "commons."[58] They do not define either of these expressions. Neither do Rai and Boyle.[59] Elsewhere, however, Boyle isolates at least four different understandings of the public domain: (i) "IP-free information artifacts," (ii) "IP-free information resources," (iii) "broadly usable information resources," and (iv) "contractually constructed commons."[60] Rai and Boyle seem to suggest that the "public domain" is that which is "outside the world of property."[61] This suggestion won't do, because it seems to embrace both (i) and (ii) and might embrace (iii) as well, yet fails to clarify what it embraces. A further difficulty is that (i) and (ii) seem to be outside only the world of *intellectual* property, not all forms of property. And (iv) offers little help, because it seems to understand the term "public domain" in virtue of one sort of commons; none of these authors defines the term "commons" with any clarity. The reader is left with a good deal of linguistic confusion or at least uncertainty.

Here is a way to get our vocabulary and ideas straight, which is part of the analytic project of this Article. Define "public domain" as a certain normative status and make clear that the presumption that something belongs in the public domain is rebuttable. Recognize that people use the word "commons" broadly so as to include both common property and open-access resources. Contrast the public domain with both common property and open-access resources — all as done in Part I. Observe that none of these expressions is defined in terms of the others, yet all of them are defined in terms of underlying Hohfeldian normative modalities, which give clarity and rigor to the linguistic and conceptual part of the enterprise.[62]

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58 *See id.* at 1747-48, 1762-67. At least I read Kumar and Rai to make this suggestion. A weaker reading is that they just offer some observations on what is going on in synthetic biology.

59 *See* Rai & Boyle, *supra* note 56, at 389-93.

60 The vocabulary follows Samuelson, *supra* note 4, at 813 n.162 (PD 1, PD 2, PD 5, and PD 6 in her labeling system). For Boyle's (vaguer) language, see James Boyle, *Foreword: The Opposite of Property?*, 66 LAW & CONTEMP. PROBS. 1, 29-30 (2003); James Boyle, *The Second Enclosure Movement and the Construction of the Public Domain*, 66 LAW & CONTEMP. PROBS. 33, 59-62 (2003).

61 Rai & Boyle, *supra* note 56, at 389.

62 *See* Stephen R. Munzer, *The Commons and the Anticommons in the Law and Theory of Property*, *in* THE BLACKWELL GUIDE TO THE PHILOSOPHY OF LAW AND LEGAL THEORY 148, 148-50 (Martin P. Golding & William A. Edmundson eds., 2005) (using a Hohfeldian analysis and showing the intertranslatability of that analysis and the Calabresi and Melamed scheme of property rules, liability rules, and rules of inalienability).

These clarifications enable us to think more effectively about "openness" and "the boundary lines between intellectual property and the public domain"[63] in synthetic biology, which relate to my normative and thematic projects, than do Kumar and Rai. Assume that DNA, parts, devices, and systems are in the public domain as defined in this Article. Their public domain status might not be permanent, for it is only presumptive. The presumption is rebuttable in either of two ways. One way is to invoke correctly some constitutional, statutory, or judicial legal rule.[64] The various structures of synthetic biology are not good candidates for copyright protection.[65] But patents might well be available, as Kumar and Rai recognize.[66] The other way of rebuttal is for the holder of synthetic biological information to protect it by trade secret or contract.[67] So if by "openness" Kumar and Rai mean that synthetic biology should be an open-access resource, we have now mapped out how that sort of commons relates to the public domain, and identified different ways in which the various structures of synthetic biology either might not belong to the public domain or can be removed from it. *Pace* Kumar and Rai, there is no "tension"[68] here, just a choice among methods. To make sound normative proposals we need to look at the next two issues. Still, there is nothing inherently problematic in the idea that if the contents of synthetic biology ought to be an open-access resource, then intellectual property rights, especially patents, may have to undergird this resource, for otherwise it might prove most difficult to bind future users and third parties.[69]

The second issue is how to avoid the undesirable consequences — including patent thickets and anticommons — that questionable foundational patents in synthetic biology might create. This issue pertains to my normative

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63 Kumar & Rai, *supra* note 55, at 1747, 1748.

64 *See* text accompanying *supra* note 4 (clause (ii)).

65 *See* Kumar & Rai, *supra* note 55, at 1763-64 (explaining the obstacles).

66 *See id.* at 1764-65 (acknowledging the legal and financial difficulties with a "patent-based commons").

67 *See* text accompanying *supra* note 4 (clause (i)). As to trade secret, the information holder would exercise a liberty-right and power to protect others from acquiring the information from the holder. As to contract, the holder would exercise a liberty-right and power to disclose it to others only on mutually agreed terms. Using trade secret or contract law in these ways presupposes either that the DNA, parts, devices, and systems of synthetic biology can be successfully withdrawn from the public domain or that they are not in the public domain. The latter possibility, obviously, contradicts the assumption made at the beginning of this paragraph.

68 Kumar & Rai, *supra* note 55, at 1747.

69 Kumar & Rai, *id.* at 1748 & n.20, seem to hint that something problematic lurks here.

project and is especially nettlesome because synthetic biology is such a new field that picking out which patents are foundational is hard.[70] However, insofar as the object is to avoid issuing such patents in the first place, Community Patent Review and thesis T2 suggest a way of doing so to the extent that getting higher quality patents is a function of scientific expertise. As to legal criteria for issuing patents, the standard for non-obviousness is becoming more stringent and not just as a result of *KSR International Co. v. Teleflex Inc*.[71] Stringency is on the increase even in biotechnology: In March 2007 the USPTO rejected, as obvious because anticipated by prior art, all claims in three important stem cell patents previously issued to a researcher and assigned to the Wisconsin Alumni Research Foundation.[72] Unlike Article 53(a) of the European Patent Convention, U.S. patent law imposes no moral constraint on patentability.[73] Yet there are obvious moral grounds for doubting the wisdom of issuing patents on dangerous synthetic genomes and allowing the synthetic chromosomes to be inserted into living microbes, which underscores the importance of my conception of the public domain.

Suppose, though, that questionable foundational patents do issue in synthetic biology. The term "patent thicket" is metaphorical and somewhat vague. Kumar and Rai make a respectable case for worrying about transaction-cost-heavy thickets of patents on DNA-binding proteins, which (roughly put) can trigger or suppress gene expression.[74] But here they underplay patent pooling and benefits to small biotechnology firms and overplay the risk of inefficient royalty stacking — in part because they ignore cooperation among innovators in the real world of biotechnological innovation.[75] As for IP rights in large-scale genomic and genetic synthesis,

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70 Kumar & Rai, *id.* at 1751-52, 1755-56, offer some shrewd guesses about which patents might turn out to be foundational.

71 127 S. Ct. 1727 (2007) (interpreting the non-obviousness standard of 35 U.S.C. § 103 (2000)).

72 *See* RUSSELL KOROBKIN, STEM CELL CENTURY: LAW AND POLICY FOR A BREAKTHROUGH TECHNOLOGY 118-22 (2007). In February 2008 the USPTO upheld, in a non-final ruling, one of the WARF patents. Press Release, Wis. Alumni Res. Found. (Feb. 28, 2008). The legal scuffling is likely to continue for some while. *See also* Aurora Plomer et al., *Challenges to Human Embryonic Stem Cell Patents*, 2 CELL STEM CELL 13 (2008).

73 Juicy Whip, Inc. v. Orange Bang, Inc., 185 F.3d 1364, 1366-67 (Fed. Cir. 1999) (holding in part that the so-called moral utility doctrine is inconsistent with the Patent Act).

74 *See* Kumar & Rai, *supra* note 55, at 1758-60.

75 *Compare id.* at 1759-60 *with* Jonathan M. Barnett, *Cultivating the Genetic Commons: Imperfect Patent Protection and the Network Model of Innovation*, 37

Kumar and Rai found only three patent *applications* by the major player (Codon Devices) in this area together with some exclusive licenses — hardly a very dense patent thicket.[76] Codon Devices protects some of its technology as trade secrets,[77] which are plainly not germane to a *patent* thicket. If we turn to the more technical and precise concept of an anticommons, Kumar and Rai adduce no empirical evidence for the existence of an anticommons anywhere in synthetic biology. The number of significant players in DNA-binding proteins and large-scale genetic and genomic synthesis is small, as is the number of issued patents in these areas. Here normative biotechnological assets are pretty well defined, so thesis T3 is inapplicable. Hence the account articulated here appears to weaken worries about the emergence of an anticommons and patent thickets in synthetic biology.

If my account weakens these worries, it hardly eliminates them, for an underlying normative issue needs resolution: which IP rights in biotechnological assets are justifiable without regard to contract, and which IP rights in these assets depend on, or are limited by, contract? This issue, as a problem in political theory, has been around at least since Locke.[78] It is also an issue for debate in the public domain as understood in Part I. It is implausible to hold, as a general position, that all IP rights arise either by general consent or by contract. If we bring in Bentham's view that any rights of property worth the name have the law behind them,[79] then we can get patents and other IP rights under the conditions laid down by many different legal systems. The initial acquisition of patents and trade secrets will not depend on contract. To hold down worries about anticommons and patent thickets, however, our underlying political and legal theory must preclude their

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SAN DIEGO L. REV. 987 (2000) (arguing that a network exists in the real world of innovation). For more creative ways to reduce patent thickets, see Ian Ayres & Gideon Parchomovsky, *Tradable Patent Rights: A New Approach to Innovation* (Univ. of Penn. Law Sch., Scholarship at Penn Law Paper No. 183, 2007), *available at* http://lsr.nellco.org/cgi/viewcontent.cgi?article=1188&context=upenn/wps (advocating the reduction of the number of patents by increasing renewal fees and creating a secondary market in which permits for patent protection can be bought and sold).

76 *See* Kumar & Rai, *supra* note 55, at 1761-62.

77 *See id.* at 1762 & n.100.

78 JOHN LOCKE, SECOND TREATISE OF GOVERNMENT §§ 25-51, *in* TWO TREATISES OF GOVERNMENT 265, 303-20 (Peter Laslett ed., 2d ed. 1967) (1690).

79 JEREMY BENTHAM, THE THEORY OF LEGISLATION 111-13 (C.K. Ogden ed., 1931) (1802); United States v. Willow River Power Co., 324 U.S. 499, 502 (1945) ("not all economic interests are 'property rights'; only those economic advantages are 'rights' which have the law back of them").

acquisition, unless we can be tolerably sure that contractual arrangements will emerge that facilitate effective bundling services, cross-licensing, alliances between upstream and downstream inventors, and the like. The trick is to facilitate such contracts without making initial acquisition so difficult that it discourages useful inventions. To perform this trick we need to work at the crossroads of political and legal theory on the one hand and institutional design on the other.

The third and final issue, which is central to my thematic project, is whether a symbiotic relationship exists between open and proprietary models of innovation in synthetic biology and, if there is such a symbiosis, whether it is beneficial from the standpoint of social welfare. Kumar and Rai are cautiously optimistic regarding the former and express reservations regarding the latter.[80] The account developed in this Article is more sanguine on both points, but frankly the available evidence from the nascent field of synthetic biology is so scanty that no firm conclusion can be drawn on either point. Let's see why.

As to the existence of a symbiotic relationship between open and proprietary models, the field of synthetic biology has both open-access resources and IP-protected resources. Notable open-access resources include the MIT Registry of Standard Biological Parts and the incipient BioBricks Foundation with its fledgling list of standard DNA parts.[81] Notable patents and trade secrets protect information and inventions concerning DNA-binding proteins and large-scale genetic and genomic synthesis. These are owned by such firms as Sangamo Biosciences, Inc., Blue Heron Biotechnology, Inc., and Codon Devices. Yet so far we have only a juxtaposition of, not a symbiosis between, open-access resources and IP-protected resources. Some synthetic biology patents are held by universities or the federal government, which may tolerate infringement or license nonexclusively.[82] Somewhat more to the point is the group Biological Innovation for Open Society (BIOS), which seeks to create "a patent-based commons"[83] for members of the BIOS group. It is hardly obvious that any of these examples yields exactly what we seek: a *symbiotic* relationship between open-access resources and IP-protected resources.

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80 *See* Kumar & Rai, *supra* note 55, at 1748 ("potentially symbiotic relationship"), 1767 ("could be beneficial"), 1768 ("market power" and "vertical integration" could be "quite detrimental to innovation") (footnote omitted).

81 Kumar & Rai provide a thumbnail sketch of the Foundation. *Id.* at 1763.

82 *See id.* at 1752, 1754 (naming Stanford University, the University of Tennessee, and the Department of Health and Human Services).

83 *Id.* at 1764.

And yet theses T1 and T2 give some hope, even though that hope is not equally realistic for all cases. The hope is most realistic in the case of the BIOS patent-based commons. The members of BIOS are a community. This community can generate scientific knowledge (T2). The knowledge thus generated makes use of such open-access resources as the MIT Registry and the BioBricks Foundation. Some of the new knowledge may be placed in the MIT Registry or the BioBricks list of standard DNA parts. Accessing these open resources can reinforce a community like BIOS. Consequently, in the case of the MIT Registry and the BioBricks Foundation on the one hand and BIOS on the other, a symbiotic relationship exists here between open-access resources and IP-protected resources.

It is difficult to construct an equally plausible argument for realistic hope in the case of Sangamo Biosciences, Blue Heron Technology, or Codon Devices. First, it is not clear that members of these firms count as communities. Second, although the firms may access resources from the MIT Registry or BioBricks, it's far from obvious that these firms will place relevant new scientific knowledge they develop in the MIT Registry or BioBricks. Of course, the creation of new knowledge will eventually flow into the public domain. To the extent that it does, in due time increased information may lower barriers to entry into the field of biotechnology and thereby may reinforce existing communities and create new ones. However, these mechanisms for the diffusion of knowledge and the use of communities go beyond the content of T1 and T2.

Would a symbiosis, if we had one, be beneficial? Kumar and Rai are skeptical. It would be beneficial, they say, if competition increased, for that would lower prices for synthetic biological products and aid innovation, and it would not be beneficial if monopoly control and vertical integration increased, for that would raise prices and deter innovation.[84] So far as I can see, their skepticism reveals what they regard as beneficial or not, but does not enable us to predict the eventual impact, for good or ill, of synthetic biology. Further, the economic vocabulary in which they couch their skepticism ignores the many other forms of discourse that my conception of the public domain includes. Thesis T2 may help slightly here in the event that scientific communities which favor open-access resources can cooperate with their IP-protection counterparts. Cooperation might occur more readily if members of these scientific communities *intend* to promote shared goals *because* they have shared interests.[85] At day's end, speculation

84 *See id.* at 1748, 1767-68 (distinguishing these possibilities).

85 *See* text accompanying *supra* note 51 (replying to objection 1).

is no substitute for evidence. Right now it is hard to determine whether a symbiotic relationship between open and proprietary models of innovation would be beneficial.

This guarded treatment of their final issue has implications for my thematic project. The talk of symbiosis between open and proprietary models of innovation points to larger contrasts between different forms of community on the one hand and of individualism on the other. Different communities are prominent throughout this Article: communities of patent peer reviewers, research scientists, and members of disease-defined organizations. The roles of individuals are likewise prominent — as innovators who respond to incentives and as people who benefit from the inventions of others. So long as ample room remains for both communities and individuals in this context, it is not evident that one needs here to settle upon any version of either communitarianism or individualism in political theory. The talk of symbiosis also shows how the understanding of the public domain advanced here leads to a firmer grasp of these contrasts and their role in institutions of property. The presumption embedded in my conception of the public domain shows that it is a site of argument and contestation, not an open-access resource from which either individuals or groups may, without any normative let or hindrance, withdraw units of the resource. This conception, then, must be understood in terms of, and eventually cashed out by, well-designed property institutions. For present purposes, these institutions must settle the metes and bounds of biotechnological assets, even if the settlement cannot abide forever.[86]

CONCLUSION

I have provided evidence and argued for each of three theses. I have given reasons for the importance of these theses and replied to objections. I have also shown that the account proposed here has some intellectual

86 Diane Leenheer Zimmerman, *Is There a Right to Have Something to Say? One View of the Public Domain*, 73 FORDHAM L. REV. 297, 371-72 (2004), states that there is a "mandatory public domain" in which "what goes into [this public domain] must stay there." Relatedly, Tyler T. Ochoa, *Origins and Meanings of the Public Domain*, 28 U. DAYTON L. REV. 215, 262-64 (2002), states that the constitutionally protected public domain is "irrevocable." These statements would be false on my understanding of the public domain. They might be true on Zimmerman's and Ochoa's respective understandings of the public domain, but it is worth noting that even constitutions can be amended.

fertility in that it improves on the suggestions of Kumar and Rai for solving a trio of issues pertaining to synthetic biology and intellectual property. Overall, the Article increases understanding of commons and anticommons, and of communal and individual ownership of biotechnological assets. It does so more effectively with a new understanding of the public domain and through the larger analytic, normative, and thematic projects that are interwoven throughout this Article.