The Natural Complexity of Patent Eligibility

Jacob S. Sherkow[*]

* Fellow, Center for Law and the Biosciences, Stanford Law School. For their comments, and for reading earlier drafts of this paper, thanks to Will Baude, Nathan Chapman, Beth Colgan, Becky Eisenberg, Shubha Ghosh, Hank Greely, Sara Gabriella Hoffman, Tim Holbrook, Matt Lamkin, Peter Lee, Mark Lemley, Lisa Larrimore Ouellette, Menesh Patel, J.J. Prescott, Zach Price, Sarah Rajec, Jacob Rooksby, Amanda Shanor, Ted Sichelman, and Andrew K. Woods. Thanks as well to the participants at WIPIP 2013 and PatCon 3 for their helpful comments. And a final thanks to Amanda and Lilah for keeping things simple.

INTRODUCTION

Recently, patents on human genes, software, and business methods have stoked a heated public discussion on patent law. Much of that discussion has focused on the doctrine of patent eligibility, or patentable subject matter, a century-and-a-half old legal doctrine that limits the types of inventions that can be patented.[1] The doctrine currently prohibits patents on "laws of nature, natural phenomena, and abstract ideas," as well as "products of nature."[2] Courts and commentators have long viewed these phrases as legalistic terms of art. That is, terms that have, or should have, particular legal significance apart from a scientific or philosophical exegesis of the words themselves.[3] But there is good reason to doubt this assumption. Since patent eligibility's inception, the Supreme Court has never provided a concrete definition or a legal test for what makes a natural "law," "phenomenon," or "product." Rather, it has tethered patent eligibility's

1. *See, e.g.*, Ed Black, Op-Ed., *Patent Reform Will Remove the Breaks from Innovation*, SAN JOSE MERCURY NEWS (Mar. 15, 2009, 8:00 PM), http://perma.cc/YF9S-BLQK ("The only real solution is to raise the basic standard of what is a patentable invention."); Editorial, *Congress, Not Courts, Must Fix Flaws in Gene-Patent System*, BOSTON.COM (Nov. 21, 2010), http://perma.cc/Q826-Q7QK ("Perhaps the best policy would be to simply do away with [gene] patents."); Editorial, *Patently Ridiculous*, N.Y. TIMES (Mar. 22, 2006), http://perma.cc/GA9R-NTLZ ("The definition of what is patentable has slowly evolved to include business practices and broad ideas."); Editorial, *Reining in Patents*, L.A. TIMES (Mar. 30, 2010), http://perma.cc/PH9V-EKSQ ("Underlying many of these disputes is a fundamental question about what patents should cover.").

2. Diamond v. Diehr, 450 U.S. 175, 185 (1981) ("Excluded from such patent protection are laws of nature, natural phenomena, and abstract ideas."); Diamond v. Chakrabarty, 447 U.S. 303, 313 (1980) ("Congress thus recognized that the relevant distinction was not between living and inanimate things, but between products of nature, whether living or not, and human-made inventions.").

3. *See, e.g.*, Dan L. Burk & Mark A. Lemley, *Inherency*, 47 WM. & MARY L. REV. 371 (2005) (viewing patentable subject matter as a function of "inherency"); Tun-Jen Chiang, *The Rules and Standards of Patentable Subject Matter*, 2010 WIS. L. REV. 1353 (dividing patent eligibility into easier "rules" and more difficult "standards"); Dennis Crouch & Robert P. Merges, *Operating Efficiently Post-*Bilski *by Ordering Patent Doctrine Decision-Making*, 25 BERKELEY TECH. L.J. 1673 (2010) (attempting to simplify patent eligibility through decision ordering); Rebecca S. Eisenberg, *Wisdom of the Ages or Dead-Hand Control? Patentable Subject Matter for Diagnostic Methods After* In Re Bilski, 3 CASE W. RES. J.L. TECH. & INTERNET 1, 50–64 (2012) (describing patent eligibility through three normative functions); John M. Golden, *Patentable Subject Matter and Institutional Choice*, 89 TEX. L. REV. 1041, 1079 (2011) ("[T]he real concern seems to be that the so-called laws of nature cited by the Supreme Court are 'abstract ideas'—generalized descriptions untethered to any particular, practical ends."); Eileen M. Kane, *Patent Ineligibility: Maintaining a Scientific Public Domain*, 80 ST. JOHN'S L. REV. 519, 551 (2006) ("It appears that 'law of nature' in patent law can be called a term of art . . . ."); Mark A. Lemley et al., *Life After* Bilski, 63 STAN. L. REV. 1315, 1332–35 (2011) (tying patent eligibility to claim scope); Michael Risch, *Everything Is Patentable*, 75 TENN. L. REV. 591 (2008) (arguing that the other requirements for patentability, such as enablement, nonobviousness, and novelty, in total, satisfy the doctrine of patent eligibility); Katherine J. Strandburg, *Much Ado About Preemption*, 50 HOUS. L. REV. 563, 569–86 (2012) (describing and criticizing patent eligibility as a test of "preemption").

"natural" terms to a varied list of scientific tropes in an apparent attempt to extract a scientific or philosophical meaning from them.[4]

This disconnect between how courts and scholars view patent eligibility's "natural" terms and how they analogize them to the real world has contributed to the doctrine's lack of either consistency or clarity.[5] Virtually no cases or legal scholarship have focused on what these terms mean in a scientific or philosophical context—that is, what science considers to be a "law of nature," whether a phenomenon is "natural," or when a product is "of nature."[6] And none have discussed whether these meanings have changed since patent eligibility's inception over 150 years ago. This Article shows how one branch of scientific philosophy—natural complexity—both illuminates and challenges the doctrine of patent eligibility and can be harnessed to ultimately simplify it.

Originally concerned with the ills of overbroad patents, early American and British decisions on patent eligibility concerned the prohibition of patenting "principles" or "abstractions," as opposed to their concrete applications.[7] This test, despite its difficulties, was a decidedly legalistic one, and the few references to "laws of nature" were simple shorthands for "principles."[8] In 1948, however, the Supreme Court, in *Funk Brothers Seed Co.*

---

4. *See, e.g.*, Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1293 (2012) (giving, as examples of "laws of nature" or "natural phenomena," "a new mineral discovered in the earth or a new plant found in the wild," the equation $E=mc^2$, and "the law of gravity" (quoting *Chakrabarty*, 447 U.S. at 309) (internal quotation marks omitted)); Lab. Corp. of Am. Holdings v. Metabolite Labs., Inc., 548 U.S. 124, 126–27 (2006) (Breyer, J., dissenting) (listing electromagnetism, steam, "the heat of the sun, electricity, [and] the qualities of metals" (quoting Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948) (citing O'Reilly v. Morse, 56 U.S. (15 How.) 62, 116 (1853)))).

5. *See* MySpace, Inc. v. GraphOn Corp., 672 F.3d 1250, 1260 (Fed. Cir. 2012) (declaring patentable subject matter a "swamp of verbiage" and a "murky morass"); Chiang, *supra* note 3, at 1354–55 ("[T]he doctrines on patentable subject matter are difficult to apply."); Risch, *supra* note 3, at 591 (characterizing patent eligibility as the "confused and inconsistent jurisprudence of patentable subject matter"); Strandburg, *supra* note 3, at 566–67 ("The precise reasons for [patentable subject matter] exclusions have been left murky, however, frustrating their implementation and often leading to incoherence in courts' reasoning about whether claims are too abstract or too 'natural' to be patentable.").

6. *But see, e.g.*, Golden, *supra* note 3, at 1079 (proposing that the doctrine only concern itself with prohibiting "abstract ideas" as a way of circumventing philosophical concerns (internal quotation marks omitted)); Kane, *supra* note 3, at 551 (writing that, despite philosophical debates over terms like "laws of nature," "[i]t appears that 'law of nature' in patent law can be called a term of art").

7. *See infra* Part I.A.

8. *See* Tilghman v. Proctor, 102 U.S. 707, 726–27 (1880) (quoting *O'Reilly v. Morse* in support of sustaining a patent directed to a process of treating fats and oils); *O'Reilly*, 56 U.S. (15 How.) at 119 ("And it makes no difference, in this respect, whether the effect is produced by chemical agency or combination; or by the application of discoveries or principles in natural philosophy known or unknown before his invention; or by machinery acting altogether upon mechanical principles. In either case he must describe the manner and process as above mentioned, and the end it accomplishes."); Le Roy v. Tatham, 55 U.S. (14 How.) 156, 175

v. Kalo Inoculant Co., separately proscribed patents on "laws of nature" or "natural phenomena."[9] And around the same time, courts also began to incorporate patent law's long-standing ban on patenting "products of nature" into this reimagined doctrine of patent eligibility.[10]

Since then, the Supreme Court has struggled to give these "natural" terms any concrete, legal meaning.[11] Unlike its jurisprudence in other areas of the law that similarly struggle with vague terms, the Court has devised no framework, no factors, and no legal definition to discern them.[12] Rather, the Court's opinions have continually relied on a list of putative examples of natural "laws," "phenomena," and "products," such as electricity, the qualities of metals, or wild plants.[13] In this way, patent eligibility's "natural" terms have shifted from legal descriptions to philosophical or scientific concepts.

(1852) ("A patent will be good, though the subject of the patent consists in the discovery of a great, general, and most comprehensive principle in science or law of nature, if that principle is by the specification applied to any special purpose, so as thereby to effectuate a practical result and benefit not previously attained." (quoting Househill Coal & Iron Co. v. Nielson, (1843) 8 Eng. Rep. 616 (H.L.); 1 Web. P.C. 673, 683)).

9. *Funk Bros.*, 333 U.S. at 130 ("[P]atents cannot issue for the discovery of the phenomena of nature. . . . [T]he heat of the sun, electricity, or the qualities of metals, are part of the storehouse of knowledge of all men. They are manifestations of laws of nature, free to all men and reserved exclusively to none. He who discovers a hitherto unknown phenomenon of nature has no claim to a monopoly of it which the law recognizes." (citation omitted)); *see also* Ted Sichelman, Funk *Forward*, *in* INTELLECTUAL PROPERTY AT THE EDGE: THE CONTESTED CONTOURS OF IP (Rochelle Dreyfuss et al. eds., forthcoming 2014), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2035027 (discussing the effect of *Funk Brothers* on patent eligibility's "natural" terms).

10. *See* Parke–Davis & Co. v. H.K. Mulford Co., 189 F. 95 (C.C.S.D.N.Y. 1911) (allowing, as patent eligible, an "isolated" and "purified" form of adrenaline), *aff'd in part, rev'd in part,* 196 F. 496 (2d Cir. 1912); Christopher Beauchamp, *Patenting Nature: A Problem of History*, 16 STAN. TECH. L. REV. 257, 300–06 (2013) (tracing the historical incorporation of the "products of nature" doctrine into the doctrine of patent eligibility).

11. *See* Chiang, *supra* note 3, at 1389 ("The label 'laws of nature' is, like the label 'abstract idea,' infinitely malleable and thus conclusory."); Sichelman, *supra* note 9, at 2 ("[T]horny and problematic legal issues in today's case law are reflected by the *Funk Brothers* decision itself. Indeed, I argue that the misguided reasoning of the *Funk Brothers* majority opinion—which declared the bacteria mixture ineligible for patenting—continues to plague patentable subject matter jurisprudence.").

12. *See, e.g.*, Friends of the Earth, Inc. v. Laidlaw Envtl. Servs. (TOC), Inc., 528 U.S. 167, 180–81 (2000) (providing an analytical framework for assessing the existence of a "case or controversy" under the Constitution); Farmer v. Brennan, 511 U.S. 825, 839–40 (1994) (defining "deliberate indifference," for purposes of "cruel and unusual" punishment under the Eighth Amendment, as "subjective recklessness . . . a familiar and workable standard" in criminal law); Asahi Metal Indus. Co. v. Superior Court, 480 U.S. 102, 113 (1987) (articulating personal jurisdiction's requirement of "fair play and substantial justice" as encompassing several factors, including "the burden on the defendant, the interests of the forum State, and the plaintiff's interest in obtaining relief").

13. *See supra* note 4.

Unsurprisingly, recent technologies have tested courts' abilities to provide coherency to this concept of "nature" in patent eligibility.[14] The results, so far, have been less than satisfactory.[15] Some of this difficulty comes from the scientific advances since patent eligibility's inception 150 years ago. Spurred by revolutions in the sciences, the past century-and-a-half witnessed an explosive increase in the amount and diversity of information about the natural world.[16] Beginning in the 1940s, this increase became the object of scientific and philosophical inquiry.[17] Scientists began to take note of "the number and variety of [nature's] constituent elements and of the elaborateness of their interrelational structure."[18] At the same time, philosophers began to describe the cognitive difficulties that this increase in information posed for reducing nature to simplistic descriptions.[19] "More," it turned out, was different.[20] This view of information's effect on science developed into a theory of "natural complexity."[21] In particular, scientific philosophers realized that natural complexity complicated efforts to describe nature with either constancy or causality, attenuated the force of certain conclusions derived from statistics, and caused "emergent properties" to appear that could not be construed as fundamental natural "laws" or "phenomena."[22] Simply put, natural complexity made using terms like "laws of nature," "natural phenomena," or "products of nature" harder to justify and more difficult to define.

The uncertainties that natural complexity imparts on patent eligibility's "natural" terms therefore explain some of the problems with the current

14. *See* Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2111 (2013) (assessing gene patents); Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1294 (2012) (assessing the patent eligibility of medical diagnostics).

15. *See* Robert R. Sachs, *Punishing Prometheus: The Supreme Court's Blunders in* Mayo v. Prometheus, PATENTLY-O (Mar. 26, 2012, 8:10 AM), http://perma.cc/3LHW-QVJ3 ("Like so many pseudo-sciences in which every phenomenon can be rationalized and in which there is no test that can show the theory to be incorrect, under *Prometheus* seemingly anything can be 'explained' as being unpatentable subject matter.").

16. *See* NICHOLAS RESCHER, COMPLEXITY: A PHILOSOPHICAL OVERVIEW 75–77 (1998) (describing the growth of scientific research, information, spending, and facilities).

17. *See generally* Warren Weaver, *Science and Complexity*, 36 AM. SCIENTIST 536, 538 (1948) (discussing the implications for the scientific study of systems "in which the number of variables is very large, and one in which each of the many variables has a behavior which is individually erratic, or perhaps totally unknown").

18. *See* RESCHER, *supra* note 16, at 1.

19. *See id.* at 87 ("[T]he increasing resource requirement for digging into ever deeper layers of complexity is such that successive triumphs in our cognitive struggles with nature are only to be gained at an increasingly greater price. The world's inherent complexity renders the task of its cognitive penetration increasingly demanding and difficult. The process at issue with the growth of scientific knowledge in our complex world is one of drastically diminishing returns.").

20. P.W. Anderson, *More Is Different*, 177 SCIENCE 393 (1972).

21. *See* RESCHER, *supra* note 16, at 25–54 (discussing natural complexity).

22. *See infra* Part II.

doctrine. First, patent eligibility struggles to equivalently exclude all claims encompassing a natural "law," "phenomena," or "product," even though natural complexity demonstrates that such concepts occupy a varied spectrum of both scope and depth. Second, without the ability to precisely delineate which patent claim elements encompass natural "laws," "phenomena," or "products," the Supreme Court has incorrectly marginalized the importance of claim language in assessing patent eligibility. And third, although patent law prides itself on being "technology neutral," the uncertainties facing patent eligibility's "natural" terms give their application an unwanted technology-specific effect.[23]

These difficulties suggest that patent eligibility's "natural" terms should be abandoned. In their place, courts should rely on a descriptive legal framework to assess patent eligibility. Constructing such a framework proves difficult, however, because patent eligibility has itself become complex: the doctrine must now contend with more, and more varied, precedent, patents, and technologies than ever before.[24] In the sciences, descriptive frameworks to naturally complex systems are often created through the twin strategies of "decomposition," breaking down a system into cognitively simple subparts, and "localization," the mapping of each of those subparts to the goals or purpose of the system.[25] This occurs in the law as well, through the use of "multiprong" or "multifactor" analyses.[26] For patent eligibility, a cognitively simple yet robust analysis could be developed by breaking down the component parts of a typical patent—the claims and the specification—and by mapping these components to the policy goals of patent eligibility. This, or a similar analysis, would bring much-needed clarity to patent eligibility despite the complexities of both science and the law.

---

23. *See infra* Part III.

24. *See generally* John R. Allison & Mark A. Lemley, *The Growing Complexity of the United States Patent System*, 82 B.U. L. REV. 77 (2002) (examining the recent increase in the complexity of the patent system).

25. *See generally* WILLIAM BECHTEL & ROBERT C. RICHARDSON, DISCOVERING COMPLEXITY: DECOMPOSITION AND LOCALIZATION AS STRATEGIES IN SCIENTIFIC RESEARCH xxviii–xxxvii (MIT Press ed. 2010) (2000) (describing decomposition and localization in scientific practice).

26. *See, e.g.*, Friends of the Earth, Inc. v. Laidlaw Envtl. Servs. (TOC), Inc., 528 U.S. 167, 180–81 (2000) (providing a multiprong analysis for standing); Asahi Metal Indus. Co. v. Superior Court, 480 U.S. 102, 113 (1987) (articulating a set of factors to assess personal jurisdiction); Lemley et al., *supra* note 3, at 1341 (proposing five factors to identify "abstract ideas" in patent eligibility); Sichelman, *supra* note 9, at 15–17 (applying a similar set of factors to rectify *Mayo* and *Myriad*); *see also* William A. Fletcher, *The Structure of Standing*, 98 YALE L.J. 221, 290–91 (1988) ("The solution [to the generality problem in standing is] to break down what might appear to be a single, general question into discrete and particular questions. In seeking to determine whether a particular plaintiff has standing, we should ask, as a question of law on the merits, whether the plaintiff has the right to enforce the particular legal duty in question. Standing, if seen in this fashion, is a question of substantive law, and the answers to standing questions will vary as the substantive law varies.").

This Article recounts the development of patent eligibility's "natural" terms, explains how natural complexity complicates this terminology and patent eligibility, generally, and proposes a method to solve these problems. Part I traces the doctrine of patent eligibility from its inception as a rule against patenting "principles" to today's prohibition on patenting "laws of nature," "natural phenomena," and "products of nature." Part II discusses how natural complexity imparts cognitive difficulties in developing and defining patent eligibility's "natural" terms. And Part III explains these difficulties' roles in some of the problems present in today's patent eligibility determinations. Part IV attempts to solve these difficulties: it posits that patent eligibility has itself become complex, and builds on the complexity literature to propose a solution; it describes how science employs the strategies of decomposition and localization to describe complex systems; and it uses this framework to develop a similar test for patent eligibility.

I. THE LAW AND SCIENCE OF PATENT ELIGIBILITY

The Constitution authorizes Congress "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries,"[27] i.e., to grant patents.[28] Since 1790, Congress has exercised this authority by statute and "fixed the conditions upon which patents and copyrights shall be granted."[29] The subject matter eligible for patenting is now codified in § 101 of the patent statute: "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof."[30] This liberal definition of "Writings and Discoveries" has changed little in over 200 years,[31] and "embodie[s the] philosophy that 'ingenuity should receive a liberal encouragement.'"[32]

Yet liberality is not limitless. Section 101, as interpreted by the Supreme Court, has long excluded various forms of inventions from patent eligibility.

---

27. U.S. CONST. art. I, § 8, cl. 8.

28. *See* Sears, Roebuck & Co. v. Stiffel Co., 376 U.S. 225, 228–29 (1964) ("Pursuant to this constitutional authority, Congress in 1790 enacted the first federal patent and copyright law, and ever since that time has fixed the conditions upon which patents and copyrights shall be granted." (citations omitted)).

29. *Id.*

30. 35 U.S.C. § 101 (2006).

31. *Compare* Patent Act of 1790, ch. 7, § 1, 1 Stat. 109, 109–12 (repealed 1793) (allowing patents for "any useful art, manufacture, engine, machine, or device, or any improvement therein"), *with* Patent Act of 1793, ch. 11, § 1, 1 Stat. 318, 318–23 (repealed 1836) (allowing patents for "any new and useful art, machine, manufacture or composition of matter"), *and* Patent Act of 1836, ch. 357, § 6, 5 Stat. 117 (repealed 1952) (same), *and* Patent Act of 1952, ch. 950, § 101, 66 Stat. 792 (changing "art" to "process" to read "any new and useful process, machine, manufacture, or composition of matter"), *and* 35 U.S.C. § 101 (same).

32. Diamond v. Chakrabarty, 447 U.S. 303, 308 (1980) (quoting 5 WRITINGS OF THOMAS JEFFERSON 75–76 (Washington ed. 1871)).

Such efforts began humbly, as attempts to avoid the ills of patent applications on "principles" or "abstractions," rather than inventions.[33] The modern doctrine, however, has since grown wildly. Today, in addition to "abstract ideas," the doctrine of patent eligibility also excludes "laws of nature," "natural phenomena," and "products of nature."[34] This has been a change in kind as well as degree. While the bar struggled to determine what precisely constituted a "principle" or an "abstraction," its difficulties were legalistic ones.[35] The difficulties inherent in defining "laws of nature," "natural phenomena," and "products of nature," however, have had a decidedly scientific or philosophical feel. Indeed, rather than articulating any precise factors to determine what constitutes natural "laws," "phenomena," or "products," the Court has tethered those terms to scientific rather than legal concepts.[36] Understanding patent eligibility's "natural" terms, therefore, requires a historical understanding of the doctrine as a fundamental shift from law to scientific philosophy.

33. *See* O'Reilly v. Morse, 56 U.S. (15 How.) 62, 116 (1853) ("[T]he discovery of a principle in natural philosophy or physical science, is not patentable."); Le Roy v. Tatham, 55 U.S. (14 How.) 156, 175 (1852) ("A principle, in the abstract, is a fundamental truth; an original cause; a motive; these cannot be patented, as no one can claim in either of them an exclusive right.").

34. Diamond v. Diehr, 450 U.S. 175, 185 (1981) ("Excluded from such patent protection are laws of nature, natural phenomena, and abstract ideas."); *Chakrabarty*, 447 U.S. at 313 ("Congress thus recognized that the relevant distinction was not between living and inanimate things, but between products of nature, whether living or not, and human-made inventions.").

35. *See* GEORGE TICKNOR CURTIS, A TREATISE ON THE LAW OF PATENTS FOR USEFUL INVENTIONS: AS ENACTED AND ADMINISTERED IN THE UNITED STATES OF AMERICA, at xxviii–xxix (The Lawbook Exch., Ltd., 4th ed. 2005) (1873) ("When it has been laid down that a 'principle,'—meaning by this use of the term a law of nature, or a general property of matter, or rule of abstract science,—cannot be the subject of a patent, the doctrine, rightly understood, asserts only that a law, property, or rule cannot, in the abstract, be appropriated by any man . . . unless the variation of means, apparatus, method, form, or arrangement of matter introduces some new law, or creates some new characteristic, which produces or constitutes a substantially different result."); S.H.H., *Patenting a Principle*, 16 AM. L. REG. 129, 129–30 (1868) ("The opinions of professional men are far from being settled, apparently, upon all the questions involved in patenting a principle. . . . Several things have contributed to this discordance of sentiment. One of the most prominent is a misapprehension of the effect and bearing of some of the cases on the subject.").

36. *See* Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1293 (2012) ("[T]he Court has written that a new mineral discovered in the earth or a new plant found in the wild is not patentable subject matter. Likewise, Einstein could not patent his celebrated law that $E=mc^2$; nor could Newton have patented the law of gravity." (quoting *Chakrabarty*, 447 U.S. at 309) (internal quotation marks omitted)); Lab. Corp. of Am. Holdings v. Metabolite Labs., Inc., 548 U.S. 124, 126–27 (2006) (Breyer, J., dissenting) ("Neither can one patent 'a novel and useful mathematical formula,' the motive power of electromagnetism or steam, 'the heat of the sun, electricity, or the qualities of metals.'" (citations omitted)); *Diehr*, 450 U.S. at 185 (quoting *Chakrabarty*, 447 U.S. at 309).

A. THE EARLY RULE AGAINST PATENTING "PRINCIPLES"

In 1790, Congress modeled the first patent statute in the U.S. after the British Statute of Monopolies.[37] More expansive than the British Statute, which allowed only "manufactures" to be patented,[38] the Patent Act of 1790 granted an inventor a monopoly for "any useful art, manufacture, engine, machine, or device."[39] Congress updated this language slightly in 1793 to include "any new and useful art, machine, manufacture or composition of matter,"[40] and has left it virtually unchanged since.[41]

Early American courts heartily adopted the British maxim that patents "for a principle or function detached from machinery" were void.[42] In *Wyeth v. Stone*, Justice Joseph Story—"one of the architects of American patent law"[43]—invalidated a patent for an automated method "to cut ice of a uniform size," concluding that "[s]uch a claim [was] utterly unmaintainable in point of law," because "[i]t is a claim for an art or principle in the abstract, and not for any particular method or machinery."[44] Denying eligibility to the asserted patent prevented monopolizing "a right to cut ice by all means or methods, or by all or any sort of apparatus, although he is not the inventor of any or all of such means, methods, or apparatus."[45] Justice Story similarly struck down a patent for a method "of communication of motion from the reed to the yarn beam" in a loom.[46] That patent, too, was "utterly void, as being an attempt to maintain a patent for an abstract principle, or for all possible and probable modes whatsoever of such communication, although they may be invented by others, and substantially differ from the mode described by the plaintiff in his specification."[47] And in *Smith v. Downing*, one of the cases concerning the Morse telegraph, the court clarified that "some expressions may have been used by one or two judges, which look like a sanction to patenting a principle, yet they are used in the above sense, of a principle in operation, in the manner set out in the specification."[48]

---

37. John F. Duffy, *Inventing Invention: A Case Study of Legal Innovation*, 86 TEX. L. REV. 1, 34–36 (2007).

38. Statute of Monopolies, 1623, 21 Jac., c. 3, § 6 (Eng.) (allowing patents for only the "working or makinge of any manner of new Manufactures within this Realme, to the true and first Inventor and Inventors of such Manufactures").

39. Patent Act of 1790, ch. 7, § 1, 1 Stat. 109, 110 (repealed 1793).

40. Patent Act of 1793, ch. 11, § 1, 1 Stat. 318, 319 (repealed 1836).

41. *See supra* note 31.

42. Blanchard v. Sprague, 3 F. Cas. 648, 650 (C.C.D. Mass. 1839) (No. 1518).

43. Frank D. Prager, *The Influence of Mr. Justice Story on American Patent Law*, 5 AM. J. LEGAL HIST. 254, 254 (1961).

44. Wyeth v. Stone, 30 F. Cas. 723, 727 (C.C.D. Mass. 1840) (No. 18,107).

45. *Id.*

46. Stone v. Sprague, 23 F. Cas. 161, 162 (C.C.D.R.I. 1840) (No. 13,487).

47. *Id.*

48. Smith v. Downing, 22 F. Cas. 511, 514 (C.C.D. Mass. 1850) (No. 13,036).

In 1852, in *Le Roy v. Tatham*, the Supreme Court accepted the analysis that a "principle," alone, could not be patented.[49] The Court assessed a process patent concerning the manufacture of metal pipes under continuous heat and pressure.[50] The patent claimed the manufacturing process "in the manner set forth [in the patent], or in any other manner substantially the same."[51] Although the case did not discuss whether it was the subject of a patent, the Court nonetheless concurred that "a principle is not patentable."[52] But it also recognized that "[t]he word *principle* is used . . . with such a want of precision in its application, as to mislead,"[53] and attempted to define the term as "a fundamental truth; an original cause; a motive."[54] "[T]hese," the Court concluded, "cannot be patented, as no one can claim in either of them an exclusive right. Nor can an exclusive right exist to a new power, should one be discovered in addition to those already known."[55] Nonetheless, the Court agreed that:

> [a] patent will be good, though the subject of the patent consists in the discovery of a great, general, and most comprehensive principle in science or law of nature, if that principle is by the specification applied to any special purpose, so as thereby to effectuate a practical result and benefit not previously attained.[56]

The Court reaffirmed the specific-application reasoning the following year in *O'Reilly v. Morse*, the seminal Morse telegraph case, striking down one of Morse's claims for "the use of the motive power of the electric or galvanic current . . . however developed for marking or printing intelligible characters, signs, or letters, at any distances."[57] The claim did "not confine [itself] to the machinery or parts of machinery . . . [but] a monopoly in its use, however developed, for the purpose of printing at a distance."[58] Such a monopoly was too broad—it impeded, rather than promoted the constitutional directive concerning the "Progress of Science."[59] As such, the Court invalidated claim 8 of Morse's patent because it prevented "some future inventor, in the onward march of science, [from] discover[ing] a

49. Le Roy v. Tatham, 55 U.S. (14 How.) 156, 175 (1852).
50. *Id.* at 172–73.
51. *Id.* at 172 (internal quotation marks omitted).
52. *Id.* at 175.
53. *Id.* at 174.
54. *Id.* at 175.
55. *Id.*
56. *Id.* (quoting Househill Coal & Iron Co. v. Nielson, (1843) 8 Eng. Rep. 616 (H.L.); 1 Web. P.C. 673, 683) (internal quotation marks omitted).
57. O'Reilly v. Morse, 56 U.S. (15 How.) 62, 112 (1853).
58. *Id.* at 113.
59. *See* U.S. CONST. art. I, § 8, cl. 8 (describing Congress's power "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries").

mode of writing or printing at a distance by means of the electric or galvanic current, without using any part of the process or combination set forth in the plaintiff's specification."[60]

This connection between "principle" and claim scope seemed to also extend to compositions of matter, as well as machines and processes. In *Parke–Davis & Co. v. H.K. Mulford Co.*, Judge Learned Hand famously upheld a patent directed to adrenaline.[61] Although the chemical was no different from how it was found in the adrenal gland, the court concluded that the act of isolating and purifying the chemical from its natural surroundings was "a purification of the principle, [for] it became for every practical purpose a new thing commercially and therapeutically."[62] This made "[t]he purpose of the claims . . . quite clear . . . with a corresponding limitation of scope."[63]

Rather than focus on issues of science or philosophy, scholars have since described these cases as concerning "overbreadth"—whether the patents attempted to claim more than they invented.[64] And indeed, Supreme Court decisions soon after *Le Roy* and *O'Reilly* bear out this logic.[65] Defining "principles" or "abstractions," therefore, was a purely legal exercise tied to the scope of patents' claims relative to their disclosure. Reduced to a simple syllogism, patent eligibility stood for little more than this: "Applying a basic scientific principle to the construction of a useful object is patentable; claiming every use of that principle isn't."[66]

B. FUNK BROTHERS SEED CO. V. KALO INOCULANT CO. *AND THE RISE OF PATENT ELIGIBILITY'S "NATURAL" TERMS*

This uniform view against patenting "principles," however, concealed two greater disputes. First, the advances in science in the early twentieth century quickly began to erode the assumption that scientific advances themselves—apart from physical machinery—should not be patent eligible.

60. *O'Reilly*, 56 U.S. (15 How.) at 113.

61. Parke–Davis & Co. v. H.K. Mulford Co., 189 F. 95, 104 (C.C.S.D.N.Y 1911), *aff'd in part, rev'd in part*, 196 F. 496 (2d Cir. 1912).

62. *Id.* at 103.

63. *Id.* at 109.

64. *See* Lemley et al., *supra* note 3, at 1333–35.

65. *E.g.*, Holland Furniture Co. v. Perkins Glue Co., 277 U.S. 245, 257 (1928) (prohibiting a patentee from "claiming a patent on the result or function of a machine [to] extend his patent to devices or mechanisms not described in the patent"); Minerals Separation, Ltd. v. Butte & Superior Mining Co., 250 U.S. 336, 349 (1919) (noting that "the scope of [the patentees'] right is limited to the means they have devised and described as constituting the process"); Westinghouse v. Boyden Power Brake Co., 170 U.S. 537, 581 (1898) ("[W]hether you call Westinghouse's discovery . . . a process, or a mode of operation . . . if he was the first to disclose it and to describe a mechanical means to give practical effect to the invention, he must be regarded as a pioneer inventor, and as entitled to protection . . . ."); Winans v. Denmead, 56 U.S. (15 How.) 330, 341–42 (1853) (patenting "principles" monopolized "any thing which is matter of common right, [rather than] what [inventors] themselves have created").

66. Lemley et al., *supra* note 3, at 1334–35.

Yet scholars struggled to conceive the contours of a potentially new regime. One commentator noted that "practical difficulties. . . . [lay in the] primary importance that the scientific discovery which is to be rewarded be very carefully defined."[67] Another, referring to Einstein's theory of relativity, recognized "[a] very serious difficulty . . . in defining what is a newly discovered 'truth or fact,' as distinguished from the use that can be made of it in the practical and industrial arts."[68] Second, courts and commentators began to tussle over the level and definition of "inventiveness" required for patent eligibility. Since 1851, the Supreme Court had required every invention to "be the product of 'more ingenuity and skill . . . than were possessed by an ordinary mechanic acquainted with the business.'"[69] The standard—amorphous and unworkable—was ardently condemned.[70]

Against this backdrop, agricultural researcher Varley Sherman Bond, in 1938, filed for a patent directed to "a bacterial culture useful for the inoculation of the seeds of leguminous plants."[71] Although the bacteria, *Rhizobia*, were well known and widely used in standard agricultural practice, the patentee had isolated and combined several strains of the bacteria that did not mutually inhibit one another.[72] Because different crops responded to different strains of *Rhizobium*, the patentee had, in essence, developed a single *Rhizobium* inoculant that could be used for multiple crops.[73] Rather than claiming a "one-size-fits-all" inoculant of specific *Rhizobium* strains, the patentee extended his claims to all inoculants "comprising a plurality of selected cultures . . . said cultures being substantially unaffected by each other."[74]

In *Funk Brothers*, the Supreme Court invalidated the patent on the ground that Bond's inoculant "fell short of invention within the meaning of the patent statutes."[75] In drawing that conclusion, however, the Court did not rely on its cases assessing the invention's level of "ingenuity" or "skill."[76] Nor did it reject the patent for being directed to a "principle"—"the idea

67. Hector M. Holmes, Book Review, 45 HARV. L. REV. 1431, 1433 (1932) (reviewing C.J. HAMSON, PATENT RIGHTS FOR SCIENTIFIC DISCOVERIES (1930)).

68. J. Lewis Stackpole, Book Review, 41 YALE L.J. 941, 941 (1932) (reviewing HAMSON, *supra* note 67).

69. *See* Duffy, *supra* note 37, at 39 (alteration in original) (quoting Hotchkiss v. Greenwood, 52 U.S. 248, 267 (1850)).

70. *Id.* at 42–43 (discussing several prominent judges' criticisms of the requirement).

71. U.S. Patent No. 2,200,532 col. 1 ll. 2–4 (filed Aug. 24, 1938).

72. Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 129–30 (1948).

73. *Id.* at 130.

74. '532 Patent col. 13 ll. 22–27.

75. *Funk Bros.*, 333 U.S. at 131–32.

76. *See id.* at 127–32; *see also* Duffy, *supra* note 37, at 39 (discussing *Hotchkiss v. Greenwood*'s requirement that inventions encompass "more ingenuity and skill . . . than were possessed by an ordinary mechanic acquainted with the business" (alteration in original) (quoting Hotchkiss v. Greenwood, 52 U.S. 248, 267 (1850)) (internal quotation marks omitted)).

that there are compatible strains"—rather than an application of one.[77] Rather, the Court invalidated the patent on the basis that Bond's invention was "the work of nature" and that "patents cannot issue for the discovery of the phenomena of nature."[78]

Unlike its predecessor cases, however, this appeal to "phenomena of nature" did not simply appear to be legal shorthand. Rather, it appeared to incorporate some of the scientific and naturalistic mysticism popular at the time.[79] The Court described *Rhizobium*'s nitrogen-fixing properties as "some mysterious process,"[80] "part of the storehouse of knowledge of all men. . . . free to all men and reserved exclusively to none."[81] These properties were "like the heat of the sun, electricity, or the qualities of metals,"[82] and "serve[d] the ends nature originally provided and act[ed] quite independently of any effort of the patentee."[83] Similarly, the Court characterized Bond's invention as "the handiwork of nature,"[84] "nature's secret,"[85] and an "ancient secret[] of nature."[86] This language dramatically departed from the Court's earlier remarks on allowing patents for a "great, general, and most comprehensive principle in science or law of nature" as long as the inventor concretely applied them.[87]

Both the dissent and the concurrence disputed the majority's notion of patent eligibility as divorced from the traditional understanding of the rule against patenting overbroad principles. In dissent, Justices Burton and Jackson simply did "not agree that the patent issued for such products is invalid for want of a clear, concise description of how the combinations were made and used."[88] This concern with the patent's description paralleled the Court's reasoning in *O'Reilly* that overbroad claims prevented "some future inventor, in the onward march of science, [from] discover[ing] a mode of writing or printing at a distance . . . without using any part of the process or

77. *Funk Bros.*, 333 U.S. at 133 (Frankfurter, J., concurring).

78. *Id.* at 130 (majority opinion).

79. *See, e.g.*, Vannevar Bush, *As We May Think*, ATLANTIC (July 1, 1945), http://perma.cc/G7AL-R33Q ("Thus science may implement the ways in which man produces, stores, and consults the record of the race. It might be striking to outline the instrumentalities of the future more spectacularly, rather than to stick closely to the methods and elements now known and undergoing rapid development, as has been done here. Technical difficulties of all sorts have been ignored, certainly, but also ignored are means as yet unknown which may come any day to accelerate technical progress as violently as did the advent of the thermionic tube.").

80. *Funk Bros.*, 333 U.S. at 128.

81. *Id.* at 130.

82. *Id.*

83. *Id.* at 131.

84. *Id.*

85. *Id.* at 132.

86. *Id.*

87. Le Roy v. Tatham, 55 U.S. (14 How.) 156, 175 (1852).

88. *Funk Bros.*, 333 U.S. at 136 (Burton, J., dissenting).

combination set forth in the plaintiff's specification."[89] In concurrence, Justice Frankfurter agreed as to the invalidity of the patent because the claims were overbroad: "the phrase 'the claims cover a composite culture' might mean 'a particular composite culture' or 'any composite culture'" including those "quite different from Bond's composite culture."[90] But Justice Frankfurter disagreed with the majority's "introduc[tion of] such terms as 'the work of nature' and the 'laws of nature.' For these are vague and malleable terms infected with too much ambiguity and equivocation."[91] In rejecting the scope and vagueness of the majority's choice of language, Justice Frankfurter voiced a prescient concern: "*Everything* that happens may be deemed 'the work of nature' . . . ."[92]

C. The Modern Doctrine of Patent Eligibility and Scientific Philosophy

Justice Frankfurter's axiom was perhaps truer than he realized. Since *Funk Brothers*, every Supreme Court opinion to substantively address patent eligibility has adopted the case's focus on "nature."[93] In *Diamond v. Chakrabarty*, the Court upheld a patent directed to a bacterium containing two synthetic pieces of circular DNA, or plasmids.[94] The Court described the function of these plasmids as giving the bacteria a "property . . . possessed by no naturally occurring bacteria,"[95] with "markedly different characteristics from any found in nature . . . and . . . . not nature's handiwork."[96] This distinguished the invention from that in *Funk Brothers* because the claim encompassed not "a hitherto unknown natural phenomenon, but . . . a nonnaturally occurring manufacture or composition of matter."[97]

In *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, the Court considered patents for a method of optimizing the dosage of thiopurine drugs in treating Crohn's disease patients.[98] The method simply directed a physician to "administer" the drug to a patient and then "determine" the level of a metabolite of that drug, where a level above or below certain values indicated a need to adjust the dosage accordingly.[99] Like patents on "principles" before it, the patents' claims do "not confine [themselves] to [any] machinery or parts of machinery,"[100] but rather sought a monopoly on

89. O'Reilly v. Morse, 56 U.S. (15 How.) 62, 113 (1853).
90. *Funk Bros.*, 333 U.S. at 134 (Frankfurter, J., concurring).
91. *Id.* at 134–35.
92. *Id.* at 135 (emphasis added).
93. *See supra* notes 84–86 and accompanying text.
94. Diamond v. Chakrabarty, 447 U.S. 303, 305 (1980).
95. *Id.*
96. *Id.* at 310.
97. *Id.* at 309.
98. Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1294–95 (2012).
99. *Id.* at 1295.
100. O'Reilly v. Morse, 56 U.S. (15 How.) 62, 113 (1853).

any "administration" of thiopurine followed by a "determination" of the quantity of their metabolites.[101] Nonetheless, the Court invalidated the patents on the grounds that they "set forth laws of nature."[102] The relationship between thiopurine administration and its metabolites were "natural laws or natural phenomena,"[103] "natural responses" that were a consequence of human biology,[104] or "natural correlations" between two events.[105] Prometheus's claims, therefore, were unpatentable natural "laws," "phenomena," and "manifestations of nature," even though the Court recognized that "all inventions at some level embody, use, reflect, rest upon, or apply laws of nature [or] natural phenomena."[106]

More recently, in *Association for Molecular Pathology v. Myriad Genetics, Inc.*, the Supreme Court considered several patents encompassing two types of DNA molecules: DNA excised directly from chromosomes, or "isolated genomic DNA," and synthetic transcripts of only the coding portions of genes, or "cDNA."[107] The opinion framed the issue as whether each class of molecules was "naturally occurring" or a "product of nature."[108] In its assessment, the Court heavily focused on the biochemical differences between isolated genomic DNA and cDNA.[109] But it framed the differences largely in "natural" terms: whether each patented molecule was "naturally occurring," whether they were variants of "natural DNA," and whether their sequences were "dictated by nature."[110] These differences counseled against the patent eligibility of isolated genomic DNA as resulting from activity that was "not an act of invention."[111]

Even the Supreme Court's jurisprudence regarding "abstract ideas"—the historical ancestor of "principles"—has recently been infected with such language. In *Gottschalk v. Benson*—a case concerning the patentability of a mathematical formula for processing binary code—the Supreme Court

101. *See Mayo*, 132 S. Ct. at 1297–98 ("First, the 'administering' step simply refers to the relevant audience, namely doctors who treat patients with certain diseases with thiopurine drugs. . . . Second, the 'wherein' clauses simply tell a doctor about the relevant natural laws, at most adding a suggestion that he should take those laws into account when treating his patient. . . . Third, the 'determining' step tells the doctor to determine the level of the relevant metabolites in the blood, through whatever process the doctor or the laboratory wishes to use. . . . The upshot is that the three steps simply tell doctors to gather data from which they may draw an inference in light of the correlations.").

102. *Id.* at 1296.

103. *Id.*

104. *Id.* at 1305.

105. *Id.* at 1296.

106. *Id.* at 1293.

107. Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2111 (2013).

108. *Id.*

109. *Id.* at 2114–15.

110. *Id.* at 2119.

111. *Id.* at 2117.

rejected the patent's claims as falling afoul of the prohibition on patenting "phenomena of nature."[112] Similarly, in *Parker v. Flook*, the Court construed its previous decisions as "[r]easoning that an algorithm . . . is like a law of nature."[113] As such, the Court invalidated the patentee's software process patent "not on the notion that natural phenomena are not processes, but rather on the more fundamental understanding that they are not . . . 'discoveries'" for the Constitution's purposes.[114] And in *Diamond v. Diehr*, the Court upheld the patentees' claims to a computerized process for automatically curing rubber as "not unpatentable simply because it contains a law of nature."[115] Despite this linguistic shift, the Court, in *Bilski v. Kappos* in 2010, boldly suggested that such language had been inherent in the patent eligibility statute for 150 years.[116]

These repeated invocations of natural "laws," "phenomenon," and "products" have never received any definition from the Supreme Court. The Court has made no attempt to impart on them any linguistic meaning, e.g., explications of the terms' ordinary usage in speech, dictionary definitions, or historical accounts of their concepts.[117] Nor has it attempted to provide them with any legal construction—normative judgments as to what natural "laws," "phenomena," or "products" *should* mean.[118] It provides no framework, no formula, and no list of factors to assess their construction. Nor does it tie them to historical concerns about descriptive overbreadth in patenting "principles."[119] Rather, the Supreme Court has engaged in a fundamentally different type of analysis: analogies to a list of examples of what the Court thinks are obvious natural "laws," "phenomena," and "products." Those include "mineral[s] discovered in the earth," "new plant[s] found in the wild," the equation $E=mc^2$, gravity, electromagnetism, steam power, "the heat of the sun, electricity, [and] the qualities of metals,"

112. Gottschalk v. Benson, 409 U.S. 63, 67–68 (1972) ("As we stated in [*Funk Brothers*], He who discovers a hitherto unknown phenomenon of nature has no claim to a monopoly of it which the law recognizes. . . . We dealt there with a 'product' claim, while the present case deals with a 'process' claim. But we think the same principle applies." (citation omitted) (quoting Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948)) (internal quotation marks omitted)).

113. Parker v. Flook, 437 U.S. 584, 589 (1978).

114. *Id.* at 593.

115. Diamond v. Diehr, 450 U.S. 175, 187 (1981) (quoting *Flook*, 437 U.S. at 590).

116. Bilski v. Kappos, 130 S. Ct. 3218, 3225 (2010).

117. *Cf.* Tun-Jen Chiang & Lawrence B. Solum, *The Interpretation-Construction Distinction in Patent Law*, 123 YALE L.J. 530, 543–48 (2013) (describing the facets of "interpretation" in claim construction).

118. *Cf. id.* at 549–52.

119. *See supra* notes 64–66 and accompanying text.

among others.[120] This is simply unlike other areas of the Court's jurisprudence that confront vague terminology in legal rules or standards.[121]

Patent eligibility's ever-growing list of excluded "sciency things" does little, if anything, to explain what exactly natural "laws," "phenomena," or "products" *are*. Declaring that one cannot patent "$E=mc^2$," for example, does not tell us why it is a "law" or a "phenomenon," which one of the two it is, or whether it can be both at the same time. Nor does it begin to resolve the fundamental problem of distinguishing natural laws from man-made representations of them.[122] Assuming that "gravity" must be excluded from patentable subject matter informs us little about which other scientific concepts must similarly be excluded. Prohibiting patents on electromagnetism, electricity, and steam power—even when such powers result solely from man-made activity—does little to elucidate what, legally, makes them unpatentable *natural* "phenomena." And concluding that one cannot patent wild plants or extracted minerals as "products of nature" does nothing more than leave that controlling term hopelessly void of meaning.

This list of scientific concepts, therefore, likely serves one particular function for the Supreme Court: as a collection of concepts that the Court believes scientists would agree on as natural "laws," "phenomena," and "products." This understanding seems to explain some of the Court's language concerning its own difficulties in making patent eligibility determinations. In his dissent in *Laboratory Corp. of America Holdings v. Metabolite Laboratories, Inc.*, Justice Stephen Breyer paused to "concede that

---

120. Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1293 (2012); Lab. Corp. of Am. Holdings v. Metabolite Labs., Inc., 548 U.S. 124, 126–27 (2006) (Breyer, J., dissenting).

121. *See* cases cited *supra* note 12.

122. Kevin Emerson Collins has written extensively on how patentable subject matter's prohibitions on "laws of nature, natural phenomena, and abstract ideas" are prohibitions on man-made *representations* of "laws of nature, natural phenomena, and abstract ideas," however defined. *E.g.*, Kevin Emerson Collins, Bilski *and the Ambiguity of "An Unpatentable Abstract Idea,"* 15 LEWIS & CLARK L. REV. 37, 46 (2011) [hereinafter Collins, Bilski *and the Ambiguity*] (analogizing patents on abstract ideas to representations of mental phenomena as patents on drugs are to patents on chemical formulas); Kevin Emerson Collins, Prometheus Laboratories, *Mental Steps, and Printed Matter*, 50 HOUS. L. REV. 391, 395–97 (2012) (describing how restrictions on patenting abstract ideas are actually prohibited on *representations* of abstract ideas in the context of the printed matter doctrine); Kevin Emerson Collins, *Propertizing Thought*, 60 SMU L. REV. 317, 329 (2007) (describing patents on abstract ideas as "mental representations of knowledge").

This issue has also, of course, occupied a central place in the philosophy of science. *E.g.*, D.M. ARMSTRONG, WHAT IS A LAW OF NATURE? 13 (1983) ("A gap can open up between law and *manifestation* of law." (emphasis added)); NANCY CARTWRIGHT, HOW THE LAWS OF PHYSICS LIE 129 (1983) ("[N]ature is not governed by simple quantitative equations of the kind we write in our fundamental theories. . . . [F]undamental equations do not govern objects in reality; they govern only objects in models."); Fred I. Dretske, *Laws of Nature*, 44 PHIL. SCI. 248, 249 n.4 (1977) ("I will also, sometimes, speak of laws and *statements of law* indifferently. I think, however, that it is a serious mistake to conflate these two notions." (emphasis added)).

the category of nonpatentable '[p]henomena of nature,' like the categories of 'mental processes' and 'abstract intellectual concepts,' is not easy to define."[123] Similarly, in *Mayo*, the Court declined the patent holder's invitation to discern among different types of natural "laws," not because the issue may not have been illustrative, but because "[c]ourts and judges are not institutionally well suited to making the kinds of judgments needed to distinguish among different laws of nature."[124] *Mayo*'s assertion may partially explain the Court's choice of popularly known scientific developments, such as electricity and steam power, even when other lesser-known examples from actually litigated cases, such as the Arrhenius equation in *Diehr*,[125] remain available.

Patent eligibility's "natural" terms are, therefore, the Supreme Court's attempt to introduce a scientific or philosophical meaning into natural "laws," "phenomena," and "products." It focuses on what the Court believes science or philosophy considers "laws of nature," "natural phenomena," and "products of nature." And, like early twentieth-century debates on granting patents to pure scientific discoveries, it struggles with the difficulties of distinguishing scientific concepts.[126] Contrary to the doctrine's historical focus on patenting "principles," patent eligibility's "natural" terms are more scientific and philosophical than legal.

II. NATURAL COMPLEXITY AND NATURAL LAWS, PHENOMENA, AND PRODUCTS

Given the Supreme Court's approach to patent eligibility's "natural" terms, science or philosophy would appear to be natural sources of discourse to help crystallize their meanings. After all, "What is a law of nature?" is a central question for the philosophy of science.[127] Unfortunately, neither science nor philosophy has provided any clarity. Rather, the issues surrounding the terms' meanings have long been—and are still—hotly debated.[128] Regularity, universality, functionality, probabilism, necessitation, and contingency—all complicate a straightforward definition.[129] At the same time, one avenue of scientific philosophy centers around these very difficulties: natural complexity.

123. *Lab. Corp.*, 548 U.S. at 134 (Breyer, J., dissenting) (quoting Parker v. Flook, 437 U.S. 584, 589 (1978)).

124. *Mayo*, 132 S. Ct. at 1303.

125. Diamond v. Diehr, 450 U.S. 175, 177–81 (1981). The Arrhenius equation generally describes the effect of temperature on chemical reaction rates. *See* Keith J. Laidler, *The Development of the Arrhenius Equation*, 61 J. CHEMICAL EDUC. 494, 494 (1984).

126. *See* Sichelman, *supra* note 9, at 10 ("[S]eparating the 'natural' from the 'synthetic' is not so simple a task."); *supra* notes 67–68 and accompanying text.

127. *See, e.g.*, philosophy sources cited *supra* note 122.

128. *See, e.g.*, philosophy sources cited *supra* note 122. *See generally* THE OXFORD COMPANION TO PHILOSOPHY 506–07 (Ted Honderich ed., 2d ed. 2005) (discussing various philosophical approaches to defining a "law of nature").

129. *See generally* ARMSTRONG, *supra* note 122.

Complexity, generally, is the measure of three facets of a system: (1) the number of elements, or components, present in the system; (2) the variety of those elements; and (3) the interrelationships between those elements.[130] As those facets increase, a system becomes increasingly "complex."[131] A simple wristwatch, for example, may contain nothing more than a fixed gear and a tension spring, turning a single hand. But wristwatches often involve many more components—several gears and springs, and, often, multiple measures of time. Those components, in turn, often come in several varieties, sizes, and shapes. And all of the components are, in one way or another, interconnected—the absence of a single gear or spring can affect the performance of many other components, and sometimes fatally so.[132] Such a watch is "complex," in philosophical terms.[133]

The principle effect of complexity is cognitive.[134] Complexity hinders our ability to reduce a system to its component parts, to understand a system's causes and effects, and to describe or explain a system with either completeness or certainty.[135] Difficulties in understanding how a complex wristwatch works may arise simply because of difficulties in determining which components are required, or how the components affect the watch's movement, either individually or in combination.[136] It may also be difficult to understand how a complex wristwatch works because we may lack the words to describe its components or those components' interactions with

---

130. RESCHER, *supra* note 16, at 1 (defining one form of complexity as "the number and variety of an item's constituent elements and of the elaborateness of their interrelational structure").

131. *See id.* at 8–16 (giving examples of increasingly complex systems).

132. This, however, is not always the case in complex systems. One branch of complexity theory, complex adaptive systems, or CAS, describes how certain complex systems can adapt to changes in their configuration despite their interconnected nature. *See generally* John H. Holland, *Complex Adaptive Systems*, DAEDALUS, Winter 1992, at 17. J.B. Ruhl has written numerous articles on how various areas of the law similarly adapt despite their complexity. *E.g.*, J.B. Ruhl, *Complexity Theory as a Paradigm for the Dynamical Law-and-Society System: A Wake-Up Call for Legal Reductionism and the Modern Administrative State*, 45 DUKE L.J. 849 (1996); J.B. Ruhl, *Law's Complexity: A Primer*, 24 GA. ST. U. L. REV. 885 (2008); J.B. Ruhl & Harold J. Ruhl, Jr., *The Arrow of the Law in Modern Administrative States: Using Complexity Theory to Reveal the Diminishing Returns and Increasing Risks the Burgeoning of Law Poses to Society*, 30 U.C. DAVIS L. REV. 405 (1997); J.B. Ruhl, *The Fitness of Law: Using Complexity Theory to Describe the Evolution of Law and Society and Its Practical Meaning for Democracy*, 49 VAND. L. REV. 1407 (1996).

133. *See* HERBERT A. SIMON, THE SCIENCES OF THE ARTIFICIAL 188–90 (3d ed. 1996).

134. *See* RESCHER, *supra* note 16, at 16 ("All in all, then, the best overall index we have of a system's complexity is the extent to which resources (of time, energy, ingenuity) must be expanded on its cognitive domestication.").

135. *See id.* at 16–21 (describing the cognitive difficulties with complex systems).

136. *See* SIMON, *supra* note 133, at 188–90 (recounting the watchmaker parable).

one another.[137] We may also simply lack the cognitive operators to understand the watch as a whole.[138]

So, too, with nature. Since 1850, almost every scientific discipline has seen the introduction, development, and adoption of radical theories and practices that have changed our understanding of the simplicity—or lack thereof—of the natural world. Scientists unearthed countless new objects and forces previously hidden from view: new sub-atomic particles and forces in physics; DNA and genes in biology; continental plates in earth science; and more.[139] The number of specialties in almost every scientific discipline multiplied many times over.[140] And through interdisciplinary research, science has uncovered a network of innumerable interrelationships in nature.[141] These revolutions, in turn, fed an explosive increase in the amount of scientific research and information. Since 1850, the quantity and funding of scientific research has, accordingly, exponentially increased.[142] The amount of scientific literature is now likely produced at one thousand times the rate it was then.[143] And so many people now work as professional scientists that over eighty percent of all the scientists who have ever lived are living now.[144]

---

137. *See* RESCHER, *supra* note 16, at 14 (discussing cognitive difficulties in ontological complexity).

138. *See id.*

139. *See* 15 CHARLES DARWIN, ON THE ORIGIN OF SPECIES (Paul H. Barrett & R.B. Freeman eds., Pickering & Chatto Ltd. 1988) (1859) (discussing evolution and natural selection); 2 MICHAEL B. GREEN ET AL., SUPERSTRING THEORY (1987); WERNER HEISENBERG, THE PHYSICAL PRINCIPLES OF THE QUANTUM THEORY (Carl Eckhart & Frank C. Hoyt trans., 1930); A.A. Penzias & R. W. Wilson, *A Measurement of Excess Antenna Temperature at 4080 Mc/s*, 142 ASTROPHYSICAL J. 419 (1965); F.J. Vine & D.H. Matthews, *Magnetic Anomalies over Oceanic Ridges*, 199 NATURE 947 (1963) (demonstrating the existence of magnetic striations over the seafloor, proof of seafloor "spreading" and "continental drift"); J.D. Watson & F.H.C. Crick, *Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid*, 171 NATURE 737 (1953) (discussing the discovery of the structure of DNA); Count K.A.H. Mörner, Rector, Royal Caroline Inst., Presentation Speech: Award Ceremony Speech (Dec. 10, 1905), *available at* http://perma.cc/BZY3-AU6X (awarding Robert Koch the 1905 Nobel Prize in medicine for his "discover[y of] the causes of individual diseases," i.e., microbes); *see also* THOMAS S. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS 111 (3d ed. 1996) ("[A]fter a revolution scientists are responding to a different world.").

140. RESCHER, *supra* note 16, at 75–77 (recounting the growth and increase in the number of subdivisions in the sciences).

141. *Id.* at 45 (describing how scientific interdisciplinarity "broaden[s] one's notion of a natural phenomenon to include not just the processes themselves . . . but also the *relationships* among them").

142. *See id.* at 75–77 (discussing the growth of scientific research).

143. *See id.* at 76 (computing the rate of production of scientific literature to increase ten-fold every fifty years).

144. *Id.*

Beginning in the 1940s, scientists and philosophers proposed that this growth was itself extraordinary.[145] In the words of Philip W. Anderson, the recipient of the 1977 Nobel Prize in physics, "More Is Different."[146] More scientific information uncovered a vast, varied, and interrelated web of information that could "not . . . be understood in terms of a simple extrapolation of the properties of a few particles."[147] Rather, this increase in scientific information made it appear that "[a]t each stage [of inquiry] entirely new laws, concepts, and generalizations [were] necessary" to theorize the whole.[148] This all implied the radical notion that "[t]he ability to reduce everything to simple fundamental laws [did] not imply the ability to start from those laws and reconstruct the universe."[149]

These observations gave rise to the study of "natural complexity,"[150] or the cognitive difficulties with synthesizing how the Earth's "many biological and physical components interact across all space and time scales."[151] Because "natural reality has an infinite descriptive depth,"[152] natural complexity counsels us to "abandon the idea that our linguistic resources can—at least in the theoretical long run—fully characterize the descriptive nature of the real."[153] Thus, the ultimate problem with terms like natural "laws," "phenomena," and "products" is that such terms "are inevitably inadequate to explain by themselves the phenomena as we actually observe them."[154] Three features—constancy and causality, probabilism, and fundamentalism—demonstrate the terms' inadequacy in describing naturally complex systems.

---

145. *See, e.g.*, Weaver, *supra* note 17, at 540 ("These problems—and a wide range of similar problems in the biological, medical, psychological, economic, and political sciences—are just too complicated to yield to the old nineteenth-century techniques which were so dramatically successful on two-, three-, or four-variable problems of simplicity. These new problems, moreover, cannot be handled with the statistical techniques so effective in describing average behavior in problems of disorganized complexity.").

146. Anderson, *supra* note 20, at 393.

147. *Id.*

148. *Id.*

149. *Id.*

150. RESCHER, *supra* note 16, at 50–52 (summarizing the procession of natural complexity).

151. Nicholas W. Watkins & Mervyn P. Freeman, *Natural Complexity*, 320 SCIENCE 323, 323 (2008) (describing natural complexity from a geoscience perspective).

152. RESCHER, *supra* note 16, at 28.

153. *Id.* at 33. Interestingly, several other scholars have written about the limits of language in other areas of patent law. *See, e.g.*, Andrew Chin, *The Ontological Function of the Patent Document*, 74 U. PITT. L. REV. 293, 299–305 (2012) (describing the limits of language in defining what constitutes enablement); *supra* note 122 (citing works by Kevin Emerson Collins discussing what constitutes an "abstract idea").

154. RESCHER, *supra* note 16, at 31.

A. CONSTANCY AND CAUSALITY

Natural "laws" or "phenomena" classically require two factors: (1) constancy, or, as termed by the philosopher David Hume, a "constant conjunction"; and (2) causality.[155] If event *A* happens in conjunction with event *B*, this is only a "law" or a "phenomenon" if event *A always* occurs in conjunction with event *B*. If, for example, water *always* boils (event *A*) when it is heated to 100°C (event *B*), then we have satisfied Hume's constancy requirement.[156] Accidents happen, however. That is, sometimes events repeatedly, even always, occur in conjunction with one another that have no causal link between the two. One famous example is the statement, "Whenever I go to Paris, it rains."[157] Even taking this statement as true—and therefore, satisfying the Humean constancy requirement—does not make it a natural "law" because the speaker's presence in Paris is surely not *causing* it to rain.[158] Rather, the speaker is simply the victim of unerring bad luck and Paris the host of bad weather.

Separating repetitive accidents from repeatable causal events is the classical philosophical problem of induction.[159] That is, how can we inductively generalize facts about the world given the epistemological uncertainty about any two events' constancy and causality? In the classical school, at least, natural "laws" or "phenomena" are only those pairings of events that can be inductively determined to be both *universally* constant and *universally* causal.[160] This view of natural laws and phenomena consequently implies that the terms occupy an immensely broad scope. For a natural relationship to be a "law" or a "phenomenon" it must "stipulate—quite ambitiously—how things are always and everywhere."[161]

Natural complexity complicates this analysis. As a natural system becomes more complex, it becomes increasingly difficult to determine whether any observed natural relationships are either constant or causal.[162]

---

155. THE OXFORD COMPANION TO PHILOSOPHY, *supra* note 128, at 506 (emphasis omitted). The twinning of constancy and causality in natural "laws" or "phenomena" is an almost infinitely rich topic in the philosophy of science. *See generally* G.E.M. Anscombe, Professor of Philosophy, Univ. of Cambridge, Inaugural Lecture Before the University of Cambridge (May 6, 1971), *in* CAUSALITY AND DETERMINATION (1971) (describing the state of the field). The purpose of this Subpart, however, is to simply describe the prevailing, classical view of constancy and causality.

156. THE OXFORD COMPANION TO PHILOSOPHY, *supra* note 128, at 506.

157. *Id.* (internal quotation marks omitted).

158. *See id.*

159. For a brief account of the traditional problem of induction, see MARIO BUNGE, CAUSALITY AND MODERN SCIENCE 251–55 (Transaction Publishers 4th ed. 2009) (1959).

160. *But see* NANCY CARTWRIGHT, THE DAPPLED WORLD: A STUDY OF THE BOUNDARIES OF SCIENCE 148–49 (1999) (criticizing this view).

161. RESCHER, *supra* note 16, at 65.

162. *See* Anderson, *supra* note 20, at 393 ("The constructionist hypothesis breaks down when confronted with the twin difficulties of scale and complexity. The behavior of large and

As the number, variety, and interconnectedness of elements in a system increases, determining which elements cause which events becomes a much harder task. Isolating and identifying not simply which elements are responsible for a particular natural phenomenon, but which interactions of those elements give rise to it greatly hinders our ability to distill what *causes* a particular phenomenon. This hindrance ultimately means that in naturally complex systems "there may often be no way of telling whether something proposed as a cause of some effect was in fact required for the occurrence of that effect."[163] Which cellular factors contribute to cancer, for example, is a famously complex question "that is already complex almost beyond measure."[164] As a result, even the best attempts by researchers to reduce cancer to several causal or constant "hallmarks" have generally failed.[165] Natural "laws" or "phenomena" of cancer simply elide over research's ability to "add[] further layers of complexity."[166]

In other instances, constancy and causality may exist at one level of complexity, but vanish entirely at another. Newton's law of universal gravitation, for example, describes the relationship between two objects' mass and distance and the gravitational force between them.[167] But it is both

complex aggregates of elementary particles, it turns out, is not to be understood in terms of a simple extrapolation of the properties of a few particles."); *see also* CARTWRIGHT, *supra* note 160, at 25–26 (discussing how complexity makes problematic "treating a real situation [by] . . . piec[ing] together a model from these fixed components"); JOHN DUPRÉ, THE DISORDER OF THINGS: METAPHYSICAL FOUNDATIONS OF THE DISUNITY OF SCIENCE 103 (1993) ("I suspect that the complex interdependencies of entities at many different levels of structural complexity characteristic of biology is sufficient to show the implausibility of the reductionistic project.").

163. DUPRÉ, *supra* note 162, at 184.

164. Douglas Hanahan & Robert A. Weinberg, *The Hallmarks of Cancer*, 100 CELL 57, 57 (2000); *see also* CARTWRIGHT, *supra* note 160, at 17–18 (discussing this in the philosophy of science context).

165. In their famous paper in 2000, notable cancer researchers Douglas Hanahan and Robert A. Weinberg proposed reducing cancer to six cellular "hallmarks" that appeared to be present in almost all cancers. Hanahan & Weinberg, *supra* note 164, at 57. But this attempt to impose constancy on a complex natural system eventually gave way; ironically, Hanahan and Weinberg's "hallmark" principle has itself "complexified." Since its publication, the authors have added two more hallmarks, while other scientists have noted that many of the hallmarks apply to noncancerous tumors, as well. Douglas Hanahan & Robert A. Weinberg, *Hallmarks of Cancer: The Next Generation*, 144 CELL 646 (2011) (adding additional hallmarks); *see also* Sébastien L. Floor et al., *Hallmarks of Cancer: Of All Cancer Cells, All the Time?*, 18 TRENDS MOLECULAR MED. 509, 514 (2012) (discussing how "the complexity of *in vivo* human cancer . . . explains why it is so difficult to treat cancer"); Yuri Lazebnik, *What Are the Hallmarks of Cancer?*, 10 NATURE REVIEWS CANCER 232, 232 (2010) (questioning whether "the proposed hallmarks of cancer [are] indeed such" given "the puzzling complexity of numerous and interrelated properties of cancers").

166. Hanahan & Weinberg, *supra* note 164, at 57.

167. LARRY D. KIRKPATRICK & GREGORY E. FRANCIS, PHYSICS: A WORLD VIEW 79 (6th ed. 2007).

empirically and philosophically not universal.[168] It does much to describe the primary attractive force between celestially sized objects, like planets, but in some naturally complex systems, such as those with a variety of smaller objects, the regularity of Newton's law is called into question. Indeed, the "universal" law of gravity seemingly fails to apply on microscopic levels because other forces, like electricity and magnetism, completely dominate its effect.[169]

A number of scientific philosophers similarly dispute the existence of constancy and causality in biology.[170] The complexity of biological diversity is, after all, simply the product of historical accident: "Rewind the tape of evolutionary history and play it again as many times as you will; it will never be the same twice."[171] Discerning causal or constant factors from this history—that is, identifying "laws" "phenomena," or even "products" in biology—is simply impossible. On this point, John Beatty, a philosopher of biology, declared that "there are no laws of biology. For, whatever 'laws' are, they are supposed to be more than just contingently true."[172] At another level, some biological processes are so complex, that one can regard each instance of them as practically unique.[173] This sentiment illustrates the problem of constancy and causality in natural "laws" and "phenomena" in general: that "[i]t is quite impossible to have for unique phenomena general laws like those that exist in classical mechanics."[174]

B. Probabilism

Where constancy and causality fail, "probabilism"—the use of probabilities or statistics as the basis for inductive reasoning—begins.[175] As

---

168. *See* CARTWRIGHT, *supra* note 122, at 56–57 (discussing gravity); DUPRÉ, *supra* note 162, at 185 ("[D]eterminism claims that there are exceptionless universal laws of nature. Notoriously, the truth of such laws cannot be empirically established.").

169. CARTWRIGHT, *supra* note 122, at 57–59. Some physicists have responded to this philosophical criticism of gravity by arguing that simply because other forces drown out gravity's effect at the quantum level does not make it less of a "law." *See, e.g.*, STEVEN WEINBERG, DREAMS OF A FINAL THEORY 91–95 (1993) (discussing gravity as a history of "anomalies" but a law nonetheless). But this argument fails to address the classical requirement that "laws" as "laws," as opposed to just statistical regularities or coincidences, must be universal. *See infra* Part II.B (discussing this counterargument with respect to probabilism).

170. *See, e.g.*, John Beatty, *The Evolutionary Contingency Thesis*, *in* CONCEPTS, THEORIES, AND RATIONALITY IN THE BIOLOGICAL SCIENCES 45, 46–47 (Gereon Wolters et al. eds., 1995); J.J.C. SMART, PHILOSOPHY AND SCIENTIFIC REALISM 59–61 (1963).

171. PAUL S. AGUTTER & DENYS N. WHEATLEY, ABOUT LIFE: CONCEPTS IN MODERN BIOLOGY 128 (2007) (paraphrasing Stephen Jay Gould).

172. Beatty, *supra* note 170, at 46.

173. *See* Ernst Mayr, *Cause and Effect in Biology*, 134 SCIENCE 1501, 1505 (1961) (discussing the "uniqueness" of biology).

174. *Id.*

175. *See* DUPRÉ, *supra* note 162, at 194 (discussing probabilism as "residual deterministic [i.e., causal and constant] thinking").

some natural systems become more complex, the "laws" that govern them, or the "phenomena" that explain them, must be increasingly couched in mathematical terms.[176] The *N*-body problem in physics perhaps serves as the best example. The "law of gravity" provides an equation for the gravitational force of one body, *N*, on another, depending on its mass and the distance between them.[177] The law is ideal when one body is fixed in space (an admittedly unrealistic situation) because each body will effect a gravitational pull on the other. As the number of bodies increases, however, the law begins to break down. Strange though it may seem, for a larger number of *N*s, i.e., the system becomes more complex, and the universal law of gravity becomes more embedded in statistical probability than mathematical certainty.[178]

In other instances, the probabilistic conclusions of experiments in naturally complex systems are regarded as "laws" or "phenomena" themselves.[179] Epidemiology—the study of "the health of a population . . . as a complex adaptive system"—must contend with a countless number, variety, and interdependency of factors: "history, culture, . . . socioeconomic structures," environment, ecosystems, and others.[180] And whatever conclusions can be drawn from such research are often bound in the language of statistics, e.g., confidence intervals, *p*-values, and Mantel–Haenszel odds ratios.[181] Yet, such conclusions are often conceived of as embodying the causalities of a system, i.e., as "laws" or "phenomena" themselves, rather than mathematical observations.[182] This leap, from mathematical observation to explanation of reality, suffers from what

176. *See id.* at 184 ("[O]ur most successful scientific theories describe a probabilistic rather than a deterministic world."). *See generally* 2 THE PROBABILISTIC REVOLUTION: IDEAS IN THE SCIENCES (Lorenz Krüger et al. eds., 1990) (discussing the increase in probabilism in psychology, sociology, economics, physiology, evolutionary biology, and physics).

177. *See supra* note 167 and accompanying text.

178. *See generally* PATRICK SUPPES, PROBABILISTIC METAPHYSICS 125–30 (1984) (discussing the history and implications of the *N*-body problem).

179. *But see* CARTWRIGHT, *supra* note 122, at 154 (describing and rejecting this approach); CARTWRIGHT, *supra* note 160, at 111–12 (same).

180. Neil Pearce & Franco Merletti, *Complexity, Simplicity, and Epidemiology*, 35 INT'L J. EPIDEMIOLOGY 515, 516–17 (2006).

181. Sandro Galea et al., *Causal Thinking and Complex System Approaches in Epidemiology*, 39 INT'L J. EPIDEMIOLOGY 97, 101 (2010) ("Epidemiological methods, frequently married with biostatistical techniques and approaches, continue to dwell, almost entirely, on the analysis of data that are collected through epidemiological studies and the application of various statistical techniques to document association present in the data collected.").

182. *See id.* at 100–01 ("Although epidemiological methods are predicated on population-based methods that should, in a perfect world, be used only for group-level inference, epidemiologists are nonetheless accustomed to thinking of our methods as providing insight into individual health and disease formation. The epidemiological concern with individual health and disease poses a substantial challenge to methods, such as complex systems dynamic models . . . .").

scientific philosopher Nancy Cartwright terms the "simulacrum account of explanation":

> I do not think these distributions are real. Statistical mechanics works in a massive number of highly differentiated and highly complex situations. In the vast majority of these it is incredible to think that there is a true probability distribution for that situation; and proofs that, for certain purposes, one distribution is as good as another, do not go any way to making it plausible that there is one at all. It is better, I think, to see these distributions as fictions . . . .[183]

Thus, terms like natural "laws" or "phenomena" in complex, probabilistic fields should have significantly less force: they are less "laws" or "phenomena" of *nature* than they are "laws" or "phenomena" of a statistical, "simulacrum account" of observations of nature.

Similarly, defining a "product" of nature is also often an exercise in probabilism, complicated by natural complexity. What scientists refer to as a "typical" human gene, for example, actually encompasses a wide variety of genetic sequences within the human population.[184] Determining the archetypal sequence of that gene, the "consensus sequence," is therefore very much a product of statistics, rather than the specific identification of a gene with the consensus sequence as it actually exists in nature.[185] Characterizing a particular genetic sequence as a "natural product" is consequently a two-step act of probabilism: using statistical methodology to determine a consensus sequence, and then using statistical methodology to subsequently determine whether the studied genetic sequence is similar enough to the consensus sequence to be considered equivalent. Even this, however, does not necessarily resolve the issue of whether a particular genetic sequence is a natural "product" because there are "a massive number of highly differentiated and highly complex" methods to compute similarity.[186] Recently, researchers' efforts to determine how much of the human genome was covered by patents claiming "an isolated DNA having at least 15 nucleotides" of a particular sequence erupted into a fiery debate over methodology.[187] This has all "led these biologists into a philosophical

183. CARTWRIGHT, *supra* note 122, at 154.

184. *See* Michele Cargill et al., *Characterization of Single-Nucleotide Polymorphisms in Coding Regions of Human Genes*, 22 NATURE GENETICS 231, 232–33 (1999) (measuring the diversity of polymorphisms in 106 human genes).

185. Thomas D. Schneider, *Consensus Sequence Zen*, 1 APPLIED BIOINFORMATICS 111, 111, 113 (2002).

186. *See* CARTWRIGHT, *supra* note 122, at 154.

187. *Compare* Jeffrey Rosenfeld & Christopher E. Mason, *Pervasive Sequence Patents Cover the Entire Human Genome*, 5 GENOME MED. 27 (2013) (claiming that randomized, 15 nucleotide DNA sequences cover approximately 41% of all human genes), *and* Christopher Mason, *Dr. Chris Mason Responds to Blog Posts on Genome Medicine Article—Updated*, PATENT DOCS (Apr. 10,

trap: confounding the model of reality (the consensus sequence) with reality."[188] Ultimately, if natural "laws," "phenomena," and "products" are "irreducibly probabilistic . . . . [They] may often be limited to distinguishing factors that influence the probability of the effect to be explained. . . . But that is the most to which we can legitimately aspire."[189]

C. *FUNDAMENTALISM*

As a general matter, natural "laws" and "phenomena" imply a sense of "fundamentalism": that is, whether a law or a phenomena is wholly irreducible, and therefore, "fundamental," or, rather, a construct of other irreducible laws.[190] Under this framework, the photon theory of light—that light is composed of smaller subunits, termed "photons"—is a "fundamental law" or a "phenomenon" because it cannot be reduced any further. The heat radiating properties of light, however, are not fundamental "laws" or "phenomena" in this sense because they are reducible: they can be explained by photon theory.[191] Light's propensity to heat a target is actually *photons*' propensity to heat a target. Under a fundamentalist interpretation, at least, natural "laws" and "phenomena" are only those observations that meet at "the point of convergence of all our arrows of explanation."[192]

Natural complexity, however, upends this distinction because, often, "[t]he behavior of large and complex aggregates of elementary particles, it turns out, is not to be understood in terms of a simple extrapolation of the properties of a few particles."[193] Rather, "at each level of complexity entirely new properties appear" that cannot be explained by simply reducing that

2013, 11:59 PM), http://perma.cc/7KEH-P64Y (same), *with* Donald Zuhn, *Genome Medicine Article Calls for Limits on Patenting of Existing Nucleotide Sequences*, PATENT DOCS (Apr. 2, 2013, 11:59 PM), http://perma.cc/5SSM-VG8U (criticizing the study's methodology and application to patent law), *and* Donald Zuhn, *Revisiting Genome Medicine Article on "Pervasive Sequence Patents" that "Cover the Entire Human Genome,"* PATENT DOCS (Apr. 8, 2013, 11:59 PM), http://perma.cc/H87W-TYPK (same), *and* Kevin E. Noonan, *A Response to Dr. Mason's "Rebuttal" to Criticisms of His Genomics Medicine Article*, PATENT DOCS (Apr. 11, 2013, 11:59 PM), http://perma.cc/K2UV-U7TT (same), *and* Donald Zuhn, *A Primer on Claim Construction—Comments on Dr. Mason's Response*, PATENT DOCS (Apr. 11, 2013, 11:55 PM), http://perma.cc/4MQT-EJ23 (same).

188. *See* Schneider, *supra* note 185, at 118.

189. DUPRÉ, *supra* note 162, at 184.

190. *See* WEINBERG, *supra* note 169, at 144–49 (discussing fundamentalism and explanatory power).

191. *See id.* at 20 ("We have an overwhelming sense that the photon theory of light is more fundamental than any statement about heat radiation and is therefore the explanation of the properties of heat radiation. And in the same way, although Newton derived his famous laws of motion in part from the earlier laws of Kepler that describe the motion of planets in the solar system, we say that Newton's laws explain Kepler's, not the other way around.").

192. *Id.* at 43; *accord* Philip W. Anderson, *Physics: The Opening to Complexity*, 92 PROC. NAT'L ACAD. SCI. U.S. 6653, 6653 (1995) ("[I]gnorance about these laws persists only on the extreme scales of the very small, the very cosmic, or the very weak and subtle.").

193. Anderson, *supra* note 20, at 393.

system to its component parts.[194] Understanding the molecular structure of water, for example, does little to explain why each snowflake forms its own unique crystalline pattern.[195] This principle of "emergence" has long been one of the defining features of complex systems.[196]

Emergence has several consequences for using the terms "laws," "phenomena," or "products" to describe naturally complex systems. First, emergence equalizes, across scientific fields, the existence of events arguably termed "laws" or "phenomena" because almost all scientific fields have irreducible, and therefore, fundamental properties. This counsels against a "hierarchy of sciences" where some sciences contain such "fundamental laws," while others are mere applications of them; emergence "does not imply that science X is 'just applied Y.'"[197] Therefore, if the laws or phenomena that govern elementary particle physics are only "natural laws" or "phenomena" because their behavior reduces to smaller component parts, then emergence suggests that the "laws" governing the social sciences are equally so because we have difficulty reducing concepts like rational choice, dichotomous balloting, or television's effect on violence.[198]

Second, emergent phenomena complicate distinguishing "natural products" from those that are the result of human intervention in naturally complex processes. The immune system, for example, produces antibodies, the workhorses of the immune system, in response to foreign macromolecules, or antigens.[199] Whether a synthetic vaccine actually confers immunity on a particular patient therefore depends on whether the immune system produces antibodies to the vaccine antigens. But such antibodies are "emergent entities that are defined by their specific antibody partners and exist only in the context of the immune system" unique to the individual in which they are produced.[200] This complicates the question of whether any particular antibody produced in response to human intervention—in this example, the administration of antigens—is a natural *product* rather than a *byproduct* of this synthetic utilization of emergent phenomena. Such antibodies exist only due to human activity, and yet are created independently from human control. The same could also be said of species

---

194. *Id.*

195. Bruce C. Gibb, *Reaching Out to Complexity*, 1 NATURE CHEMISTRY 252, 252 (2009) (describing snowflake formation through complexity and emergence).

196. R.B. Laughlin & David Pines, *The Theory of Everything*, 97 PROC. NAT'L ACAD. SCI. U.S. 28, 30 (2000) (discussing emergence).

197. Anderson, *supra* note 20, at 393.

198. William A. Gorton, *The Philosophy of Social Science*, INTERNET ENCYCLOPEDIA PHIL., http://perma.cc/5BC7-C6J4 (last visited Jan. 16, 2014).

199. *See* Holland, *supra* note 132, at 18–19.

200. Marc H.V. Van Regenmortel, *Reductionism and Complexity in Molecular Biology*, 5 EMBO REP. 1016, 1019 (2004).

altered by climate change or exotic particles from "atom-smasher" experiments.

Lastly, emergence suggests, in fact, that some "fundamental laws" or "phenomena" may not be fundamental after all—not because they are irreducible, but because they simply fail to govern emergent properties of their aggregates. That is, even "grant[ing] that a law is true—even a law of 'basic' physics or a law about the so-called 'fundamental particles'—is far from admitting that it is universal—that it holds everywhere and governs in all domains."[201] Some "phase transitions" in physical chemistry—the dividing lines between phases of matter, like liquids or solids—demonstrate this aphorism because they are subject to emergent properties that appear to directly oppose the "fundamental laws" governing their components. For example, certain iron-based magnets, cooled below certain temperatures, display magnetic direction even though the "fundamental laws" governing magnetism concerning their individual atoms in isolation would dictate otherwise.[202] This highlights the paradox of calling either of these properties fundamental "laws of nature." For, "if one thinks that laws are among the fundamental facts we hope to discover about the universe, such dependency will seem a serious embarrassment."[203]

III. THE EFFECTS OF NATURAL COMPLEXITY ON PATENT ELIGIBILITY

Natural complexity therefore confounds classical notions of natural "laws," "phenomena," and "products." It places significant cognitive difficulties on determining whether "laws" or "phenomena" are either constant or causal, as is traditionally required. It further muddies clear definitions of natural "laws," "phenomena," or "products" by tying such terms to probabilistic determinants. And it repudiates patent eligibility's natural terms' adherence to principles of fundamentalism.

Because the Supreme Court's historical reliance on such terms is tethered to a scientific understanding of them, the difficulties complexity imparts on patent eligibility's "natural" terms account for several of the doctrine's troubles. First, patent eligibility wrongly equates all claims directed to natural "laws," "phenomena," and "products," even though natural complexity shows that such terms encompass a wide variety of concepts. Second, the difficulties in defining such terms have led the Supreme Court to marginalize patent claim language. And third, the vagueness of what constitutes natural "laws," "phenomena," and "products" has had an impermissible technology-specific effect for molecular biology.

201. CARTWRIGHT, *supra* note 160, at 24.

202. Paul Humphreys, *Emergence, Not Supervenience*, 64 PHIL. SCI. S337, S344 (1997) (describing the spontaneous symmetry breaking of ferromagnets below Curie temperatures as an example of emergent phenomena).

203. DUPRÉ, *supra* note 162, at 206.

A. FALSE EQUIVALENCY

The current doctrine of patent eligibility falsely equates all "laws of nature," "natural phenomena," and "products of nature," irrespective of their individual content.[204] Any patent claim that encompasses one of these identities is rendered ineligible.[205] Thus, a court would treat a claim encompassing wide-ranging, almost universal natural "laws," such as mass-energy equivalence, identically to highly irreproducible and narrow data from clinical trials.[206] Over time, the Supreme Court has given several justifications for this equivalency: that treating all natural "laws," "phenomena," and "products" the same is cognitively simpler; that all such claims monopolize knowledge about the natural world—a normatively undesirable result; and that such patents, by way of stare decisis, are not "Discoveries" for the Constitution's purposes. Given that natural complexity complicates precise definitions of natural "laws," "phenomena," and "products," this calls for a critical re-examination of the Court's justifications.

First, the Court has expressly declined to draw distinctions among different natural "laws" or "phenomena" because, among other reasons, "[c]ourts and judges are not institutionally well suited to making the kinds of judgments needed to distinguish among different laws of nature,"[207] paralleling other areas of the Court's scientifically cautious jurisprudence.[208] According to the Court, this counsels in favor of "a bright-line prohibition against patenting laws of nature" because it "serves as a somewhat more easily administered proxy."[209] This is not atypical: other areas of patent law have long favored bright-line rules as proxies for cognitive simplicity.[210] But in the patent eligibility context, such favor glosses over the predicate

204. Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1303 (2012) ("[O]ur cases have not distinguished among different laws of nature according to whether or not the principles they embody are sufficiently narrow.").

205. Bilski v. Kappos, 130 S. Ct. 3218, 3225 (2010) ("The Court's precedents provide three specific exceptions to § 101's broad patent-eligibility principles: 'laws of nature, physical phenomena, and abstract ideas.'" (quoting Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980))).

206. *Mayo*, 132 S. Ct. at 1297 (comparing Einstein's famous equation, $E=mc^2$, to the conclusions derived from the clinical trial data at issue in the patent claims and holding the claim invalid); *see also* John P.A. Ioannidis, *Contradicted and Initially Stronger Effects in Highly Cited Clinical Research*, 294 JAMA 218, 218 (2005) (discussing the difficulties in reproducing and drawing definitive conclusions from most clinical trials).

207. *Mayo*, 132 S. Ct. at 1303.

208. *See, e.g.*, Gen. Elec. Co. v. Joiner, 522 U.S. 136, 148 (1997) (Breyer, J., concurring) ("[J]udges are not scientists and do not have the scientific training that can facilitate the making of [scientific] decisions. . . . [W]hen law and science intersect, those duties often must be exercised with special care.").

209. *Mayo*, 132 S. Ct. at 1303.

210. *See, e.g.*, Peter Lee, *Patent Law and the Two Cultures*, 120 YALE L.J. 2, 34–35 (2010) (discussing the use of a bright-line rule in the context of prosecution history estoppel).

question of whether it is cognitively simple to discern natural "laws," "phenomena," or "products" in the first instance—something that natural complexity suggests is not. Indeed, the difficulties with some of the traditional issues associated with natural "laws" and "phenomena"—constancy, causality, probabilism, and fundamentalism—even independent of natural complexity cast doubt on the Court's rationale that its refusal to distinguish among natural "laws" and "phenomena" is due to cognitive simplicity.[211]

Second, the Court has recently expressed its belief that allowing any patents encompassing natural "laws," "phenomena," or "products" "will inhibit future innovation premised upon them,"[212] by "preempt[ing] the use of a natural law" in research.[213] Thus, while "the underlying functional concern here is a *relative* one: how much future innovation is foreclosed relative to the contribution of the inventor," a "narrow law of nature . . . can [still] inhibit future research."[214] But if natural "laws" or "phenomena" have little inherent content or are not "laws" or "phenomena" in the traditional sense (as natural complexity would suggest), research preemption should be of significantly less concern. The natural "laws" at issue in *Mayo*, for example, concerned blood concentrations of drug metabolites as derived from clinical study data.[215] And the Court recognized that the "naturalness" of the gene sequences at issue in *Myriad* was a fiction: "[T]here is no 'typical' gene because nucleotide sequences vary between individuals, sometimes dramatically."[216] These putative "laws" suffer from the various complications natural complexity imposed: they were neither constant nor causal; they were based on probabilistic inference; and they were not "fundamental" in any sense of the word. In fact, the clinical data incorporated into the *Mayo* patents' specifications suggested that the "law" claimed in those patents

211. *See* Sichelman, *supra* note 9, at 10 ("This tension is exacerbated by current judicial and Patent Office practice, which—in order to keep the administrative costs of gatekeeping low—tend to draw bright lines to demarcate areas of patentable subject matter from non-patentable subject matter. These practices remove the flexibility that a more policy-driven approach requires, and introduces more than a modicum of arbitrariness in many cases. Of course, these concerns raise the specter of the old rules-standards debate—which are often difficult to answer without concerted empirical analysis—but in a legal field with rapid change, rigid rules often seem out of place.").

212. *Mayo*, 132 S. Ct. at 1301.

213. *Id.* at 1294.

214. *Id.* at 1303; *accord* Bilski v. Kappos, 130 S. Ct. 3218, 3231 (2010) (rejecting a "patent [on] risk hedging [because it] would pre-empt use of this approach in all fields, and would effectively grant a monopoly over an abstract idea"); Parker v. Flook, 437 U.S. 584, 589 (1978) (quoting Gottschalk v. Benson, 409 U.S. 63, 71–72 (1972)); *Benson*, 409 U.S. at 72 (concluding that the patent "would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself").

215. *Mayo*, 132 S. Ct. at 1295.

216. Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2112 n.1 (2013).

applied to *less than half* of patients.[217] This would presumably leave researchers free to challenge the veracity of the "law" in a variety of contexts, or make practical use of it for those situations falling outside of the specifications' clinical data, rather than meaningfully preempting research in any way. True concerns about preemption, therefore, counsel in favor of making individualized determinations about the exclusionary scope of natural "laws," "phenomena," and "products" rather than the Court's current per se exclusionary rule.[218]

And third, the Court suggests that stare decisis compels it to forbid all claims concerning natural "laws," "phenomena," and "products" because its "cases have not distinguished among different laws of nature according to whether or not the principles they embody are sufficiently narrow."[219] But, in other areas, the Court has acknowledged that stare decisis carries less force if "facts have so changed, or come to be seen so differently, as to have robbed the old rule of significant application or justification."[220] The relatively recent scientific and philosophical recognition of natural complexity, and its effect on terms like natural "laws," "phenomena," and "products," seem like precisely the sort of facts, seen so differently, as to rob older conceptions of patent eligibility's "natural" terms of their reasonable application. When patent eligibility concerned itself with "principles" and "abstractions," a uniform exclusionary rule may have had its justifications. But given natural complexity's effect on these terms, the Court's own jurisprudence on stare decisis favors abandoning its reliance on past uniformity.

B. Marginalization of Claim Language

Because "all inventions at some level embody, use, reflect, rest upon, or apply laws of nature, [or] natural phenomena,"[221] the Supreme Court has repeatedly made clear that claims are not patent ineligible simply if they

---

217. *See* U.S. Patent No. 6,355,623 B2 col. 17 ll. 10–22 (filed Apr. 8, 1999) (tabulating the claimed dosage ranges only for patients that initially responded to drug therapy and had a drug metabolism that fell within specified ranges—45 out of 107 subjects).

218. *See* Strandburg, *supra* note 3, at 587–91 (criticizing per se exclusion in patentable subject matter's preemption rationale).

219. *Mayo*, 132 S. Ct. at 1303; *accord Bilski*, 130 S. Ct. at 3225 ("[T]hese exceptions have defined the reach of the statute as a matter of statutory *stare decisis* going back 150 years. . . . [as] 'part of the storehouse of knowledge of all men . . . free to all men and reserved exclusively to none.'" (second ellipses in original) (quoting Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948))).

220. Planned Parenthood of Se. Pa. v. Casey, 505 U.S. 833, 855 (1992) (citing Burnet v. Coronado Oil & Gas Co., 285 U.S. 393, 412 (1932) (Brandeis, J., dissenting)); *accord* Am. Trucking Ass'ns, Inc. v. Scheiner, 483 U.S. 266, 302 (1987) (O'Connor, J., dissenting) ("Significantly changed circumstances can make an older rule, defensible when formulated, inappropriate . . . .").

221. *Mayo*, 132 S. Ct. at 1293.

contain natural "laws" or "phenomena."[222] Rather, the doctrine of patent eligibility only excludes claims that *encompass* natural "laws" or "phenomena," or "simply state the law of nature while adding the words 'apply it.'"[223] In drawing this distinction, a patent's claim language—the precise verbiage used in a patent's claims—has long been thought to be "of primary importance"[224] because claim language does not simply describe the invention, but "define[s] and circumscribe[s]" the invention itself.[225] Natural complexity, however, makes defining what a natural "law" or "phenomena" *is* in the first instance increasingly difficult. As a result, the Court has had trouble parsing claim language into separate "elements"[226] to determine whether claims read on natural "laws" or "phenomena" themselves or whether they simply "use, reflect, rest upon, or apply" those "laws" or "phenomena."[227]

In response to its troubles parsing claim language, the Court has marginalized, and in some cases, entirely discounted, the importance of claim language precision. It has, instead, adopted a variety of proxies to ascertain whether "the invention" reads on natural "laws," "phenomena," or "products"—even though there is no concept of "the invention" apart from

222. *Id.* ("[A] process is not unpatentable simply because it contains a law of nature or a mathematical algorithm." (quoting Diamond v. Diehr, 450 U.S. 175, 187 (1981)) (internal quotation marks omitted)).

223. *Id.* at 1294 (citing Gottschalk v. Benson, 409 U.S. 63, 71–72 (1972)).

224. Merrill v. Yeomans, 94 U.S. 568, 570 (1876); *see also Mayo*, 132 S. Ct. at 1294 ("Our conclusion rests upon an examination of the particular claims before us in light of the Court's precedents.").

225. Ariad Pharm., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1347 (Fed. Cir. 2010) ("Claims define the subject matter that, after examination, has been found to meet the statutory requirements for a patent. Their principal function, therefore, is to provide notice of the boundaries of the right to exclude and to define limits; it is not to describe the invention, although their original language contributes to the description and in certain cases satisfies it. Claims define and circumscribe, the written description discloses and teaches." (citation omitted)). *But see* Oskar Liivak, *Rescuing the Invention from the Cult of the Claim*, 42 SETON HALL L. REV. 1, 7–8 (2012) (rejecting this view on historical grounds as a "cult").

226. *See* Perkin–Elmer Corp. v. Westinghouse Elec. Corp., 822 F.2d 1528, 1533 n.9 (Fed. Cir. 1987) ("Because claims are composed of a number of limitations, the limitations have on occasion been referred to as 'claim elements' or 'elements of the claim' . . . .").

227. *Mayo*, 132 S. Ct. at 1293; *see also id.* at 1294 ("[A] process that focuses upon the use of a natural law [must] also contain other elements or a combination of elements, sometimes referred to as an 'inventive concept,' sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the natural law itself." (quoting Parker v. Flook, 437 U.S. 584, 594 (1978))); Bilski v. Kappos, 130 S. Ct. 3218, 3230 (2010) ("*Diehr* emphasized the need to consider the invention as a whole, rather than 'dissect[ing] the claims into old and new elements and then . . . ignor[ing] the presence of the old elements in the analysis.'" (alterations in original) (quoting *Diehr*, 450 U.S. at 188)); *Flook*, 437 U.S. at 590 n.12 ("[T]he Court [has] upheld a patent on an improvement on a papermaking machine that made use of the law of gravity to enhance the flow of the product. The patentee, of course, did not claim to have discovered the force of gravity, but that force was an element in his novel conception.").

the patent's claims.[228] Notably, as in *Diehr*, the Court resorted to reading the claims "as a whole."[229] Where the claims, "as a whole," were directed to "a function which the patent laws were designed to protect," the application is eligible.[230] Where, "as a whole," they are not, "a competent draftsman [could] evade the recognized limitations on the type of subject matter eligible for patent protection."[231]

Similarly, in *Mayo*, the Court repeatedly referred to the "inventive concept" of the patent independent of the patent's precise claim language.[232] This allowed the Court to elide over the precise claim language at issue by turning patent eligibility into a quantitative rather than qualitative inquiry: "[D]o the patent claims add *enough* to their statements of the correlations to allow the processes they describe to qualify as patent-eligible processes that *apply* natural laws?"[233] In the Court's words, patent claims making use of "laws of nature" are not patent eligible "unless that process has additional features that provide practical assurance that the process is

---

228. *See* Aro Mfg. Co. v. Convertible Top Replacement Co., 365 U.S. 336, 344–45 (1961) ("[It is a] basic fallacy . . . [to] require[ ] the ascribing to one element of the patented combination the status of patented invention in itself. . . . [T]his Court has made it clear . . . that there is no legally recognizable or protected 'essential' element, 'gist' or 'heart' of the invention . . . ."); Retractable Techs., Inc. v. Becton, Dickinson & Co., 659 F.3d 1369, 1372 (Fed. Cir. 2011) (Moore, J., dissenting) ("The error in *Retractable* is the majority's attempt to rewrite the claims to better conform to what it discerns is the 'invention' of the patent instead of construing the language of the claim."); Computer Docking Station Corp. v. Dell, Inc., 519 F.3d 1366, 1373 (Fed. Cir. 2008) ("The *words* of the claims define the scope of the patented invention." (emphasis added) (citing Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582 (Fed. Cir. 1996))); Vas–Cath Inc. v. Mahurkar, 935 F.2d 1555, 1565 (Fed. Cir. 1991) ("We find the district court's concern with 'what the invention is' misplaced . . . . 'The invention' is defined by the claims on appeal.").

229. *See Diehr*, 450 U.S. at 187 ("[I]f the computer use incorporated in the process patent significantly lessens the possibility of 'overcuring' or 'undercuring,' the process *as a whole* does not thereby become unpatentable subject matter." (emphasis added)); *id.* at 188 ("In determining the eligibility of respondents' claimed process for patent protection under § 101, their claims must be considered *as a whole*." (emphasis added)); *id.* at 192 ("On the other hand, when a claim containing a mathematical formula implements or applies that formula in a structure or process which, when considered *as a whole*, is performing a function which the patent laws were designed to protect . . . then the claim satisfies the requirements of § 101." (emphasis added)); *id.* at 193 n.15 ("The fact that one or more of the steps in respondents' process may not, in isolation, be novel or independently eligible for patent protection is irrelevant to the question of whether the claims *as a whole* recite subject matter *eligible* for patent protection under § 101." (first emphasis added)).

230. *Id.* at 192.

231. *Id.*

232. *Mayo*, 132 S. Ct. at 1294 ("[A] process that focuses upon the use of a natural law [must] also contain other elements or a combination of elements, sometimes referred to as an '*inventive concept*,' sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the natural law itself." (emphasis added) (quoting *Flook*, 437 U.S. at 594)); *id.* at 1299 ("[P]utting the formula to the side [in *Flook*] there was no '*inventive concept*' in the claimed application of the formula." (emphasis added) (quoting *Flook*, 437 U.S. at 594)).

233. *Id.* at 1297.

more than a drafting effort designed to monopolize the law of nature itself."[234]

In other instances, the Court has simply belittled the significance of claim language. In *Flook*, for example, the Court criticized the use of claim language in the eligibility determinations as "the draftsman's art [that] would ill serve the principles underlying the prohibition against patents for 'ideas' or phenomena of nature."[235] "A competent draftsman could attach some form of post-solution activity to almost any mathematical formula," the Court declared.[236] The Court has since repeated this "draftsman" epithet in almost every one of its patent eligibility cases.[237]

The Court's decision in *Myriad* may initially appear as an exception to its diminishment of claim language.[238] In invalidating Myriad's composition claims directed to molecules of DNA, the Court noted that "Myriad's claims are simply not expressed in terms of chemical composition, nor do they rely in any way on the chemical changes that result from the isolation of a particular section of DNA. Instead, the claims understandably focus on the genetic information encoded in the BRCA1 and BRCA2 genes."[239] But this brief allusion to claim language factored little in the Court's decision separating isolated genomic DNA from cDNA. Indeed, the actual claim language for both classes of DNA was remarkably similar: both expressed themselves as limited to an "isolated DNA."[240] The Court's effort in *Myriad* does less to parse claim language as the determinant of patent eligibility than it uses claim language as a cover to decide what is and is not "natural."

Ultimately, this denigration of claim language has made claim drafting increasingly problematic.[241] Without guidance as to what constitutes a natural "law," "phenomena," or "product," patent practitioners have few

234. *Id.*

235. *Flook*, 437 U.S. at 593.

236. *Id.* at 590.

237. *E.g.*, *Mayo*, 132 S. Ct. at 1294 ("[C]ases warn us against interpreting patent statutes in ways that make patent eligibility 'depend simply on the draftsman's art' without reference to the 'principles underlying the prohibition against patents for [natural laws].'" (alteration in original) (quoting *Flook*, 437 U.S. at 593)); Lab. Corp. of Am. Holdings v. Metabolite Labs., Inc., 548 U.S. 124, 137 (2006) (Breyer, J., dissenting) ("[*Diehr*] warn[s] against 'allow[ing] a competent draftsman to evade the recognized limitations on the type of subject matter eligible for patent protection.'" (third alteration in original) (quoting Diamond v. Diehr, 450 U.S. 175, 192 (1981))).

238. *See* Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2118 (2013).

239. *Id.*

240. *See id.* at 2113.

241. *See* Rebecca S. Eisenberg, *Re-Examining the Role of Patents in Appropriating the Value of DNA Sequences*, 49 EMORY L.J. 783, 785 (2000) ("The standard patent lawyer's response to the 'products of nature' limitation is to treat it as a technical, claim-drafting problem.").

ways to assess whether a claim element constitutes one.[242] And even with such guidance, patent practitioners are left with "no definitive answer on what additional elements/steps would be sufficient to ensure that a natural phenomena would have a practical application that would be patentable."[243] Patent practitioners must therefore cope with a field where "esoteric terms of art are simply indispensable" but where "the inherent complexity of technology, the limitations of language, and the doctrinal standard for evaluating patents" provide little concrete measure as to how to assess such terms for eligibility.[244] Now, "[t]he diversity and dizzying complexity of contemporary innovation, the broader reach of patentable subject matter, and the brisker pace of technological advancement render prescient claim drafting an ideal far more difficult to achieve today."[245]

C. Technology-Specific Effects

Patent law has long prided itself on being "technology-neutral"; it generally does not set different rules for inventions in different areas of technology.[246] Relatively few legal doctrines turn on the class of technology sought to be patented, and even fewer statutory provisions distinguish among technologies.[247] The Federal Circuit has noted that this "accords the same treatment to all forms of invention."[248] This principle of technological neutrality is further embodied in the watershed international agreement on patents, the Agreement on Trade-Related Aspects of Intellectual Property Rights ("TRIPS").[249] Article 27(1) of TRIPS requires signatories to confirm that "patents shall be available for any inventions, whether products or

242. *See* 1 DONALD S. CHISUM, CHISUM ON PATENTS § 1.03[2][f][ix] (2013) ("The three determinations for implementing [*Mayo*] are as follows. First, one determines whether a claim is drawn to a law of nature, natural phenomena, or abstract idea. . . . The first weak point is the Court's failure to define what constitutes a 'law of nature.' The absence of a definition is reflected in the Court's rather summary determination that the claims at issue did involve such a 'law of nature.'").

243. 2 JOHN GLADSTONE MILLS III ET AL., PATENT LAW FUNDAMENTALS § 7:4.50 (2d ed. 2013).

244. Lee, *supra* note 210, at 19–20.

245. John R. Thomas, *Claim Re-Construction: The Doctrine of Equivalents in the Post-*Markman *Era*, 9 LEWIS & CLARK L. REV. 153, 166 (2005).

246. *But see* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1675–95 (2003) (arguing that, normatively, courts should use "policy levers" to adopt technological specificity in some fields of art).

247. *See* Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology-Specific?*, 17 BERKELEY TECH. L.J. 1155, 1156 (2002) ("Patent law has a general set of legal rules to govern the validity and infringement of patents in a wide variety of technologies. With very few exceptions, the statute does not distinguish between different technologies in setting and applying legal standards.").

248. Eolas Techs. Inc. v. Microsoft Corp., 399 F.3d 1325, 1339 (Fed. Cir. 2005).

249. Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299; *see also* Uruguay Round Agreements Act, Pub. L. No. 103-465, 108 Stat. 4809 (1994).

processes, in all fields of technology."[250] Ideally, the normative purpose of the rule is forward-looking: it ensures that patent eligibility can "adapt flexibly to new technologies," without waiting for the laborious legislative process to unwind itself each time a pioneering technology seeks patent protection.[251] In this sense, U.S. patent law is "a unified patent system that provides technology-neutral protection to all kinds of technologies."[252]

Technologically-neutral language, however, can have technologically specific application.[253] Although the difficulties natural complexity imparts on patent eligibility's "natural" terms would appear to apply across multiple fields, the Court has, in practice, only applied them in the biotechnology context. Indeed, *every* Supreme Court decision to substantively address arguments that a patent claimed a "law of nature" or a "natural phenomena" (as opposed to an "abstract idea") has concerned patents in the biotechnology space. *Funk Brothers* concerned the patenting of bacterial inoculants;[254] *Chakrabarty*, recombinant bacteria;[255] *Mayo*, medical diagnostic tests;[256] and *Myriad*, human genes.[257] Even *Laboratory Corp.*—a dissent from a dismissal of an improperly granted writ—concerned biotechnology.[258] This biotechnology-specific effect has also been generally true of the Federal Circuit and its predecessor court, the U.S. Court of Customs and Patent Appeals.[259] Exceptions have been rare.[260]

250. Agreement on Trade-Related Aspects of Intellectual Property Rights, *supra* note 249, art. 27(1), at 331.

251. Burk & Lemley, *supra* note 247, at 1156; *id.* at 1158 ("Congress cannot enact a new form of intellectual property statute each time a new technology arises.").

252. *Id.* at 1156.

253. *See generally id.* (documenting how courts apply the nonobviousness standard differently between biotechnology and software patents).

254. Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 129 (1948).

255. Diamond v. Chakrabarty, 447 U.S. 303, 305 (1980).

256. Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1291 (2012).

257. Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2111 (2013).

258. Lab. Corp. of Am. Holdings v. Metabolite Labs., Inc., 548 U.S. 124, 125 (2006) (Breyer, J. dissenting) (concerning medical diagnostic tests).

259. *E.g.*, PerkinElmer, Inc. v. Intema Ltd., 496 Fed. App'x 65, 66 (Fed. Cir. 2012) (screening for Down's syndrome); Classen Immunotherapies, Inc. v. Biogen IDEC, 659 F.3d 1057, 1059 (Fed. Cir. 2011) (immunization schedule for chronic immune-mediated disorders); Pioneer Hi-Bred Int'l, Inc. v. J.E.M. Ag Supply, Inc., 200 F.3d 1374, 1375 (Fed. Cir. 2000) (seeds for hybrid corn), *aff'd*, 534 U.S. 124 (2001); Application of Bergy, 596 F.2d 952, 969 (C.C.P.A. 1979) (bacteria), *vacated in part sub nom.* Diamond v. Chakrabarty, 444 U.S. 1028 (1980); Application of Kirk, 376 F.2d 936, 939 (C.C.P.A. 1967) (hormones); *see also* Animal Legal Defense Fund v. Quigg, 932 F.2d 920, 922–23 (Fed. Cir. 1991) (addressing whether PTO's "interpretative rule" that "nonnaturally occurring non-human multicellular living organisms, including animals, to be patentable subject matter" under §101, fell under the Administrative Procedure Act).

260. There appears to have been only three cases where the Federal Circuit or its predecessor court has described a property of a patented invention as a "law of nature" or "natural phenomena" outside of the biotechnology context. EMI Grp. N. Am., Inc. v. Cypress

Meanwhile, patents in other technologies have avoided being labeled as "laws of nature," "natural phenomena," or "products of nature." Questions concerning the patent eligibility of mathematical algorithms—even those describing aspects of the natural world—have been shunted to "abstract ideas." *Diehr*, for example, turned on whether the industrial application of the Arrhenius equation—the influence of temperature on the rate of chemical reactions—was too *abstract* to be patented, rather than whether it encompassed, and wholly preempted, a "law of nature" or a "natural phenomenon."[261] Similarly, chemical-process patents have largely evaded scrutiny under patent eligibility's "natural" terms since the Supreme Court's 1966 decision in *Brenner v. Manson*, allowing such patents to go forward as long as the patentee could identify the chemical compound's specific utility.[262] This despite the fact that chemical process patents are largely directed to sequential series of chemical reactions—reactions that, like the technology in *Mayo*, simply take advantage of telling a reader to make use of natural regularities in step-wise fashion.[263] Even nanotechnology, a field that largely takes advantage of rare but often naturally occurring materials' inherent properties, has thus far escaped scrutiny as potentially ineligible subject matter.[264]

This difference in how patent eligibility is applied to biotechnology is not because these technologies do not raise the same concerns as those in the biological context. The dangers in patenting the Arrhenius equation, for example—that the patent's claims will likely be too broad relative to their disclosure,[265] that doing so would inhibit further research in the equation's area of science,[266] and that it would monopolize a "part of the storehouse of

Semiconductor Corp., 268 F.3d 1342, 1351 (Fed. Cir. 2001) (describing a "vapor-induced fuse explosion mechanism" as an inherent "law of nature"); *In re* Bonczyk, 10 F. App'x 908, 911 (Fed. Cir. 2001) (calling "energy" a "natural phenomenon"); *In re* Arnold, 185 F.2d 686, 691 (C.C.P.A. 1950) (characterizing the ideal frequency used in electrostatic fusion as a "phenomenon of nature").

261. Diamond v. Diehr, 450 U.S. 175, 188 (1981); *see* Laidler, *supra* note 125, at 494 (describing the Arrhenius equation).

262. Brenner v. Manson, 383 U.S. 519, 534–36 (1966).

263. *Cf.* Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1298 (2012) ("For these reasons we believe that the steps are not sufficient to transform unpatentable natural correlations into patentable applications of those regularities.").

264. *See* Mark A. Lemley, *Patenting Nanotechnology*, 58 STAN. L. REV. 601, 613–14 (2005) (describing nanotechnology patents and stating that there is "no question about patentable subject matter"); *see also* U.S. Patent No. 6,689,674 B2 (filed May 7, 2002) (claiming a method for fabricating nanotubes by using a nanoparticle catalyst to assemble itself on a matrix).

265. *Cf.* Lemley et al., *supra* note 3, at 1317 (equating patent law's prohibition on "abstract ideas" to a concern with preventing overbroad claims).

266. *Cf. Mayo*, 132 S. Ct. at 1294 ("At the same time, upholding the patents would risk disproportionately tying up the use of the underlying natural laws, inhibiting their use in the making of further discoveries.").

knowledge of all men,"[267]—parallel those raised in *Funk Brothers*, *Mayo*, and *Myriad*. Nor does this biotechnology-specific effect mean that nonbiological inventions are any less "natural" in principle. It is also surely not because nonbiological inventions are somehow less affected by natural complexity than their biological counterparts.[268] Rather, it simply seems that courts have had more difficulty struggling with patent eligibility's "vague and malleable terms infected with too much ambiguity and equivocation"[269] in some scientific contexts rather than others.

IV. Simplifying Patent Eligibility

A. *Patent Eligibility's Complexity*

Despite the problems natural complexity poses for using patent eligibility's "natural" terms, the Supreme Court seems to be obstinate in using them. And recent opportunities for the Court to provide a legalistic framework to patent eligibility, such as *Bilski*, *Mayo*, and *Myriad*, have done little more than promote the doctrine's "subjective and empty words."[270] Scholars' proposals to provide workarounds to using the terms have gained, unfortunately, little traction.[271] And Congress, even in its most recent overhaul of the patent statute—the most significant in sixty years—has abdicated responsibility.[272] Any realistic solution to the riddle of patent eligibility's "natural" terms must take these limits into account. Calls to reform patent eligibility by eliminating or circumventing the doctrine or calls asking for Congress or the Patent and Trademark Office ("PTO") to step in have failed before; there is good reason to believe they will fail

267. *Cf.* Bilski v. Kappos, 130 S. Ct. 3218, 3225 (2010) (quoting Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948)) (internal quotation marks omitted).

268. *But see* Burk & Lemley, *supra* note 246, at 1676 ("Biotechnology products arise out of living systems and are typically intended to interact with other human or nonhuman living systems. Such interactions, whether physiological or ecological, are enormously complex and the systems involved are poorly characterized.").

269. *Funk Bros.*, 333 U.S. at 135 (Frankfurter, J., concurring).

270. CLS Bank Int'l v. Alice Corp. Pty., 717 F.3d 1269, 1335 (Fed. Cir. 2013) (Rader, C.J., additional reflections) ("I enjoy good writing and a good mystery, but I doubt that innovation is promoted when subjective and empty words like 'contribution' or 'inventiveness' are offered up by the courts to determine investment, resource allocation, and business decisions."), *cert. granted*, 82 U.S.L.W. 3131 (Dec. 6, 2013) (No. 13–298).

271. *See, e.g.*, Chiang, *supra* note 3 (not cited by any cases); Crouch & Merges, *supra* note 3 (cited by *CLS Bank*, although not followed); Eisenberg, *supra* note 3 (cited by *Mayo*, although not followed); Golden, *supra* note 3 (not cited by any cases); Kane, *supra* note 3 (not cited by any cases); Risch, *supra* note 3 (explicitly rejected by *Mayo*); Strandburg, *supra* note 3 (not cited by any cases). *But see* Lemley et al., *supra* note 3 (cited by *Mayo*, 132 S. Ct. at 1301–02, for the proposition that the doctrine of patent eligibility concerns whether the invention "forecloses more future invention than the underlying discovery could reasonably justify").

272. *See* Leahy–Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (failing to amend § 101).

again.[273] But, as this Article seeks to demonstrate, any attempt to provide more concrete definitions to patent eligibility's "natural" terms is also bound to fail. "Natural laws," "phenomena," and "products" are, at this point, too bound up in confusing and contradictory Supreme Court precedent, and too infected with the vagaries of natural complexity, to be clearly resolved.

In this way, and like the science it attempts to assess, the doctrine of patent eligibility has itself "complexified." Relative to its predecessor 150 years ago, patent eligibility must now concern itself with more elements: more technologies, more patents, more claims, and more precedent.[274] These elements have also increased in variety: more diverse technologies, more types of patents, more classes of claims, and more administrative procedures to challenge them.[275] And the number of interrelationships between these elements has similarly increased.[276]

This recognition that patent eligibility is, itself, complex provides an important foundation for reform. Indeed, this suggests that patent eligibility would tend to benefit from other successful approaches "involve[d in] the consideration of a most complexly organized whole."[277] Like traditional legal analyses, scientific approaches to natural complexity have long relied upon methods of "collection, description, classification, and the observation of concurrent and apparently correlated effects."[278] And, like the law, science has called upon several familiar legal tropes to accomplish its tasks: "weighing evidence; . . . deciding what is relevant and what is not; . . . [and] finding, interpreting, and facing facts."[279] Borrowing science's strategies to accomplish its goals may therefore be useful strategies for patent eligibility.

---

273. *See, e.g.*, Diamond v. Chakrabarty, 447 U.S. 303, 317 (1980) ("The choice [on patentable subject matter] we are urged to make is a matter of high policy for resolution within the legislative process after the kind of investigation, examination, and study that legislative bodies can provide and courts cannot. . . . Whatever their validity, the contentions now pressed on us should be addressed to the political branches of the Government, the Congress and the Executive, and not to the courts."); Crouch & Merges, *supra* note 3, at 1683–91 (asking courts to address patent eligibility last in an effort to avoid difficult eligibility determinations); Golden, *supra* note 3, at 1041 ("[T]he enterprise of regulating patentable subject matter should be primarily entrusted to the USPTO, rather than, as it is now, to the courts."); Risch, *supra* note 3, at 598–609 (advocating for the elimination of patent eligibility by using other areas of the patent statute).

To be clear: this is not to say that these proposals were not good, or that they would not have worked had they been implemented. This is only to say that these proposals have little chance of actually being adopted.

274. *See* Josh Lerner, *150 Years of Patent Office Practice*, 7 AM. L. & ECON. REV. 112 (2005); Josh Lerner, *150 Years of Patent Protection*, 92 AM. ECON. REV. 221 (2002).

275. *See* sources cited *supra* note 274.

276. *See* Allison & Lemley, *supra* note 24, at 104–25 (describing, empirically, the interrelationships among these characteristics).

277. Weaver, *supra* note 17, at 536.

278. *Id.* at 536–37.

279. *Id.* at 542.

B. DECOMPOSITION AND LOCALIZATION AS STRATEGIES FOR NATURAL COMPLEXITY

In the sciences, the problem of describing complex interactions is often solved through the twin processes of "decomposition and localization."[280] Decomposition concerns breaking down a complex system into subparts—"the subdivision of the explanatory task so that the task becomes manageable and the system intelligible."[281] In physics, for example, this may concern decomposing a particular phenomenon into subatomic particles.[282] Neurobiologists often decompose the brain into separate neural structures.[283] And, in molecular biology, decomposition concerns breaking down physiology into cells, proteins, or genes.[284] Decomposition is the strategy of "divide and conquer."

Localization concerns identifying the function or functions of each subpart; "the identification of the different activities proposed in a task decomposition with the behavior or capacities of specific components."[285] That is, it attempts to "localize" one or more properties of the complex system to the behavior of one or more subparts. In neurobiology, for example, a portion of the left frontal cortex is responsible for producing speech, although not responsible for comprehending it.[286] Localization is, essentially, mapping a *function* of a system to one of its components. Together, decomposition and localization allow one to develop a "mechanistic" explanation of a complex system.[287]

Harnessing decomposition and localization as strategies in simplifying complex problems first requires an understanding of where to begin. To that end, "[b]efore it is possible, or even relevant, to develop a fully mechanistic explanation of *how* a system performs some function . . . it is necessary to identify *what* functions are performed and *what* system performs these functions."[288] This can be termed "isolating the locus of control."[289] In

---

280. *See generally* BECHTEL & RICHARDSON, *supra* note 25 (describing decomposition and localization in scientific practice).

281. *Id.* at 23.

282. William Bechtel, *Reducing Psychology While Maintaining Its Autonomy via Mechanistic Explanations*, *in* THE MATTER OF THE MIND: PHILOSOPHICAL ESSAYS ON PSYCHOLOGY, NEUROSCIENCE, AND REDUCTION 172, 178 (Maurice Schouten & Huib Looren de Jong eds., 2007) (describing decomposition in physics).

283. Tadeusz Zawidzki & William Bechtel, *Gall's Legacy Revisited: Decomposition and Localization in Cognitive Neuroscience*, *in* THE MIND AS A SCIENTIFIC OBJECT: BETWEEN BRAIN AND CULTURE 293, 293 (Christina E. Erneling & David Martel Johnson eds., 2005).

284. Fred C. Boogerd et al., *Mechanistic Explanations and Models in Molecular Systems Biology*, 18 FOUND. SCI. 725 (2013).

285. BECHTEL & RICHARDSON, *supra* note 25, at 24.

286. *See* Zawidzki & Bechtel, *supra* note 283, at 298–99 (discussing localization in the context of Broca's and Wernicke's areas).

287. BECHTEL & RICHARDSON, *supra* note 25, at 17–23.

288. *Id.* at 35.

289. *Id.* (emphasis omitted).

some instances, "[f]inding the right system is often difficult."[290] But in others, "nature seems to divide naturally into systems."[291] As such, identifying the locus of control of any particular system is, often, a dynamic product of trial and error.[292]

The question, "How does a car move?" serves as a good example of decomposition and localization in practice. As an initial matter, one should recognize that the question is deceptively complex. The internal combustion engine is not famous for being simple.[293] Aside from the complexity of the engine, moving from point *A* to point *B* is contingent on many variable, interdependent parts: the wheels, the engine, the drivetrain, the gasoline, and, of course, the driver. All must be present and all must act in concert for the car to move at all. Nonetheless, in asking *how* the car physically moves, we can begin by isolating the locus of control by separating the system into car and driver. Here, the system that is moving is the car itself, rather than the driver, alone. (The driver is surely responsible for starting and operating the car, but it is the car that moves the driver, not the other way around.) Once this is identified, we can decompose the car into various components—the engine, the drivetrain, and the wheels, for instance. We can then localize each component to a particular function of the system: the engine is powered by gasoline and powers the drivetrain, the drivetrain powers the wheels, and so on. And from there, we can generalize these functions to a mechanistic description of the car's movement: it converts the chemical energy of the gasoline into mechanical energy that moves the wheels.[294]

To be sure, decomposition and localization as strategies for simplifying complex phenomena has its limits. The appearance of emergent properties of complex systems—the behavior of which does not appear to be controlled by any particular mechanism of the individual, underlying components—makes decomposition and localization particularly difficult.[295] For truly emergent phenomena, where "the parts do not seem to be performing intelligible subtasks contributing to the overall task . . . decomposition and localization . . . fall short."[296] Similarly, where the functions of a system solely

290. *Id.* at 39.

291. *Id.*

292. *See id.* at 40 ("In most domains of inquiry, such recognition evolves with time and research as scientists develop conceptual frameworks to determine a particular way of decomposing nature into systems.").

293. *See* 2 CHARLES FAYETTE TAYLOR, THE INTERNAL-COMBUSTION ENGINE IN THEORY AND PRACTICE: COMBUSTION, FUELS, MATERIALS, DESIGN 423 (rev. ed. 1985) ("The subject of detail design of a machine so complex as an engine would require much more space than is available here and could easily fill several volumes if covered in a thorough manner.").

294. *See* BECHTEL & RICHARDSON, *supra* note 25, at 39 (giving a car as an example of decomposition and localization).

295. *Id.* at 202–03.

296. *Id.* at 203.

depend on the connections between elements, rather than any individual properties of its separate components, we should be counseled to "abandon[] decomposition and localization."[297] Nonetheless, decomposition and localization have historically solved a broad variety of complex scientific problems, including those in cellular respiration,[298] fermentation,[299] and biochemical genetics.[300] Even if decomposition and localization fail in simplifying mechanistic explanations to complex phenomena, "they may serve as probative tools for facilitating discovery."[301]

C. A MECHANISTIC DESCRIPTION OF PATENT ELIGIBILITY

Decomposition and localization appear to be especially apt strategies for solving the patent eligibility puzzle. Rather than rely on "a largely meaningless 'litany' recited before 'the Court . . . chooses up sides and decides the case,'"[302] decomposition and localization provide an avenue to mechanistically describe which particular *factors* actually control the Court's patent eligibility jurisprudence.[303] This description should remand patent eligibility inquiries from high levels of abstraction—What *is* a "law of nature"?—to more concrete, narrower questions. These narrower questions, built into a "multiprong" or "multifactor" analysis, can provide a legalistic, descriptive test that harmonizes and explains the Court's past precedent while moving away from the vagaries of natural "laws," "phenomena," and "products." This analytical approach to patent eligibility should be cognitively easier than the current state of affairs.[304]

This strategy of replacing standards' reliance on "subjective and empty words"[305] with narrower questions of application has proved successful elsewhere in the law. For example, the Constitution's requirement that federal courts hear only "cases or controversies"—the meanings of which have been debated since Ratification—is now assessed through a robust

---

297. *Id.* at 222–23.

298. *Id.* at 72–88.

299. *Id.* at 153–68.

300. *Id.* at 173–92.

301. *Id.* at 243.

302. *Cf.* Fletcher, *supra* note 26, at 221 (alteration in original) (discussing a similar problem regarding standing); *see also id.* at 290 ("The solution . . . is . . . to break down what might appear to be a single, general question into discrete and particular questions.").

303. *Cf.* BECHTEL & RICHARDSON, *supra* note 25, at 17–23 (identifying the goal of decomposition and localization as providing mechanistic explanations of complex systems).

304. *See id.* at 23 (describing decomposition as "the subdivision of the explanatory task so that the task becomes manageable and the system intelligible"); Fletcher, *supra* note 26, at 290 ("As Justice Iredell wrote in 1793 in his great dissent in *Chisholm v. Georgia*: 'I have often found a great deal of confusion to arise from taking too large a view at once . . . .' The solution for Iredell was (as it is here) to break down what might appear to be a single, general question into discrete and particular questions." (alteration in original) (footnotes omitted)).

305. *Cf.* CLS Bank Int'l v. Alice Corp. Pty., 717 F.3d 1269, 1335 (Fed. Cir. 2013) (Rader, J., additional reflections) (criticizing patent eligibility's continued reliance on such terms).

analytical framework.[306] Similarly, the Constitution's prohibition on "cruel and unusual" punishments incorporates familiar and well-worn common law standards.[307] And personal jurisdiction's call for "fair play and substantial justice"—truly subjective and empty terms, if there ever were ones—has since been parceled into several objective factors.[308] Indeed, this approach of pruning increasingly gnarly jurisprudence into cleaner branches "is as time-honored in law as the striving for generality."[309] Patent eligibility—which continues to reference lists of philosophically pregnant conceits, such as whether gravity is, in fact, a "natural law"—is ripe for a similar trimming.[310]

Ideally, any such breakdown would avoid the hopelessly undefinable terms "laws of nature," "natural phenomena," and "products of nature," and replace them with a standard that is both objective and clear. Constructed properly, such an analysis could also overcome the difficulties complexity generally imparts on the doctrine of patent eligibility by allowing for nuance among marginal eligibility cases, respecting claim language, and eliminating technological bias.[311] Breaking down patent eligibility into cognitively simple—and concrete—subparts is also both politically and judicially viable: it requires neither the intervention of Congress nor a radical shift in jurisprudence, something for which the Supreme Court has expressed its distaste.[312] And litigants are more likely to achieve better results from courts: it is more like what courts typically *do*.[313] Faced with indefinite, complex terms, decomposition and localization appear to be coherent, feasible strategies to resolving patent eligibility's "natural" terms.

306. *See* Friends of the Earth, Inc. v. Laidlaw Envtl. Servs. (TOC), Inc., 528 U.S. 167, 180–81 (2000) (providing an analytical framework for assessing the existence of a "case or controversy" under the Constitution).

307. Farmer v. Brennan, 511 U.S. 825, 839–40 (1994) (incorporating the criminal law concept of "deliberate indifference" into defining "cruel and unusual" punishment).

308. Asahi Metal Indus. Co. v. Superior Court, 480 U.S. 102, 113 (1987) (analyzing "fair play and substantial justice" as including "the burden on the defendant, the interests of the forum State, and the plaintiff's interest in obtaining relief").

309. Fletcher, *supra* note 26, at 290.

310. *See* CARTWRIGHT, *supra* note 122, at 56–59 (discussing gravity); DUPRÉ, *supra* note 162, at 185–87 (same).

311. *See supra* Part III.

312. *See* Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1303 (2012) (refusing to jettison § 101 in favor of other statutory requirements because "[t]he approach is . . . not consistent with prior law. The relevant cases rest their holdings upon section 101, not later sections").

313. *See id.* (describing how courts and judges are poorly suited to address questions of scientific philosophy); Fletcher, *supra* note 26, at 290 (discussing how courts do well at breaking down general issues of legal theory into discrete questions).

1. Identifying the Locus of Control and Decomposing Patents

The first step in decomposition and localization is identifying the "locus of control"—the aspect of the system that "carries out a transformation of inputs into outputs."[314] While identifying a system's locus of control "is often difficult,"[315] this is not the case for patent eligibility: the locus of control for patent eligibility is the patent document. It is the patent document itself—rather than extrinsic evidence, such as scientific norms, enforcement policies, or market effects—that ultimately controls whether a patent application falls within the bounds of patentable subject matter.[316]

A patent can typically be decomposed into only two components: its claims and its specification. Under 35 U.S.C. § 112(a), the patent must "contain a written description of the invention, and of the manner and process of making and using it"—its specification.[317] The specification must also "conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor . . . regards as the invention."[318] A patent may also contain other elements—drawings,[319] appendices,[320] and even models of the invention[321]—but these are not always necessary, and they are often of minor importance when interpreting the patent document.[322]

---

314. BECHTEL & RICHARDSON, *supra* note 25, at 35.

315. *Id.* at 39.

316. This may appear to be a tautology—what controls patent eligibility depends, after all, on how we define it—but courts and commentators do appear to take it as a descriptive truth in principle, if not practice. *See* Ass'n for Molecular Pathology v. USPTO, 689 F.3d 1303, 1324 (Fed. Cir. 2012) ("[I]t is important to state what this appeal is not about. It is not about whether individuals . . . are entitled to a second opinion. Nor is it about whether the [patentee] . . . has acted improperly in its licensing or enforcement policies with respect to the patents. The question is also not whether is it desirable for one company to hold a patent or license covering a test that may save people's lives, or for other companies to be excluded from the market encompassed by such a patent—that is the basic right provided by a patent, *i.e.*, to exclude others from practicing the patented subject matter."), *aff'd in part, rev'd in part sub nom.* Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107 (2013); Jeanne C. Fromer, *Patent Disclosure*, 94 IOWA L. REV. 539, 554 (2009) ("[T]he patent document is typically the primary situs of information about patented inventions."). At the same time, Mark Janis and Timothy Holbrook have written about the practical difficulties in such clean distinctions between patent law's definitions and their objects. Mark D. Janis & Timothy R. Holbrook, *Patent Law's Audience*, 97 MINN. L. REV. 72, 111–16 (2012). Nonetheless, Janis and Holbrook are "unsure whether conjuring up a different heuristic is likely to advance the law here." *Id.* at 111.

317. 35 U.S.C. § 112(a) (2006 & Supp. V 2011).

318. *Id.* § 112(b).

319. *Id.* § 113 (2006).

320. *See, e.g.*, U.S. Patent No. 8,349,334 B2 col. 93–388 (filed June 30, 2011).

321. 35 U.S.C. § 114.

322. *See* Phillips v. AWH Corp., 415 F.3d 1303, 1314–17 (Fed. Cir. 2005) (en banc) (discussing the central importance of the claims and the specification in interpreting a patent).

The claims and the specification serve several functions. The claims "alert[ ] the public of the metes and bounds of an inventor's discovery"[323] or "the outer boundaries of the patent."[324] In this way, the claims "define the *scope of protection* afforded by the patent" that, like land grants, provide "descriptions of lands by metes and bounds in a deed which *define the area* conveyed but *do not describe the land*."[325] And, like any land grant, claims fence their domain from their neighbors': they "differentiate [the invention] over the prior art."[326] The patent specification, on the other hand, "serves a teaching function, as a '*quid pro quo*' in which the public is given 'meaningful disclosure in exchange for being excluded from practicing the invention for a limited period of time.'"[327] The specification describes the land of the invention—it provides a general description of the invention as a whole, explains its contribution to the art, and lists examples of how to use the invention.[328] And, until recently, a patent could be invalidated for failing to include, in the specification, the best mode of making or using the invention.[329] In short: "Specifications teach. Claims claim."[330]

2. Localizing Patents' Components to Patent Eligibility's Goals

The second step in decomposition and localization is to map, or "localize," the system's components to particular outputs of the system—here, the ultimate patent eligibility determination.[331] That is, how does each function of the claims and specification map to answer whether a particular claim is patent eligible? Viewing each of those functions through the lens of the Supreme Court's patent eligibility jurisprudence provides some insight

323. *In re* Rosuvastatin Calcium Patent Litig., 703 F.3d 511, 536 (Fed. Cir. 2012). *But see* Janis & Holbrook, *supra* note 316, at 112–16 (discussing the contradictory jurisprudence in this area).

324. Mark A. Lemley, *Point of Novelty*, 105 NW. U. L. REV. 1253, 1272 (2011).

325. *In re* Vamco Mach. & Tool, Inc., 752 F.2d 1564, 1577 n.5 (Fed. Cir. 1985).

326. John Burke, *The Prior Art by Admission Doctrine: Judicially Created Private Prior Art*, 13 FED. CIR. B.J. 607, 624 (2004).

327. Univ. of Rochester v. G.D. Searle & Co., 358 F.3d 916, 922 (Fed. Cir. 2004) (quoting Enzo Biochem, Inc. v. Gen–Probe Inc., 323 F.3d 956, 970 (Fed. Cir. 2002)); *see* Fromer, *supra* note 316, at 594–99 (calling for a reinvigorated disclosure requirement); Sean B. Seymore, *The Teaching Function of Patents*, 85 NOTRE DAME L. REV. 621, 669 (2010) (calling for simpler patent disclosure to better fulfill the teaching function). *But see* Timothy R. Holbrook, *Possession in Patent Law*, 59 SMU L. REV. 123, 131–46 (2006) (arguing that structural limitations in patent law minimize the teaching function).

328. *See* Donald S. Chisum, *Weeds and Seeds in the Supreme Court's Business Method Patents Decision: New Directions for Regulating Patent Scope*, 15 LEWIS & CLARK L. REV. 11, 18 (2011).

329. *See generally* Lee Petherbridge & Jason Rantanen, *The Pseudo-Elimination of Best Mode: Worst Possible Choice?*, 59 UCLA L. REV. DISCOURSE 170 (2012) (discussing the legal status of the best mode requirement).

330. SRI Int'l v. Matsushita Elec. Corp. of Am., 775 F.2d 1107, 1121 n.14 (Fed. Cir. 1985).

331. *Cf.* BECHTEL & RICHARDSON, *supra* note 25, at 35.

into a mechanistic description of patent eligibility apart from traditional assessments of its "natural" terms.

a. Claim Scope

The central function of patent claims is "to define the *scope of protection* afforded by the patent."[332] To that end, a significant portion of the Supreme Court's patent eligibility jurisprudence has focused on claims that appeared to be so broad as to potentially cover yet undeveloped technologies. In *Benson*, for example, the Court characterized the applicants' claims as virtually unlimited in scope, "not limited to *any* particular art or technology, to *any* particular apparatus or machinery, or to *any* particular end use."[333] Rather, the claims "purported to cover *any* use of the claimed method in a general-purpose digital computer of *any* type."[334] This made the claims "so abstract and sweeping as to cover both known and unknown uses of the BCD to pure binary conversion."[335] In *Flook*, the Court noted that the applicant's claims "cover[ed] *any* use of [the applicant's] formula for updating the value of an alarm limit" in its field, which, although not expressly disclosed in the patent application, nonetheless "cover[ed] a broad range of potential uses of the method."[336] Allowing such claims to proceed, in the Court's view, would make "the beachhead of [the patent] privilege . . . wider, and the area of public use narrower" than Congress had presumably directed.[337] And in *Bilski*, the Court referred to the petitioners' claims as merely "broad examples of how hedging can be used in commodities and energy markets,"[338] and noted that "[i]f a high enough bar is not set when considering patent applications of this sort, patent examiners and courts could be flooded with claims that would put a chill on creative endeavor and dynamic change."[339]

Scholars have written extensively about this concern over claim breadth in the Court's assessment of "abstract ideas." In one seminal article, *Life After* Bilski, Mark A. Lemley, Michael Risch, Ted Sichelman, and R. Polk Wagner argued that "the rule against patenting abstract ideas is best understood as an effort to prevent inventors from claiming their ideas too broadly."[340] In another article, Dan L. Burk and Mark A. Lemley similarly noted that "[t]he rule against patenting abstract ideas, while couched in terms of patentable

332. *In re* Vamco Mach. & Tool, Inc., 752 F.2d 1564, 1577 n.5 (Fed. Cir. 1985).

333. Gottschalk v. Benson, 409 U.S. 63, 64 (1972) (emphasis added).

334. *Id.* (emphasis added).

335. *Id.* at 68.

336. Parker v. Flook, 437 U.S. 584, 586 (1978) (emphasis added).

337. *Id.* at 596 (quoting Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 531 (1972)).

338. Bilski v. Kappos, 130 S. Ct. 3218, 3231 (2010).

339. *Id.* at 3229.

340. Lemley et al., *supra* note 3, at 1317.

subject matter, is really a judicial effort to restrict the permissible scope of patents."[341] Kevin Emerson Collins has explicated the nuances concerning abstract *claim* scope and abstract *claim language* scope.[342] And Alan L. Durham has recognized that "[t]he scope of the claim, and its impact on the progress of the technological arts, is what ultimately condemns it" under § 101.[343] Meanwhile, in the lead up to *Mayo,* Rebecca S. Eisenberg famously highlighted the diversity of these approaches.[344]

Claim scope's strong effect on the Supreme Court's "abstract ideas" jurisprudence suggests that it likely plays a similar role in the Court's assessments of natural "laws," "phenomena," and "products." Indeed, claim scope was at the core of the Court's recent decisions in *Mayo* and *Myriad.* In *Mayo,* the Court read its prior case law concerning "abstract ideas" as "warn[ing] us against upholding patents that claim processes that too broadly preempt the use of a *natural law.*"[345] And paralleling its language in *Benson,* the Court construed the claims at issue in *Mayo* as "set[ting] forth in highly general language . . . *all* processes that make use of the correlations after measuring metabolites."[346] Thus, although the *Mayo* Court struggled throughout its opinion to define a "natural law" in order to ground its decision,[347] it simultaneously voiced a simpler concern over the contested claims' breadth as it had done in its "abstract ideas" cases. And in *Myriad,* the Court again recognized that patent eligibility was concerned with claim scope—"imped[ing] the flow of information that might permit, indeed spur, invention"[348]—while simultaneously characterizing the claims as "concerned primarily with the *information* contained in the genetic *sequence,* not with the specific chemical composition of a particular molecule."[349] Thus, although the *Myriad* Court rooted its decision in the "naturalness" of isolated genomic DNA as opposed to cDNA, it, too, expressed simpler, normative concerns about claim breadth.

---

341. Burk & Lemley, *supra* note 246, at 1642.

342. Collins, Bilski *and the Ambiguity, supra* note 122, at 51 ("Critically—and this point is often overlooked—abstraction in the language used to delineate the scope of a claim can be independent of abstraction in the individual embodiments of an invention that are described by the claim language.").

343. Alan L. Durham, *The Paradox of "Abstract Ideas,"* 2011 UTAH L. REV. 797, 814.

344. Eisenberg, *supra* note 3, at 56–61.

345. Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1294 (2012) (emphasis added).

346. *Id.* at 1302 (emphasis added). *Compare id., with* Parker v. Flook, 437 U.S. 584, 586 (1978) (noting that the "patent claims cover *any* use of [the applicant's] formula for updating the value of an alarm limit" (emphasis added)).

347. *E.g., Mayo,* 132 S. Ct. at 1297–98 (comparing physical "principles" to "laws of nature"); *id.* at 1298–99 (mathematical equations); *id.* at 1302 (statistical relationships).

348. Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2116 (2013) (alteration in original) (quoting *Mayo,* 132 S. Ct. at 1305).

349. *Id.* at 2118 (first emphasis added).

Even prior to these cases, a number of scholars noted the potential for claim scope to bridge "abstract ideas" and "natural laws," "phenomena," and "products." Tun-Jen Chiang, in particular, has argued that patent eligibility's prohibition on applications directed to "abstract ideas" and "laws of nature" "are one and the same in purpose and effect and are simply limits on the scope of patents."[350] Similarly, Efthimios Parasidis struggled with uniformly combining the two doctrines, but did suggest a hybrid framework for the two, complete with a binary decision-tree.[351] And, in *Life After* Bilski, Lemley, Risch, Sichelman, and Wagner likened "a claim to an abstract idea [to] a claim to a product of nature: not limited to real-world applications of human inventiveness, and thus ineligible for patenting."[352]

At the same time, distinguishing merely broad patent claims from ones so broad they render themselves ineligible for patent protection remains a difficult task. And while precisely resolving the contours of that question remains outside the scope of this Article, the best proposal thus far—the one proposed by Lemley, Risch, Sichelman, and Wagner—has identified five factors important to that inquiry: the generative potential of the claimed invention; the nature of invention in the industry; the pace of innovation in the field; the number of disclosed embodiments relative to the breadth of the claims; and the difference between the claimed invention and the prior art.[353] In the aftermath of *Myriad*, Sichelman has recently demonstrated the fruitfulness of applying these factors to the Court's traditional "natural" terms cases.[354] Sichelman argued that the result in *Funk Brothers*, for example, could be explained from Varley Sherman Bond's invention's generative and cumulative nature: Bond's seed inoculant mixture gave rise to the potential of other, undisclosed noninhibitory inoculant mixtures for use in an industry—agriculture—famous for building innovation on old practices.[355] Similarly, the claims in both *Mayo* and *Myriad* were predicated on few embodiments in the context of highly generative and rapidly developing technologies.[356]

Localizing claim scope to patent eligibility—and away from philosophically troublesome attempts to define what "natural" truly means—provides a substantially clearer and more workable understanding of the prohibition on patenting natural "laws," "phenomena," or "products." And it would appear to solve the greater problems with natural complexity's effect on cabining patentable subject matter. It would not be subject to the current

350. Chiang, *supra* note 3, at 1381 n.148.

351. Efthimios Parasidis, *A Uniform Framework for Patent Eligibility*, 85 TUL. L. REV. 323, 406–08 (2010).

352. Lemley et al., *supra* note 3, at 1329.

353. *Id.* at 1341.

354. Sichelman, *supra* note 9, at 15.

355. *Id.* at 15–16.

356. *Id.* at 15–17.

false equivalency of patent eligibility—that is, that patent claims on *all* "natural laws," regardless of their scope, are ineligible—because, unlike asking whether a patent claim *is* or *is not* a natural law, claim scope inquiries are inherently spectral: the breadth of a claim is an inherently multihued inquiry. A focus on claim scope would also refocus patent eligibility on claim language, and not on unarticulated notions of "the invention as a whole," because such a focus would presumably pay close attention to specific claim language.[357] And while such a focus may still cause the doctrine to suffer from technological specificity, a renewed concern with the patent document and the absence of the biologically loaded word, "Nature," counsels that technological specificity is at least less likely to happen. Whether, in making patent eligibility determinations, courts assess claim scope through the factors identified by Lemley, Risch, Sichelman, and Wagner, or others, any mechanistic description of patent eligibility should rely in part on an analysis of the scope of the contested claims.

b. The Claims' and Specification's Relationship to the Prior Art

Both the claims and the specification serve another function: demarcating the invention's boundaries from the prior art.[358] The specification in particular will often include a description of not only how to make and use the invention, but also why the invention is an important contribution in its field beyond that of previously existing innovations.[359] While the invention's relationship with the prior art has not been traditionally thought of as playing an important role in determining patent eligibility, the Court's recent trio of cases—*Bilski*, *Mayo*, and *Myriad*—have increasingly noted patents' relationships to prior art in their respective fields. In *Bilski*, the Court noted that the patent's underlying principle—commodities hedging—was "long prevalent in our system of commerce and taught in any introductory finance class."[360] Far from radically reinventing finance, the procedure taught by the patent application was an older, "basic concept of . . . protecting against risk."[361] Furthermore, the Court noted that several elements of the contested claims concerning certain random analysis techniques were already "well-known" to practitioners.[362] The claims and

357. *But see* Collins, Bilski *and the Ambiguity*, *supra* note 122, at 51 (arguing that the two inquiries can be separated).

358. *See* Burke, *supra* note 326, at 624; Chisum, *supra* note 328, at 18. *But see* Diamond v. Diehr, 450 U.S. 175, 188–91 (1981) (rejecting novelty as a consideration in § 101 determinations).

359. Chisum, *supra* note 328, at 18.

360. Bilski v. Kappos, 130 S. Ct. 3218, 3231 (2010) (quoting *In re* Bilski, 545 F.3d 943, 1013 (Fed. Cir. 2008) (Rader, J., dissenting)) (internal quotation marks omitted).

361. *Id.*

362. *Id.*

specification, therefore, did little, if anything, to distinguish the patent's greater contribution to the field of commodities purchasing.

More recently, in *Mayo*, the Court repeatedly focused on the fact that the patent described "well-understood, routine, conventional activity previously engaged in by researchers in the field."[363] According to the Court, the patent's direction to "determine" the particular level of a metabolite in a patient's blood simply "tells doctors to engage in well-understood, routine, conventional activity previously engaged in by scientists who work in the field."[364] The Court analogized this to the "[p]urely 'conventional or obvious' '[pre]-solution activity'" at issue in *Flook*.[365] And the Court noted that "any additional steps consist[ed] of well-understood, routine, conventional activity already engaged in by the scientific community."[366] These statements, too, expressed the belief that the patent—aside from simply claiming a "law of nature"—added nothing to the greater medical diagnostics field at large.

And the *Myriad* Court remarked that the patented genes were extracted through "well known laboratory methods" and synthesized according to "processes similarly well known in the field of genetics."[367] The Court specifically noted that "Myriad's patent descriptions highlight the problem with its claims" in that it "simply detail[ed] the 'iterative process' of [gene] discovery"—something well known in genetics.[368] This counseled the Court to characterize "Myriad's principal contribution [as] uncovering the precise location and genetic sequence," rather than "creating" or "inventing" the sequences themselves.[369]

These recent statements about the claims' and specification's relationships to their inventions' respective arts evince concern over granting method patents to inventions accomplished through an art's core operational techniques—hedging in finance, dosing in medicine, or sequencing in genetics. In such instances, allowing method patents to essentially mimic these techniques—even if the particular patented *use* of the techniques otherwise met the remaining strictures of the patent statute—raises the specter of monopolizing the techniques themselves. Distilled to a truism, claims' and specifications' prior-art demarcating function concerns itself more with *how* an invention is accomplished than

363. Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1294 (2012).

364. *Id.* at 1298.

365. *Id.* (second alteration in original) (quoting Parker v. Flook, 437 U.S. 584, 590 (1978)).

366. *Id.*

367. Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2112 (2013).

368. *Id.* at 2117–18.

369. *Id.* at 2116.

what an invention is.[370] The more a patent relies on "well-understood, routine, conventional activity previously engaged in by researchers in the field,"[371] the more likely the patent will fail for ineligibility.

To be sure, there are several problems with equating claim demarcation to an invention's field's core operation techniques: it greatly overlaps with other aspects of patentability, notably obviousness; it may discriminate against inventions made through trial and error rather than a "flash of genius," in contravention of the patent statute; and it potentially places an increased fact-finding burden on the PTO.[372] But, like tacking claim language toward scope rather than "abstractness," this approach seems to avoid the shoals complexity threatens on interpreting natural "laws," "phenomena," and "products." It would seem to also avoid the false equivalency trap because assessing a patent's claims and specification relative to "well-understood" techniques in its field is not an all-or-nothing proposition. Such an assessment would also reorient patent eligibility to claim language rather than scientific philosophy. And far from promoting a technological bias, the inquiry would allow nuanced, field-by-field determinations into the invention's place in its particular art. This, too, would be a marked improvement to amorphous definitions of natural "laws," "phenomena," and "products."

c. The Specification's Teaching Function

Lastly, the specification also serves a teaching function, or as defined by the Federal Circuit, "a '*quid pro quo*' in which the public is given 'meaningful disclosure in exchange for being excluded from practicing the invention for a limited period of time.'"[373] The Federal Circuit's diction, namely—"meaningful"—proves rather illuminating. While patent law's other requirements concerning the specification—written description and enablement—involve whether the specification's disclosure is *sufficient* enough to practice the invention,[374] the specification's function in patent eligibility is tied to whether the disclosure is *meaningful* enough for the invention to receive patent protection at all. Here, too, recent patent eligibility litigation proves instructive. In *Mayo*, in particular, the Supreme Court repeatedly described its concern with the contested patent

370. Jacob S. Sherkow, *And How:* Mayo v. Prometheus *and the Method of Invention*, 122 YALE L.J. ONLINE 351, 352 (2013) ("Rather than focusing on *what* the invention is, [this function] focuses on *how* the invention is accomplished.").

371. *Mayo*, 132 S. Ct. at 1294.

372. Sherkow, *supra* note 370, at 354–57.

373. Univ. of Rochester v. G.D. Searle & Co., 358 F.3d 916, 922 (Fed. Cir. 2004) (quoting Enzo Biochem, Inc. v. Gen–Probe Inc., 323 F.3d 956, 970 (Fed. Cir. 2002)).

374. *See* 35 U.S.C. § 112(a) (2006 & Supp. V 2011) (requiring that the specification be written "in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same").

application—and patent applications, in general—as what it presumed to "tell" others in the field. A fictional attempt by Albert Einstein to patent a process using "$E=mc^2$" in nuclear acceleration failed, in the Court's view, because it amounted to little more than "telling linear accelerator operators to refer to the law to determine how much energy an amount of mass has produced"—a meaningless, even if enabling disclosure.[375] A similar fictional attempt by Archimedes to patent an application of buoyancy with respect to shipbuilding also failed in the Court's esteem because that "consist[ed] of simply telling boat builders to refer to that principle in order to determine whether an object will float."[376] Analogously, the patent application in *Mayo* failed, in part, because even though the specification more than sufficiently enabled physicians to control drug dosage according to the patent, it did little more than teach users of the invention to make use of a particular principle in otherwise "well-understood" techniques.[377]

Similarly, in *Myriad*, the Court repeatedly referenced the shortcomings of Myriad's specifications—that they detailed Myriad's method of discovering the genes but nothing more. These disclosures described only "fairly uniform" approaches to making use of the technology "insofar as any scientist engaged in the search for a gene would likely have utilized a similar approach."[378]

These concerns with the quality of the specification's disclosure—not just its sufficiency—focus on whether the specification actually fulfills its teaching function in a manner worthy of the societal quid pro quo for the patent grant—whether the disclosure is *meaningful* to its particular art. Although the *Mayo* and *Myriad* Courts did not ground their decisions in those terms, their dicta concerning the patents' specifications highlight the difference between specifications that teach a *meaningful* new way of implementing the claimed invention and those that simply describe variants on "well-understood, routine, conventional activity."[379] In some ways, this provides an avenue to reinvigorate § 101's statutory command that all patented inventions be both "new and useful."[380] A patent specification that teaches neither new nor useful concepts—even if it makes use of old

375. *Mayo*, 132 S. Ct. at 1297.

376. *Id.*

377. *See id.* ("[T]he 'wherein' clauses simply tell a doctor about the relevant natural laws, at most adding a suggestion that he should take those laws into account when treating his patient. That is to say, these clauses tell the relevant audience about the laws while trusting them to use those laws appropriately where they are relevant to their decisionmaking (rather like Einstein telling linear accelerator operators about his basic law and then trusting them to use it where relevant).").

378. Ass'n for Molecular Pathology v. Myriad Genetics Inc., 133 S. Ct. 2107, 2119–20 (2013) (quoting Ass'n for Molecular Pathology v. USPTO, 702 F. Supp. 2d 181, 203 (S.D.N.Y. 2010)).

379. *See Mayo*, 132 S. Ct. at 1298.

380. 35 U.S.C. § 101 (2006).

concepts in a new, useful, and nonobvious way—may, in some cases, run afoul of patent eligibility. This potentially demonstrates another avenue for localizing disclosure's teaching requirement to patent eligibility.

3. Building a Mechanistic Description of Patent Eligibility

The scope of the claims, the claims' and specification's relationship to the prior art, and the "meaningfulness" of the specification's disclosure all affect whether a patent application is, or is not, patent eligible. Taken together, these three functions describe a mechanistic view of patent eligibility. At these functions' extremes, the inquiry is disjunctive. If a claim's scope is wildly too broad, the claim will almost certainly be rendered ineligible under one of the traditional patent eligibility inquiries. If the invention, as set forth in the claims or described in the specification, operates perfectly coequal with "well-understood" operational methods in the invention's field, then it, too, will likely be rendered ineligible. Or, if the specification's disclosure is so meaningless that it fails to teach its practitioners anything "new or useful" about its field, its overlying patent application may fail as well.

At the same time, these factors are not always present at such extremes. There are, to be sure, close cases. And the precise metrics courts should use in analyzing these factors is well up to debate. Regarding overly broad claim scope, the factors proposed by Lemley, Risch, Sichelman, and Wagner do not appear to be an exhaustive list.[381] Even those may require a further, nuanced explanation.[382] Similarly, determining how much the underlying invention—as defined in the claims or described in the specification—overlaps with "well-understood" operational techniques in its field may require a detailed understanding of how to assess how an invention's field performs research or business. And practically assessing "meaningfulness" of the specification's contribution to the art will likely require further parsing by the courts.

But these factors at least provide concrete, legalistic explanations for the Supreme Court's patent eligibility jurisprudence; mechanistic descriptions of how the actual components of the patent document determine patentable subject matter. Like modern understandings of complex phenomena in the sciences, decomposition and localization here provide insight into how the poorly articulated, confusing, and seemingly

381. Lemley et al., *supra* note 3, at 1341 ("In sum, we believe at least five factors are critical to a proper scope-based determination for patentable subject matter eligibility under § 101 . . . . No one factor should dominate; we advocate a contextual, common-law approach. Courts and scholars are likely to develop other factors as our approach is applied over time.").

382. *See* Peter Lee, *The Evolution of Intellectual Infrastructure*, 83 WASH. L. REV. 39, 89 (2008) (analogizing the differences in these approaches as tradeoffs between "analytical rigor" and "valuable flexibility"); Sichelman, *supra* note 9, at 15–17 (describing some difficulties in applying these factors to the technologies at issue in *Mayo* and *Myriad*).

contradictory area of patentable subject matter can be explained by reference to patents themselves, rather than unrelated discourses into scientific philosophy. This is one of the principal strengths—not weaknesses—in decomposition and localization in legal analysis: it simultaneously roots legal decision-making in concrete identifiable legal factors while allowing courts the opportunity to engage in the underlying policy levers regarding technological innovation.[383]

Whether courts, or rather, another legal institution, should be engaging in such explicit policy determinations for patent eligibility—regarded by some as simply a threshold test or a "coarse filter" that should be easy to apply—is another, higher-order question.[384] And given the modern development of patent law, whether patent eligibility does any useful work apart from its statutory cousins—novelty, nonobviousness, and enablement—is another, separate question.[385] But there is little simplicity or ease in the doctrine as it currently exists, and the Supreme Court has recently and explicitly rejected arguments to abandon it.[386] Few would argue that the Court's repeated invocation of philosophically pregnant terms, like "law of nature," rests on firm, principled, legal analysis. An honest acknowledgment of how these factors affect patent eligibility, if nothing else, frees legal decision makers from grappling with the complexity of natural "laws," "phenomena," or "products."

Applying this mechanistic framework to *Mayo* and *Myriad*, the Court's two recent patent eligibility cases, one can reach similar, normatively desirable outcomes without reference to natural "laws," "phenomena," or "products." As recently detailed by Sichelman, the first function, claim

383. *See* Burk & Lemley, *supra* note 246, at 1642–58 (describing patentable subject matter through "policy levers" rather than legal formalism); Lemley et al., *supra* note 3, at 1327 ("Lack of rigidity is not inherently bad; we suggest a flexible, factors-based test ourselves. But because gatekeeping rules attempt to draw conceptual lines around classes of technology with unclear boundaries—instead of using the policy-based factors that should drive patentable subject matter determinations—the result is a set of tests that overexclude and underexclude in a costly and haphazard way.").

384. *Compare, e.g.*, Anna B. Laakmann, *An Explicit Policy Lever for Patent Scope*, 19 MICH. TELECOMM. & TECH. L. REV. 43, 60–61 (2012) (arguing that courts should engage in explicit policy determinations for patent eligibility), *and* Lemley et al., *supra* note 3, at 1327 (same), *and* Arti K. Rai, *Engaging Facts and Policy: A Multi-Institutional Approach to Patent System Reform*, 103 COLUM. L. REV. 1035, 1040–41 (2003) (arguing that both courts and the PTO should), *with* Mary Mitchell & Dana A. Remus, *Interstitial Exclusivities After* Association for Molecular Pathology, 109 MICH. L. REV. FIRST IMPRESSIONS 34, 39 (2010) (arguing that only Congress should), *and* Melissa F. Wasserman, *The Changing Guard of Patent Law:* Chevron *Deference for the PTO*, 54 WM. & MARY L. REV. 1959, 2008–12 (2013) (arguing that the PTO, rather than the Federal Circuit, should).

385. Risch, *supra* note 3, at 591–92 (advocating for the elimination of patent eligibility by using other areas of the patent statute).

386. Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1304 (2012) (rejecting the government's arguments to abandon patent eligibility in light of patent law's evolution).

breadth, likely weighs heavily against the validity of the claims at issue in *Myriad* but would appear to allow them in *Mayo*.[387] In *Myriad*, the scope of the claim likely prohibited a great deal of follow-on innovation and encompassed a number of practical applications for the gene, only some of which were disclosed in the specification.[388] In addition, the invention—a discrete application of information in a rapidly advancing field—was potentially the subject of significant improvement by future researchers.[389] Indeed, since the *Myriad* patents on *BRCA1* and *BRCA2* were filed in 1998, genetic sequencing technologies have completely revolutionized.[390] In *Mayo*, however, the claims were relatively narrow and likely did not hinder follow-on innovation.[391] Rather, they appeared more like incremental improvements, with few applications, in an otherwise cumulatively developing field.[392] Since the Prometheus Laboratories patents were filed in 1998, there has been little improvement in honing the appropriate dosage of thiopurine drugs to treat Crohn's and inflammatory bowel disease.[393]

The second function—distinguishing the claims and specification from the prior art—would seem to counsel against the validity of both the *Mayo* and *Myriad* patents. Both were directed to core operational techniques in their respective fields—drug dosing in *Mayo* and sequencing in *Myriad*—that added only an informational component. That is, the operational techniques described in the *Mayo* patents, "administering" the drug, and "determining" its metabolite, were well known in the prior art. Indeed, the *Mayo* patents themselves described them as such.[394] The only element distinguishing the contested claims was the particular dosage threshold itself. Similarly, the operational techniques of many of the claims in the

387. Sichelman, *supra* note 9, at 15–17.

388. *Id.*

389. *Id.* at 15–16.

390. *See* Michael L. Metzker, *Sequencing Technologies—The Next Generation*, 11 NATURE REVIEWS GENETICS 31, 31 (2010).

391. Sichelman, *supra* note 9, at 15.

392. *Id.* at 15–16.

393. *See* L. Chouchana et al., *Review Article: The Benefits of Pharmacogenetics for Improving Thiopurine Therapy in Inflammatory Bowel Disease*, 35 ALIMENTARY PHARMACOLOGY & THERAPEUTICS 15, 21 (2012) (listing, in a review of recent literature concerning thiopurine dosage, remarkably similar range dosage thresholds to those in Prometheus's patents).

Interestingly, however, a good deal of follow-on innovation concerning thiopurine treatment has recently come about using molecular diagnostics—the same technology at issue in the *Myriad* case. *See, e.g.*, *id.* at 24–27 (discussing testable pharmacogenetic factors contributing to thiopurine metabolism).

394. *See, e.g.*, U.S. Patent No. 6,355,623 B2 col. 8, ll. 37–43 (filed Apr. 8, 1999) ("Previous studies suggested that measurement of 6-MP metabolite levels can be used to predict clinical efficacy and tolerance to azathioprine or 6-MP. However, it was unknown what concentrations of 6-MP metabolites correlated with optimized therapeutic efficacy or with toxicity." (citations omitted)).

Myriad patents were also well-known to researchers at the time.[395] And again, the only element distinguishing the contested claims from the known operational techniques was the particular sequence itself. The proximity between the *Mayo* and *Myriad* patents and core operational techniques in their fields strongly counsels in favor of finding the contested claims invalid.

The last function—the meaningfulness of the specification—likely cuts the other way, however. Both cases' patents provided not merely sufficient but *meaningful* information concerning their fields. As detailed in the *Mayo* patents, "it was unknown what concentrations of [thiopurine] metabolites correlated with optimized therapeutic efficacy or with toxicity."[396] The patents expressly and clearly provided such information: less than 230 picomoles of thiopurine metabolites per titer of blood indicated a need to increase the dosage; greater than 400 picomoles of thiopurine metabolites per titer of blood indicated a need to decrease the dosage.[397] This information was both "new and useful" to practitioners in the field.[398] Similarly, the specifications of the *Myriad* patents were quite meaningful with respect to detecting whether a particular patient possessed an increased risk for breast cancer. If a patient possessed the sequence variants disclosed in the patent specification, their risk for developing breast cancer increased by a calculable amount—also disclosed in the patents.[399] If a patient did not, their risk was presumed to be the same as that found in the general population.[400] This type of analysis, applied to breast cancer, was both "new and useful" for clinical purposes,[401] and counsels against the Court's invalidity determination.

This mechanistic-functional analysis of *Mayo* and *Myriad* demonstrates the principal benefit to the approach: it compels similar, normatively desirable results to those reflected in the Court's opinions without relying on philosophical language. The *Mayo* patents, which prior to the Supreme

395. *See, e.g.*, U.S. Patent No. 5,693,473 col. 30, ll. 41–46 (filed June 7, 1995) ("Preferred embodiments relating to methods for detecting BRCA1 or its mutations include enzyme linked immunosorbent assays (ELISA), radioimmunoassays (RIA), immunoradiometric assays (IRMA) and immunoenzymatic assays (IEMA), including sandwich assays using monoclonal and/or polyclonal antibodies.").

396. '623 B2 Patent col. 8, ll. 40–42.

397. *Id.* at col. 20, ll. 10–25.

398. *See* C. Cuffari et al., *Quantitation of 6-Thioguanine in Peripheral Blood Leukocyte DNA in Crohn's Disease Patients on Maintenance 6-Mercaptopurine Therapy*, 74 CANADIAN J. PHYSIOLOGY & PHARMACOLOGY 580, 582 (1996) (discussing the development of "an assay to measure 6TG levels in leukocyte DNA").

399. '473 Patent *passim.*

400. *Id. passim.*

401. *See* Elizabeth B. Claus et al., *Genetic Analysis of Breast Cancer in the Cancer and Steroid Hormone Study*, 48 AM. J. HUM. GENETICS 232, 232 (1991) (remarking that, at the time, this was the largest data set collected to study genetic risk profiles for breast cancer).

Court's decision were subject to a nuanced analysis by commentators,[402] receive an equally nuanced portrait here. Their claims do not appear overly broad, nor do their specifications disclose meaningless improvements, but their contributions above and beyond core operational techniques for diagnostics border on zero. This clearly and strongly factored into the Court's opinion in *Mayo* with its repeated reference to "well-understood, routine, conventional activity previously engaged in by researchers in the field"[403]—stronger, perhaps, than concerns regarding the breadth of the patents' claims or the meaningfulness of the specifications' contributions. The *Myriad* patents, however, received almost universal censure from commentators and scientists alike.[404] Accordingly, the mechanistic analysis presented here condemns those patents under both the claim-breadth and prior-art demarcating functions. In this way, patent eligibility can replace attempts to define natural "laws," "phenomena," and "products" with the sort of legal analysis courts are typically tasked to do. Without it, it would seem, patent eligibility may remain needlessly complex.

CONCLUSION

Patent law's traditional concern over patents on "principles" or "abstractions" has been replaced with incantations against "laws of nature," "natural phenomena," and "products of nature." These words, however, are meaningless as both legal terms of art and as scientific concepts. Since their adoption, the Supreme Court has provided no framework or set of factors to assess whether a patent's claims come within those terms' ambit. And worse yet, a branch of scientific philosophy, known as natural complexity, stresses the cognitive difficulties imposed on crafting general rules about a multi-elemental, multi-variable, interconnected concept of Nature. The Court's continued reliance on this legally and scientifically meaningless terminology explains some of the difficulties the doctrine of patent eligibility suffers from today, including falsely equating all natural concepts as unpatentable "laws" or "phenomena," marginalizing claim language, and effecting an anti-biotechnology bias.

Today, after years of doctrinal accretion, patent eligibility has itself become complex. Consequently, distilling patent eligibility into a simple

402. *See* Lemley et al., *supra* note 3, at 1344 ("[T]he claim was to very specific measurements of a particular drug. Like *Metabolite, Prometheus* involves an application of the natural principles discovered by the patentee. It is not generative, nor will it unduly bar future inventors. If, however, this claim were expanded to cover *all* drugs without *any* specific measurements, then it would be an abstract idea.").

403. Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1294 (2012).

404. *See, e.g.*, Lori B. Andrews & Jordan Paradise, *Gene Patents: The Need for Bioethics Scrutiny and Legal Change*, 5 YALE J. HEALTH POL'Y L. & ETHICS 403, 404 (2005) (criticizing Myriad's patents on public health grounds); Aaron S. Kesselheim et al., *Gene Patenting—The Supreme Court Finally Speaks*, 369 NEW ENG. J. MED. 869 (2013) (same for research preemption purposes).

formula—without doing significant, and politically untenable harm to the Supreme Court's patent jurisprudence—remains challenging. Complexity theorists, however, have recognized twin strategies to developing "mechanistic" descriptions of complex phenomena: "decomposition," breaking a system down into cognitively simple subparts, and "localization," mapping the functions of those subparts to the system as a whole. While this may appear inapplicable to the law, many other complex areas of jurisprudence use this methodology by breaking down high-order, generalized questions into separate "factors" or "prongs" that map to the law's substantive purposes. Patent eligibility could be similarly simplified by decomposing the inquiry into assessing how the functions of each component part of the patent document—the claims and the specification—localize to patent eligibility's policy goals. In particular, courts should consider the scope of the patent's claims, the claims' and the specification's relationship to the prior art, and whether the specification provides a meaningful—not merely sufficient—disclosure of a "new and useful" technology. This analysis has several advantages to the current state of affairs: it frees patent eligibility from its focus on scientifically meaningless terms; it is likely to be politically palatable to both the Supreme Court and Congress; and it does not readily suffer from some of the difficulties patent eligibility currently poses on patent law, generally. Such a test, regardless as to how it is ultimately crafted, is unlikely to be without its own uncertainties. But without decomposition and localization, patent eligibility will likely remain needlessly complex.