AGAINST THE ABSTRACT-IDEAS EXCLUSION

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ABSTRACT

Can someone patent the mathematical formulae that lie at the root of advances in artificial intelligence? What about the discovery of biological mechanisms that make certain drugs work? These questions are governed by the doctrine of patentable subject matter, which excludes "laws of nature, natural phenomena, and abstract ideas" from patents. In a watershed series of recent cases, the Supreme Court reinvigorated the doctrine. The Court's intervention has inspired a robust debate involving legislators, administrators, judges, and scholars. But this debate has focused on the Court's new test for how to exclude abstract ideas while accepting the premise that they should be excluded.

This Article contests that virtually uncontested premise. Its thesis is that patent law's exclusion of abstract ideas rests on a weak foundation. The Supreme Court's rationale for the exclusion is that abstract ideas are "basic tools" or "building blocks" of future scientific discovery, so patenting them would hamstring downstream innovation. But this rationale is faulty because the building-block potential of abstract ideas signifies not just the *cost* of monopolizing them but also the *benefit* of incentivizing them. The fact that an idea can serve as a tool for future innovation shows the importance of incentivizing the idea, which is what patents aim to do.

So, for the Court's rationale to hold, it must be true that as an invention becomes more abstract, the costs of patent protection increase at a greater rate than its benefits such that, beyond some level of abstractness, the costs outweigh the benefits. In other words, the cost and benefit curves must cross once (the "single-crossing condition"). But the Court has never articulated a reason—and there *is* no reason—to think that this necessary condition holds.

This conclusion has profound implications for our understanding of patent law: It shows that a longstanding article of faith is not well-grounded. This pessimistic verdict does not lead to a wholesale rejection of the Court's reengagement with patentable subject matter, but it provides a new framework for assessing the doctrine, suggesting substantive and procedural reforms.

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[A] patent system must be related to the world of commerce rather than to the realm of philosophy.
- *Brenner v. Manson*, 383 U.S. 519, 536 (1966)

I. INTRODUCTION

In a quartet of recent cases, the Supreme Court breathed new life into the doctrine of patentable subject matter (also known as patent eligibility) after the Federal Circuit had left it for dead.[1] The Court reaffirmed longstanding law that "laws of nature, natural phenomena, and abstract ideas" are not eligible for patent protection.[2] And it announced a two-part test for patent eligibility: First determine whether the patent claim is directed to one of the three ineligible concepts mentioned above and then, if so, ask whether the invention does enough to transform the claim from an ineligible concept into an eligible application of the concept.[3]

The Supreme Court's intervention has propelled patent eligibility from obscurity to the forefront of patent practice and scholarship.[4] Judges of the Federal Circuit, which has exclusive jurisdiction over patent appeals, have voiced deep concern over the Court's new test.[5] The Patent and Trademark

1. *See* Bilski v. Kappos, 561 U.S. 593, 612 (2010) (invalidating a patent on a method of hedging risk); Mayo Collaborative Servs. v. Prometheus Lab'ys, Inc., 566 U.S. 66, 92 (2012) (invalidating a patent on a medical diagnostic method based on a law of nature); Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 569 U.S. 576, 580 (2013) (disallowing patents on naturally occurring DNA sequences but allowing them on synthetic cDNA); Alice Corp. Pty. Ltd. v. CLS Bank Int'l, 573 U.S. 208, 226–27 (2014) (invalidating a patent on a method of intermediated settlement for financial transactions).

2. *Prometheus*, 566 U.S. at 70; *Myriad*, 569 U.S. at 589; *Alice*, 573 U.S. at 216.

3. *Alice*, 573 U.S. at 217–18. For further discussion, see *infra* notes 286–289 and accompanying text.

4. This is reflected in the attention given to the doctrine in textbooks and scholarly articles before and after the Supreme Court decisions. In a leading casebook, the number of pages devoted to patent eligibility almost tripled and the percentage of the patent chapter devoted to it doubled. *Compare* ROBERT P. MERGES, PETER S. MENELL & MARK A. LEMLEY, INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE (4th ed. 2006), *with* PETER S. MENELL, MARK A. LEMLEY & ROBERT P. MERGES, INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE: 2019 (Clause 8 Publ'g 2019). And a search of Westlaw's *Law Reviews & Journals* database shows a 230-percent increase in articles including "patentable subject matter" or "patent eligibility" in the title when comparing the decade preceding *Bilski* to the decade following it.

5. *See, e.g.*, Berkheimer v. HP Inc., 890 F.3d 1369, 1374 (Fed. Cir. 2018) (Lourie, J., concurring); Athena Diagnostics, Inc. v. Mayo Collaborative Servs., LLC, 927 F.3d 1333 (Fed. Cir. 2019) (denying rehearing en banc, with eight separate concurring or dissenting opinions criticizing Supreme Court jurisprudence and calling for greater clarity from the Court or Congress); *see also* Ryan Davis, *Rader Calls Out Fed. Circ.'s Role in Patent Law Confusion*, LAW360 (Sep. 7, 2022), https://www.law360.com/articles/1527779/rader-calls-out-fed-circ-s-role-in-patent-law-confusion.

Office has scrambled to offer guidelines for its interpretation.[6] Congress, lobbied by various groups, has considered amending the law.[7] Scholars, too, have been active in this debate: Some have criticized the doctrine[8] while others have offered qualified defenses or rationalizations.[9]

Although the Court's intervention in patent eligibility is new, the principle that abstract ideas are unpatentable is old. Its roots in American jurisprudence stretch back to the mid-nineteenth century[10] and in English jurisprudence to a half century earlier.[11] The principle is so well-settled that it is often stated as a self-evident truth.[12] Almost all commentary on the subject interrogates the Court's new framework for how to exclude abstract ideas while accepting the underlying premise that they should be excluded.[13]

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6. *See, e.g.*, 2019 Revised Patent Subject Matter Eligibility Guidance, 84 Fed. Reg. 50 (Jan. 7, 2019); U.S. PAT. & TRADEMARK OFF., OCTOBER 2019 UPDATE: SUBJECT MATTER ELIGIBILITY (2019).

7. *See, e.g.*, Restoring America's Leadership in Innovation Act of 2024, H.R. 8134, 118th Cong. § 7 (2024); Patent Eligibility Restoration Act of 2023, S. 2140, 118th Cong. (2023); Patent Eligibility Restoration Act of 2022, S. 4734, 117th Cong. (2022); Restoring America's Leadership in Innovation Act of 2021, H.R. 5874, 117th Cong. § 7 (2021); Restoring America's Leadership in Innovation Act of 2020, H.R. 7366, 116th Cong. § 7 (2020); Restoring America's Leadership in Innovation Act of 2018, H.R. 6264, 115th Cong. § 7 (2018). *See generally* KEVIN J. HICKEY, CONG. RSCH. SERV., R45918, PATENT-ELIGIBLE SUBJECT MATTER REFORM: BACKGROUND AND ISSUES FOR CONGRESS 32–40 (2022) (summarizing administrative and legislative developments).

8. *See, e.g.*, Michael Risch, *Everything Is Patentable*, 75 TENN. L. REV. 591 (2008); Ted M. Sichelman, *Funk Forward*, in INTELLECTUAL PROPERTY AT THE EDGE: THE CONTESTED CONTOURS OF IP (Rochelle Dreyfuss, Jane Ginsburg & Carol Rose eds., 2014); Dmitry Karshtedt, *The Completeness Requirement in Patent Law*, 56 BOS. COLL. L. REV. 949 (2015); David O. Taylor, *Confusing Patent Eligibility*, 84 TENN. L. REV. 157 (2016); Christopher M. Holman, *The Mayo Framework Is Bad for Your Health*, 23 GEO. MASON L. REV. 901 (2016).

9. *See, e.g.*, Mark A. Lemley, Michael Risch, Ted Sichelman & R. Polk Wagner, *Life After* Bilski, 63 STAN. L. REV. 1315 (2011); Rochelle C. Dreyfuss & James P. Evans, *From* Bilski *Back to* Benson*: Preemption, Inventing Around, and the Case of Genetic Diagnostics*, 63 STAN. L. REV. 1349 (2011); Katherine J. Strandburg, *Much Ado About Preemption*, 50 HOUS. L. REV. 563 (2012); Dan L. Burk, *The Curious Incident of the Supreme Court in* Myriad Genetics, 90 NOTRE DAME L. REV. 505 (2014); Talha Syed, *Reconstructing Patent Eligibility*, 70 AM. U. L. REV. 1937 (2021).

10. *See* Le Roy v. Tatham, 55 U.S. 156 (1852); O'Reilly v. Morse, 56 U.S. 62 (1853).

11. *See* Boulton & Watt v. Bull, 126 Eng. Rep. 651 (1795); Neilson v. Harford, 151 Eng. Rep. 1266, Webster's Pat. Cases 295 (1841).

12. *See* Strandburg, *supra* note 9, at 571.

13. The only exception appears to be Michael Risch's 2008 article, which proposes that "any invention that satisfies the Patent Act's requirements of category, utility, novelty, nonobviousness, and specification is patentable . . . without need to consider non-statutory subject matter restrictions . . . ." Risch, *supra* note 8, at 591. However, Risch's proposal would largely reach the same categorical exclusions through a strict reading of the enumerated categories in § 101 and the utility requirement. *See id.* at 607.

This Article contests that virtually uncontested premise. It argues that the longstanding principle that abstract ideas are unpatentable rests on weak foundations.

This Article begins its critical reexamination by scrutinizing the Supreme Court's modern rationale for excluding abstract ideas, known as "preemption."[14] The rationale is that abstract ideas and laws of nature are "the basic tools of scientific and technological work," so patenting them would inhibit a great deal of downstream innovation requiring these tools.[15] "Upholding the patents," the Court has said, "would risk disproportionately tying up the use of the underlying natural laws, inhibiting their use in the making of further discoveries."[16]

This Article argues that this rationale is faulty because it misses the simple but vital point that the greater cost signifies concomitantly greater benefit. The fact that an innovation is useful for future innovations not only signals the cost of monopolizing it; it also shows the importance of the innovation to scientific progress and, thus, the benefit of incentivizing it, which is what patents aim to do.

So, the Court's analysis rests—logically, it must rest—on the assumption that the social costs of patenting an innovation increase at a greater rate than its social benefits as the innovation becomes more abstract. It bears repeating this point, for it is a necessary, albeit hitherto unnoticed, premise of the Court's rationale: An innovation has social value, and part of its social value is as a building block for future innovations. The greater the building-block value of an innovation, the more harmful it is to monopolize it through a patent, as the Court has recognized; but, by the same token, the greater the building-block value of an innovation, the more important it is to incentivize it. So, for an increase in an innovation's abstractness (and hence its building-block value) to tip the scales against patentability, the increase in abstractness must raise social costs faster than it raises benefits. To put a fine point on it, for the Court's preemption rationale to hold, the costs and benefits of patenting as a function of an innovation's abstractness must look something like this:

14. *Bilski*, 561 U.S. at 610, 612; *Alice*, 573 U.S. at 216.
15. *Prometheus*, 566 U.S. at 86; *Myriad*, 569 U.S. at 589; *Alice*, 573 U.S. at 216.
16. *Prometheus*, 566 U.S. at 73.

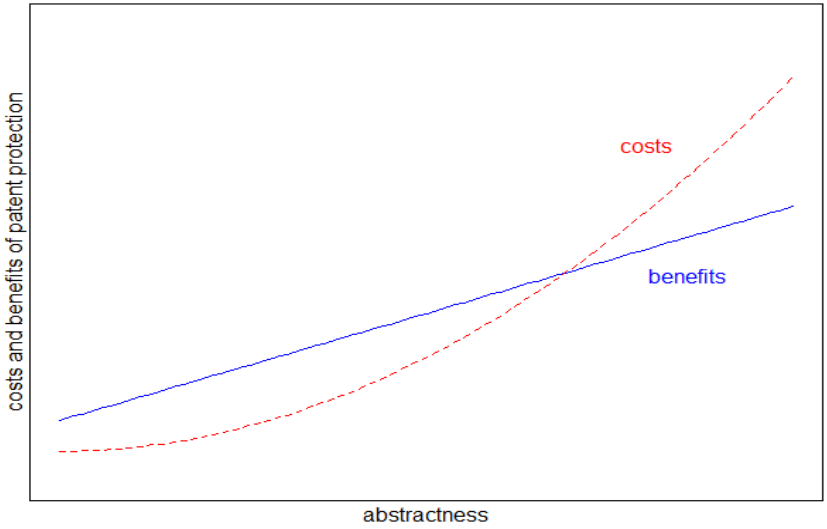

Figure 1: The social costs and benefits of patent protection as a function of an innovation's abstractness, as implicitly hypothesized by the Supreme Court.

As the Figure illustrates, a necessary condition for the validity of the Court's preemption rationale is that the benefits of patent protection increase at a greater rate than its costs as a function of an innovation's abstractness, such that the benefit-cost balance flips from positive to negative beyond some level of abstractness. I call this crucial assumption the *single-crossing condition*, referring to the fact that the benefit and cost curves cross once.[17] The missing piece in the Court's logic is that it has failed to offer any reason to think that this necessary condition holds. In fact, there is no such reason. Abstractness is one of innumerable possible features of an invention—including, for example, the field of invention, the materials used in the invention, the length of time it took to come up with the invention, and the characteristics of the inventor. Proponents of excluding abstract ideas have never explained why this feature somehow flips the benefit-cost balance of patenting from positive to negative. They have identified a reason to believe that the costs of patenting might be higher for abstract ideas—namely, abstract ideas have many applications down the stream of future innovation—but that reason indicates that abstract ideas

17. The term comes from economics. *See, e.g.*, TORSTEN PERSSON & GUIDO TABELLINI, POLITICAL ECONOMICS: EXPLAINING ECONOMIC POLICY 23 (2000); BERNARD SALANIÉ, THE ECONOMICS OF CONTRACTS: A PRIMER 31–32 (2d ed. 2005). The important thing about the Figure is its illustration of the single-crossing condition, not the particular functional forms plotted (linear or exponential or other forms). For a precise, formal statement of the single-crossing condition, see *infra* note 150.

are *more* valuable, so the *benefits* of patenting are also higher. There is simply no reason to believe that the benefits of patenting outweigh the costs when an invention has few downstream applications (and is, in that respect, a less valuable invention) but the costs outweigh the benefits when the invention has more downstream applications (a more valuable invention). There is, in short, no principled reason to believe that the single-crossing condition holds. Therefore, the preemption rationale crumbles.[18]

A thorough analysis of the abstract-ideas exclusion, however, demands more than rebutting the preemption rationale. In over a century and a half of jurisprudence, the Supreme Court has also offered other justifications for the exclusion. These are often conflated in the commentary, but this Article synthesizes the jurisprudence and identifies four distinct justifications: (1) patenting abstract ideas would result in overbroad claims, (2) patenting abstract ideas would give patentees a monopoly over many unforeseen applications, (3) abstract ideas exist in nature prior to any human innovation, and (4) abstract ideas are the basic tools of future innovation (preemption).[19] Another important justification (offered by scholars, not courts) is that as a matter of comparative institutional analysis, non-intellectual-property regimes for incentivizing innovation are better suited to abstract ideas.[20]

This Article argues that all these justifications are wanting.[21] In particular, the argument based on comparative institutional choice ignores the problem of *endogeneity*. Scholars argue that because basic science attracts those who are motivated by intellectual curiosity or prestige, not profit, patents are ill-suited to incentivizing basic research. But profit-motivated scientists may be attracted to applied rather than basic science *precisely because* patents are unavailable in basic science, greatly reducing its profit potential. If patents *were* available for basic research, basic research would attract more profit-seekers. Therefore, it's circular to defend the present system on the basis of different profit motives between basic and applied scientists because this difference is endogenous to the system.[22] Failure to engage the counterfactual of an IP regime that embraces abstract ideas dooms the institutional argument.[23]

This analysis does not spell out an argument for patentability; it spells out an argument for equality. It shows that *different* treatment of abstract and

18. *See infra* Section III.C.
19. *See infra* Section II.B.
20. *See infra* Section III.G.
21. *See infra* Part III.
22. *See infra* notes 245–254 and accompanying text.
23. *See infra* Section III.G.

applied ideas does not make sense. An institutional designer proceeding on first principles would do better to treat them the same. Whether that treatment is to make them all patentable or all unpatentable depends on the pros and cons of patent rights compared to other innovation policy tools, a question beyond the scope of this Article (or any one article, for that matter).[24]

Debunking the justifications for second-class treatment of abstract ideas is not only a theoretical contribution; it also has important policy implications. The upshot is not, as one might first suppose, that the Supreme Court's reengagement with patent eligibility has been a mistake. But this Article's insights help to isolate what is beneficial in the Court's new doctrine, suggesting substantive and procedural reforms.

First, commentators have criticized the Court's new patent-eligibility test for being disjointed from its preemption rationale,[25] but since the rationale is infirm, the incoherence is actually a blessing. A patent eligibility test that is unmoored from its faulty rationale produces better outcomes than a preemption-coherent test would.[26]

The source of these better outcomes, as commentators have pointed out, is that the Court's new framework provides a procedural fast track to invalidate bad patents by permitting a patent-ineligibility determination before discovery.[27] What this Article adds to this procedural understanding is the recognition that the reason certain patents are ripe for early invalidation has nothing to do with them being abstract ideas or building blocks of future innovation. Rather, these patents are bad because they are obvious. This implies that the procedural fast track is at once overinclusive and underinclusive: It mistakenly targets nonobvious abstract ideas, and it mistakenly fails to target obvious nonabstract ideas. This Article thus argues that the early-invalidation mechanism should be extended to grounds of patent invalidity other than subject-matter ineligibility, including obviousness, and that this extension would not violate proper procedure.[28]

Finally, this Article's analysis of caselaw shows that courts' engagement with patent eligibility has often been triggered by concerns about unworthy

24. For different views on this question, see *infra* notes 231, 243 and accompanying text.

25. *See* Strandburg, *supra* note 9, at 613 ("The preemption rubric simply doesn't fit with the inventive concept rule . . . ."); Syed, *supra* note 9, at 1976 (noting a "basic disconnect" between the rationale and the test of ineligibility).

26. *See infra* Section IV.B.

27. *See* Paul Gugliuzza, *The Procedure of Patent Eligibility*, 97 TEX. L. REV. 571, 575–76 (2019).

28. *See infra* Section IV.C.

patents in certain fields, especially business methods and software.[29] These concerns are often justified, although the categorical-exclusion approach is misguided.[30] As such, courts should replace the field-transcending abstract-ideas exclusion with targeted scrutiny of questionable fields like business methods and software.[31]

The remainder of this Article unfolds as follows. Part II reviews and synthesizes the jurisprudence of patentable subject matter. Section III.A distinguishes the three subject matter exclusions—abstract ideas, laws of nature, and natural phenomena—and explains why this Article's analysis applies only to abstract ideas and laws of nature ("abstract ideas" for short). Section III.B discusses the standards that an acceptable justification for excluding abstract ideas must meet, and Sections III.C–III.H show why none of the extant justifications meets these standards. Part IV explores policy implications. The Conclusion recapitulates the argument and speculatively connects the abstract-ideas exclusion to broader themes in American life and thought.

II. THEMES OF PATENTABLE SUBJECT MATTER

A. PATENT LAW BASICS

The goal of American patent law is to encourage scientific and technological innovation, as reflected in the Constitution's grant of congressional 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."[32] To advance this goal, the Patent Act gives innovators time-limited exclusive rights to many uses of their innovations.[33]

The reason these exclusive rights are considered necessary to incentivize innovation has to do with the special character of intangible products of the mind, compared to tangible products. Ideas are special in that they are "public goods": One person's use of an idea does not diminish another person's use ("nonrivalrous"), and the use of an idea once disclosed is hard to limit

29. *See infra* notes 315–318 and accompanying text.

30. *See infra* notes 319–328 and accompanying text.

31. *See infra* Section IV.D.

32. U.S. CONST. art. I, § 8, cl. 8.

33. *See* 35 U.S.C. § 271 (providing for patent infringement liability); 35 U.S.C. § 154 (specifying the patent term's length, which is generally 20 years from the date of filing the patent application).

("nonexcludable").[34] For example, a formula for how to make a drug can be used by many people without making the drug any less effective; and, once the formula is disclosed, it is not possible (without legal protection) to stop others from learning it.[35] Contrast this to, say, a chair or a piece of land, where one person's use does limit other people's use, and it is relatively easy to exclude others. Given their public-good nature, ideas are subject to a "freeriding" problem: People other than the idea's creator can easily take it and use it.[36] The prospect of such freeriding diminishes incentives to innovate by making it harder for innovators to recoup the cost of their investment (in time, money, and effort) and profit from the innovation. Patents boost incentives to innovate by providing legal protection against others' use of one's innovation.[37]

But although patent rights have the upside of incentivizing innovation, they also have the downside of making the patented invention harder to access.[38] That is because the owner of the exclusive patent right, by virtue of being exclusive, can sell the patented product above the price it would fetch in a competitive market. For example, a patent system might produce more lifesaving drugs relative to a policy regime without patents, but those drugs might be less accessible to people who need them. Managing this tradeoff between incentivizing innovation and restricting access to innovations—the incentive-access tradeoff—has long been the central policy of American patent law.[39]

To effectuate the policy goal of incentivizing innovation while curtailing access restrictions, the Patent Act establishes a number of requirements for obtaining a patent. To merit a patent, an invention or discovery must be *useful*.[40]

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34. *See, e.g.*, Sepehr Shahshahani, *The Role of Courts in Technology Policy*, 61 J.L. & ECON. 37, 40 (2018).

35. *See* Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609, 614–16 (National Bureau of Economic Research 1962) (explaining the difficulty of trading in information in the absence of legal protection).

36. Shahshahani, *supra* note 34, at 40.

37. *Id.*

38. *Id.*

39. *See, e.g.*, Wheaton v. Peters, 33 U.S. 591, 657–58, 661 (1834); Kendall v. Winsor, 62 U.S. 322, 327–29 (1858); Sears, Roebuck & Co. v. Stiffel Co., 376 U.S. 225, 229–31 (1964); Graham v. John Deere Co. of Kansas City, 383 U.S. 1, 5–10 (1966); Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 530–31 (1972); Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 480–81 (1974). *See generally* WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 11 (2003).

40. 35 U.S.C. § 101.

It must also be *new* (or *novel*), in the sense of not having been previously disclosed or practiced.[41] And it must be *nonobvious*, meaning, as the name suggests, that it should not be "obvious . . . to a person having ordinary skill in the art to which the claimed invention pertains."[42] In addition, the statute enacts a number of *disclosure* requirements to make sure that the boundaries of exclusive rights are clearly understood and that the benefits of an innovation accrue to the public after the patent term ends.[43] These include *enablement*, meaning the patent application must describe the invention well enough for a person skilled in the invention's field to be able to make and use it;[44] *written description*, meaning the patent application must be sufficient for a skilled scientist "to recognize that the inventor invented what is claimed";[45] and *claim definiteness*, meaning the patent application must clearly describe the scope of the claimed invention.[46]

B. THEMES OF PATENTABLE SUBJECT MATTER

An additional requirement of patentability is that an invention must fall within patentable subject matter. The core of the requirement is that there can be no patents on "[l]aws of nature, natural phenomena, and abstract ideas."[47] For example, one cannot patent a mountain or a stream (natural phenomena), nor the law of gravity or the knowledge that the structure of DNA resembles a double helix (laws of nature), nor the laws of differentiation and integration or the fundamental theorem of calculus (abstract ideas)—even if they were new, nonobvious, useful, and properly disclosed.[48]

Although the way courts have implemented these categorical exclusions has changed over time,[49] the exclusions themselves are longstanding.[50] This Article's target—unlike that of virtually all commentary on the subject—is not

41. *Id.*; 35 U.S.C. § 102.

42. 35 U.S.C. § 103.

43. 35 U.S.C. § 112. For further discussion of disclosure, see *infra* notes 181–185 and accompanying text.

44. *See, e.g.*, Consol. Elec. Light Co. v. McKeesport Light Co., 159 U.S. 465, 474 (1895) [hereinafter *Incandescent Lamp Case*].

45. Gentry Gallery, Inc. v. Berkline Corp., 134 F.3d 1473, 1479 (Fed. Cir. 1998).

46. Nautilus, Inc. v. Biosig Instruments, Inc., 572 U.S. 898, 910 (2014).

47. *Prometheus*, 566 U.S. at 70 (quoting *Diamond v. Diehr*, 450 U.S. 175, 185 (1981)); *Myriad*, 569 U.S. at 589; *Alice*, 573 U.S. at 216.

48. See *infra* Section III.A for elaboration of the patent-ineligible categories.

49. The standard account is that the Federal Circuit was lax about enforcing the subject matter bars before the Supreme Court revived them. *See, e.g.*, Strandburg, *supra* note 9, at 567; Syed, *supra* note 9, at 1939.

50. *See supra* notes 10–12 and accompanying text.

the Supreme Court's new test for implementing the exclusions,[51] but rather some of the exclusions themselves. Specifically, this Article contests the virtually uncontested principle that abstract ideas and laws of nature should not be patentable (the "abstract-ideas exclusion").[52] Tackling this fundamental principle requires a thorough understanding of its rationale. So, instead of recounting the principle's development chronologically, which has been ably done by other scholars,[53] this Article's discussion is organized thematically. Teasing apart the different (though sometimes related) rationales for the abstract-ideas exclusion, which are often conflated in caselaw and commentary, brings distinct lines of argument into sharp relief. And it dovetails with Part III to come, which debunks each of the arguments.

The first theme in the caselaw is to link subject matter exclusions to concerns about the scope of the patent right—concerns that, in today's doctrinal scheme, would fall under the disclosure requirement.[54] This theme comprises two related but distinct subthemes: that patents on abstract ideas would be overbroad, and that they would cover innumerable, often unknown, applications.

Both themes were sounded in *Boulton & Watt v. Bull*, the first case often cited on subject matter exclusions.[55] The case concerned James Watt's patent on a method to decrease the consumption of steam and fuel in steam engines. The questions presented were "[w]hether the . . . patent was good in law" and "[w]hether the . . . specification . . . was . . . sufficient to support the . . . patent."[56] The court was deadlocked, with two justices supporting the patent and two finding it invalid (there was no opinion of the court).[57]

Justice Heath wrote, "it seems impossible [t]o specify a principle [meaning an idea], and its application to all cases, which furnishes an argument that it cannot be the subject of a patent," thus justifying the exclusion of abstract ideas on the ground that they have innumerable applications.[58] By the same token, he thought the specification was defective—even though a jury had

51. *See supra* note 3 and accompanying text.

52. *See, e.g.*, *Prometheus*, 566 U.S. at 70; *Myriad*, 569 U.S. at 589; *Alice*, 573 U.S. at 216.

53. *See, e.g.*, Dana Remus Irwin, *Paradise Lost in the Patent Law? Changing Visions of Technology in the Subject Matter Inquiry*, 60 FLA. L. REV. 775 (2008); Syed, *supra* note 9, at 1961–76.

54. *See supra* notes 43–46 and accompanying text (explaining disclosure).

55. *Boulton*, 126 Eng. Rep. at 651.

56. *Id.* at 653.

57. *See id.* at 659–60 (Rooke, J., holding for the patent); *id.* at 661 (Heath, J., holding against the patent); *id.* at 662 (Buller, J., holding against the patent); *id.* at 667–68, 670 (Eyre, C.J., holding for the patent).

58. *Id.* at 661.

found that anyone acquainted with steam engines could build one following the patent's instructions—because "this patent extends to all machinery that may be made on this principle," and *all* such machinery cannot be specified.[59] For Justice Heath, the problem of innumerable (and hence unspecifiable) applications not only served as a justification for the abstract-ideas exclusion but also made the patent "void for . . . uncertain description," thus linking subject matter and disclosure concerns.[60]

Justice Buller's opinion, which also found the patent invalid, was more concerned with overbreadth: "though the Plaintiffs' invention consisted only of an improvement of the old machine he has taken the patent for the whole machine, and not for the improvement alone," so "their right cannot be sustained."[61] This, though, is a finding that Watt's patent was overbroad, not a justification for excluding abstract ideas.

It is important to note that the patentability of abstract ideas (or "principles," as the justices called them) was not debated in *Boulton*. All justices—those who thought Watt's patent was valid and those who thought it was not—agreed that principles as such are not patentable.[62] To the extent there was a debate over patentable subject matter, it revolved over a conception of patent-ineligibility so broad that it is almost unfathomable today: that processes or methods are unpatentable.[63] Of course, that debate has long since been settled in favor of patent eligibility in both American and English law.[64]

Subject matter concerns were also linked with disclosure and breadth in the second seminal English case on patent eligibility, *Neilson v. Harford*.[65] Neilson discovered that it is beneficial to apply hot (not cold) air for smelting iron, and he took out a patent for an "improved application of air to produce heat in fires, forges, and furnaces" by interposing a vessel in which air was to be heated between when it left a blowing apparatus and when it entered the

59. *Id.*

60. *Id.*

61. *Boulton*, 126 Eng. Rep. at 664–65.

62. *Id.* at 659 (Rooke, J.); *id.* at 661 (Heath, J.); *id.* at 662 (Buller, J.); *id.* at 667–68 (Eyre, C.J.).

63. *Compare id.* at 659 (Rooke, J., holding that methods and processes are patentable), *and id.* at 666–67 (Eyre, C.J., same), *with id.* at 660–61 (Heath, J., holding that only "machinery" and "substances (such as medicines)" are patentable), *and id.* at 663–64 (Buller, J., holding that a "mode of using a thing" is unpatentable).

64. *See, e.g.*, Corning v. Burden, 56 U.S. 252, 267–68 (1853); Cochrane v. Deener, 94 U.S. 780, 787 (1876); Tilghman v. Proctor, 102 U.S. 707, 722 (1880); *see also Le Roy*, 55 U.S. at 183–86 (Nelson, J., dissenting) (surveying English courts' eventual acceptance of process patents).

65. 151 Eng. Rep. 1266, Web. Pat. Cases 295.

furnace.[66] The chief question was whether the patent is invalid for defective specification—what we would call today a failure of enablement or written description.[67] Specifically, there was much argument over whether a sentence in the specification—"the form or shape of the air vessel or receptacle is immaterial to the effect, and may be adapted to the local circumstances and situation"—rendered the patent void.[68] The fear was—and this is what ties the disclosure problem to patentable subject matter—that in the absence of any concrete description of the vessel, the patent would amount to a patent on the "principle" (i.e., the idea or natural law) that hot air is better than cold air for smelting iron, encompassing any and all methods of carrying it into effect, though the inventor himself may not have had a good understanding of how to do so.[69] Ultimately, the judges, bolstered by the jury's finding that the specification was sufficient to enable persons skilled in the art to effectuate Neilson's claimed improvement, held that the specification was not defective.[70] As for the question of patenting an idea, the court found it to be a "difficult" one but upheld the patent by holding that it was a patent on a *mode* of applying the principle "by interposing a receptacle for heated air between the blowing apparatus and the furnace," not on the principle itself.[71]

The theme of overbreadth was also sounded in Justice Story's opinion in the 1840 case *Wyeth v. Stone*, concerning a patent on a new method and machine for cutting ice.[72] The patent, after describing the machinery and method, went on to claim "as new, to cut ice of a uniform size, by means of an apparatus worked by any other power than human."[73] Justice Story wrote that the patent may be valid if it is for the machines described in the specification, but not if it encompasses "any mode whatsoever of cutting ice by means of an apparatus, worked by power, not human, in the abstract, whatever it may be."[74] The latter claim would be invalid because "it is for an abstract principle, and broader than the invention, which is only cutting ice by one particular mode, or by a particular apparatus or machinery."[75]

66. *Neilson*, Web. Pat. Cases at 300, 307.
67. *See supra* notes 43–46 and accompanying text (explaining disclosure).
68. *Neilson*, Web. Pat. Cases at 309.
69. *See id.* at 335–36, 339, 342–43, 354–55.
70. *Id.* at 372.
71. *Id.* at 371.
72. *See* 30 F. Cas. 723, 725 (C.C.D. Mass. 1840).
73. *Id.* at 727.
74. *Id.*
75. *Id.*

Though the opinion uses the word "abstract," and is thus sometimes cited as an American progenitor of the abstract-ideas exclusion, careful reading shows that Justice Story was making a point about claims beyond the scope of patentee's invention, not about abstract ideas as a category: "No man can have 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. *A claim broader than the actual invention of the patentee* is, for that very reason . . . void."[76] Indeed there was nothing "abstract"—in modern doctrine's sense of being an idea or fundamental truth unconnected to real-world referents or applications—about the patentee's claim, even in its most expansive (and unpatentable) interpretation.[77] A method of cutting ice, just like a method of operating steam engines (*Boulton*) or furnaces (*Neilson*), is plainly an applied, not abstract, innovation.

The most famous case sounding the overbreadth theme is *O'Reilly v. Morse*.[78] The case concerned Samuel Morse's patent claims on his advances in telegraph technology, one of which claimed not only "the specific machinery, or parts of machinery, described in the . . . specifications and claims," but more generally "the use of . . . electro-magnetism, however developed, for making or printing intelligible characters, letters, or signs, at any distances."[79] The Supreme Court held that the claim was "too broad, and not warranted by law," because it covered more than what Morse had actually invented or described in the patent application.[80] Supplementing the overbreadth rationale with the innumerable-future-applications rationale, the Court warned that the claim would ensnare "some future inventor, in the onward march of science" who discovered a better mode of communicating by electric telegraphy, even if they did not use the inventions specified in Morse's patent.[81]

As we shall see, the opinion in *Morse* has inspired an influential genre of scholarly justifications for the abstract-ideas exclusion.[82] It is remarkable in that light that the actual opinion has nothing to do with patent eligibility. The opinion discusses in turn the issues of (1) novelty or priority,[83] (2) adequacy of

76. *Id.* (emphasis added).
77. For more on the definition of "abstract ideas," see *infra* Section III.A.
78. 56 U.S. 62 (1853).
79. *Id.* at 86.
80. *Id.* at 113.
81. *Id.*
82. *See infra* Section III.D.
83. *See Morse*, 56 U.S. at 106.

specification,[84] and (3) infringement[85]—which shows that the Court did not think it was saying anything about patentable subject matter. That part of the opinion (under the second issue) which has been sometimes interpreted as a patent eligibility holding is in fact purely about overclaiming.[86] The Court did not say that the category of Morse's invention is ineligible for patenting; it said that Morse "claims an exclusive right to use a manner and process *which he has not described and indeed had not invented*, and therefore . . . the claim is too broad, and not warranted by law."[87] And it cited *Wyeth v. Stone* as "directly in point"[88]—an accurate characterization, as *Wyeth* was also about overclaiming.[89]

This is an important point because it shines light on certain ambiguities in the early caselaw—ambiguities that have been misinterpreted in subsequent judicial decisions and commentary. The problem is that the early American cases resorting to the overbreadth justification in striking down "abstract" claims were using the word "abstract" in a different sense than the term has acquired today (and the sense in which it is used in this Article). In these early opinions, especially *Wyeth* and *Morse*, "abstract" means something like "overly general" or "generalized beyond the actual invention";[90] it does not mean something like "unconnected to real-world referents or applications,"[91] which

84. *Id.* at 112.

85. *Id.* at 123. There was also what one might call issue 2.5—the effect of the lack of a disclaimer in the patent. *See id.* at 120.

86. In a recent decision, the Supreme Court sided with this interpretation of *Morse*. *See* Amgen Inc. v. Sanofi, 598 U.S. 594, 606–10 (2023) (discussing *Morse* as an exemplar of the requirement that a patent claim cannot go beyond what the inventor has enabled).

87. *Morse*, 56 U.S. at 113 (emphasis added); *see also id.* at 117 ("[I]t is the high praise of Professor Morse, that he has been able . . . to discover a method by which intelligible marks or signs may be printed at a distance. And for the method or process thus discovered, he is entitled to a patent. But he has not discovered that the electro-magnetic current, used as motive power, in any other method, and with any other combination, will do as well.").

88. *Id.* at 118.

89. *See supra* notes 75–77 and accompanying text. It is also worth noting, though it does not bear on the substance of the present discussion, that the famous passages in *Wyeth* are dicta, as Justice Story ultimately dismissed the suit based on a technical defect in the patent's assignment which neither party had raised. *See* Wyeth v. Stone, 30 F. Cas. 723, 731 (C.C.D. Mass. 1840).

90. *See supra* notes 72–89 and accompanying text (discussing *Wyeth* and *Morse*); *see also* Parke-Davis & Co. v. H.K. Mulford Co., 189 F. 95, 103 (C.C.S.D.N.Y. 1911) (Hand, J.) (referring to the "rule" that "claims must not be too abstract" and holding that the patent at issue is not abstract because "each [claim] forms a concrete enough criterion to test the product intended" and the specification "is sufficient to identify the product").

91. *See Abstract*, MERRIAM-WEBSTER, https://www.merriam-webster.com/dictionary/abstract (defining "abstract" as "disassociated from any specific instance" or "expressing a quality apart from an object").

is the sense in which modern doctrine understands the term and which canonically excludes mathematical truths or formulas.[92] Put differently, these cases are about abstract *claim language*, not abstract *inventions*. *Wyeth* and *Morse* did *not* invoke the overbreadth rationale as a justification for categorically excluding abstract ideas from patents; they simply found the patent claims at issue void for claiming more than the inventor had discovered.[93] It is only later cases, especially *Gottschalk v. Benson*, that attempted to turn the overbreadth and multiple-unknown-uses lines of thought into a justification for the abstract-ideas exclusion.[94] This matters because, as the discussion below will show, patent law today has separate and well-developed doctrines to deal with problems of overbreadth and unforeseen applications, and addressing those problems under the rubric of patent eligibility only breeds confusion.[95]

Another theme in the caselaw is to justify the exclusion of abstract ideas, laws of nature, and natural phenomena on the grounds that their existence predates human discovery and they do not owe their origin to human innovation. Though there are passing references to this idea in earlier cases,[96] the justification was first meaningfully invoked in *Parker v. Flook*.[97] "The underlying notion" behind the abstract-ideas exclusion, wrote the Court, "is

92. For further elaboration on the definition of "abstract ideas," see *infra* Section III.A.

93. *See supra* notes 76–77, 87–89 and accompanying text. The same is not true, however, of Justice Heath's opinion in *Boulton*, which invoked the problem of innumerable applications both as a justification for the abstract-ideas exclusion and as an independent ground for voiding Watt's patent. *See supra* notes 58–60 and accompanying text.

94. In *Gottschalk v. Benson*, the Court held that a method for converting binary-coded decimal (BCD) numerals into pure binary numerals was not patent-eligible. 409 U.S. 63 (1972). The method claim in *Benson*—by contrast to the inventions at issue in *Boulton*, *Neilson*, *Wyeth*, and *Morse*—was truly abstract in the modern sense that it did not refer to specific real-world applications. "Here," according to the Court, "the 'process' claim is so abstract and sweeping as to cover both known and unknown uses of the BCD to pure binary conversion. The end use may (1) vary from the operation of a train to verification of drivers' licenses to researching the law books for precedents and (2) be performed through any existing machinery or future-devised machinery or without any apparatus." *Id.* at 68. By conflating "abstract" (in the modern sense) with "sweeping," this passage takes an idea about overclaiming and turns it into a justification for categorical exclusions. This conflation has been carried forward in scholarly commentary, as discussed *infra* in Section III.D.

95. *See infra* Section III.D.

96. *See Le Roy*, 55 U.S. at 175 ("The elements of the power exist; the invention is not in discovering them, but in applying them to useful objects."); Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 131–32 (1948) (referring to the "handiwork of nature" and "ancient secrets of nature now disclosed" and suggesting that patents extend only to an "invention," not a "discovery").

97. 437 U.S. 584 (1978).

that a scientific principle . . . reveals a relationship that has always existed."[98] The Court pointed to Newton's law of gravity, noting that "this relationship always existed—even before Newton announced his celebrated law."[99] As such, abstract ideas do not meet the novelty requirement of the Patent Act, and allowing their patenting would contravene the "proposition that in granting patent rights, the public must not be deprived of any rights that it theretofore freely enjoyed."[100] *Diamond v. Chakrabarty* approved this "preexisting" idea in holding that "the relevant distinction" for patent eligibility is "between products of nature, whether living or not, and human-made inventions."[101]

Another important rationale for excluding abstract ideas and laws of nature is that they are the basic tools or building blocks of future scientific and technological work, so patenting them would inhibit a great deal of downstream innovation. This rationale was first articulated in *Benson*, where the Court stated that "[p]henomena of nature, though just discovered, mental processes, and abstract intellectual concepts are not patentable, as they are the basic tools of scientific and technological work."[102] The Court invalidated the patent claim on a method for converting binary-coded decimal numerals into pure binary numerals on the grounds that "[t]he mathematical formula . . . has no substantial practical application except in connection with a digital computer," so "the patent would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself."[103]

In its most recent patent-eligibility decisions, the Supreme Court has elaborated on this "preemption" idea and fixed it as the central justification for the abstract-ideas exclusion. Quoting *Benson*'s "basic tools" language, the Court in *Mayo v. Prometheus* added that "monopolization of those tools through the grant of a patent might tend to impede innovation more than it would tend to promote it."[104] Specifically, "there is a danger that the grant of patents that tie up their use will inhibit future innovation premised upon them."[105] The Court thus invalidated patent claims on methods to calibrate the proper dosage of an autoimmune drug based on the concentration of certain metabolites in a patient's blood on the grounds that "upholding the patents would risk

98. *Id.* at 593 n.15.
99. *Id.*
100. *Id.*
101. 447 U.S. 303, 313 (1980).
102. 409 U.S. at 67.
103. *Id.* at 71–72.
104. 566 U.S. at 71.
105. *Id.* at 86.

disproportionately tying up the use of the underlying natural laws [i.e., the correlation between proper dosage and metabolite concentration], inhibiting their use in the making of further discoveries."[106] The Court repeated the same reasoning, which it has also characterized as a "'building-block' concern,"[107] in its next two (and thus far latest) patent eligibility cases.[108]

In sum, an analytical review of the caselaw reveals four distinct, though sometimes related, justifications for the abstract-ideas exclusion: (1) a patent claim on an abstract idea or law of nature would be overbroad; (2) such a patent claim would cover a multitude of unknown applications; (3) abstract ideas and laws of nature preexist in nature and are not products of human innovation; and (4) abstract ideas and laws of nature are basic tools of scientific and technological work, so allowing their patenting would hamstring a great deal of future innovation.

Before turning to a closer examination of these rationales, it is worth noting that textual statutory interpretation has played a trivial role in the development of subject matter exclusions. Though one can trace the subject matter requirement to statutory text in § 101 of the Patent Act and its predecessors, all the action has always been in judge-made law.[109] From *Boulton & Watt v. Bull* in 1795 to the twenty-first century American cases, the courts have ignored or, at most, paid lip service to the idea of parsing the statute's text or structure or history.[110] There is no statutory interpretation of that sort in *Wyeth*, *Le Roy*, *Morse*,[111] or the *Telephone Cases*,[112] nor in the early cases that

106. *Id.* at 73.

107. *Id.* at 89.

108. *See Myriad*, 569 U.S. at 589; *Alice*, 573 U.S. at 216.

109. *See* 35 U.S.C. § 101 (identifying a "process, machine, manufacture, or composition of matter" as patentable subject matter); *see also* 35 U.S.C. § 100(b) (defining "process").

110. In *Boulton*, the patent's validity nominally depended on construction of the term "manufacture" in the Statute of Monopolies (21 Jac. 1, c .3.), but instead of parsing the statute's text or structure or legislative history, each Justice set forth his view of wise patent policy and then gave "manufacture" a meaning that accorded with that view. *See* 126 Eng. Rep. at 655–56, 660–61, 663, 666. Indeed, one Justice first set forth his view of what should qualify as patentable and then said "I *approve of* the term manufacture in the statute" because it accorded (or could be made to accord) with his view. *Id.* at 660–61 (Heath, J.) (emphasis added).

111. Except for Justice Grier's dissent, which discusses the term "art" in the Patent Act and compares it to British statutes, but even Grier's discussion proceeds from considerations of policy rather than statutory text. *See* O'Reilly v. Morse, 56 U.S. 62, 130–32 (1853) (Grier, J., dissenting).

112. Dolbear v. Am. Bell Tel. Co., 126 U.S. 1 (1888) [hereinafter *Telephone Cases*].

deal with patent eligibility in passing.[113] The first Supreme Court case dealing with patent eligibility to even acknowledge that a statutory interpretation question might exist and require an answer is *American Fruit Growers v. Brogdex Co.*, where the Court worked out an answer it found to be reasonable and then interpreted the statute to fit that.[114] Subsequent cases occasionally acknowledged the statute but likewise did not engage in any meaningful textual statutory interpretation.[115] Indeed, *Flook* explicitly foreswore "a purely literal reading of § 101."[116] Even *Chakrabarty* and *Diehr*, which begin with statutory language and legislative history, go on to analyze the judicially developed exclusions without any pretense of grounding them in the statute.[117] The only opinion that can be characterized as genuinely attempting a textual approach to patent eligibility is the lead opinion in *Bilski*, an approach which barely commanded a majority in that case[118] and was promptly discarded in subsequent cases.[119] In short, the categorical exclusions come from judges' sense of wise patent policy, not from the statute.

That is not meant as criticism. To give the subject matter of patents a scope that would advance the constitutional policy of "promot[ing] the progress of science and useful arts" is entirely appropriate and in keeping with the longstanding common-law mode of judging in patent law.[120] It is hard to see what else courts can do, given the broad language of § 101, which hardly provides any guidance as to subject matter limits, and the tradition of

113. Namely, Rubber-Tip Pencil Co. v. Howard, 87 U.S. 498 (1874); Am. Wood-Paper Co. v. Fibre Disintegrating Co., 90 U.S. 566 (1874); Mackay Radio & Tel. Co. v. Radio Corp. of Am., 306 U.S. 86 (1939).

114. *See* 283 U.S. 1, 11 (1931) (picking a dictionary that the Court thought "well defined" the term "manufacture").

115. *See* Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130–32 (1948) (excluding laws of nature without any reference to the statute); *Benson*, 409 U.S. at 64 (mentioning the Patent Act but not engaging in any statutory interpretation).

116. *Flook*, 437 U.S. at 588–89, 594 (acknowledging that the claim "is a 'process' in the ordinary sense of the word" but invalidating it all the same).

117. *See Diamond v. Chakrabarty*, 447 U.S. 303, 308–10 (1980); *Diamond v. Diehr*, 450 U.S. 175, 181–85 (1981).

118. *Compare Bilski*, 561 U.S. at 603–04 (attempting to divine the plain meaning of "process" in § 101), *with id.* at 624–25 (Stevens, J., concurring) (criticizing the plain-meaning approach).

119. *See Prometheus*, 566 U.S. at 71–73 (adopting the traditional judicial exclusions and grounding them in policy); *accord Myriad*, 569 U.S. at 589; *Alice*, 573 U.S. at 216.

120. On the primacy of the common-law method in patent law, see Craig Allen Nard, *Legal Forms and the Common Law of Patents*, 90 B.U. L. REV. 51, 53 (2010); Peter S. Menell, *The Mixed Heritage of Federal Intellectual Property Law and Ramifications for Statutory Interpretation*, *in* INTELLECTUAL PROPERTY AND THE COMMON LAW 63, 64 (Shyamkrishna Balganesh ed., 2013).

common-law judicial development since the inception of patent law. So, although a committed textualist could criticize the whole enterprise of judicially developed subject-matter exclusions as alien to the statute, that will not be the plan of attack in this Article. Rather, this Article aims to beat the abstract-ideas exclusion on its own terms—to show that it does not make good policy sense in light of the constitutional purpose of patent law.

III. REEXAMINING THE ABSTRACT-IDEAS EXCLUSION

This Part systematically evaluates each of the four judicial justifications for the abstract-ideas exclusion identified in the preceding Part, as well as their scholarly glosses and amendments. First, though, it is necessary to understand what exactly the excluded categories of patentable subject matter mean and which of them the following analysis targets.

A. CATEGORY DEFINITIONS AND SCOPE CONDITIONS

The Supreme Court in its century and a half of jurisprudence on the subject has used various formulations to identify patent law's subject matter exclusions.[121] Since *Prometheus*, it has settled on the three-part formulation "laws of nature, natural phenomena, and abstract ideas."[122] Commentators often fail to distinguish these categories; but they are distinct, and a thorough analysis of their theoretical grounding must start by identifying what each category means. The point here is not to craft philosophically airtight definitions out of a rage for ontology or classification, but rather to supply working definitions in order to attain a clear idea of what each category refers to. An added benefit of this approach, as the following analysis will reveal, is that it shows why the three different categories might implicate different policies.

Here is this Article's definitional scheme: *Abstract ideas* are ideas that can be expressed with little or no recourse to real-world referents. *Natural phenomena* are phenomena existing or occurring in nature that can be readily

121. *See, e.g.*, Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948) ("laws of nature," "phenomena of nature" and "the work of nature"); *Flook*, 437 U.S. at 598–99 (Stewart, J., dissenting) ("laws of nature, physical phenomena, and abstract ideas"); *Chakrabarty*, 447 U.S. at 309 (same); *Benson*, 409 U.S. at 67 ("[p]henomena of nature, . . . mental processes, and abstract intellectual concepts"); Mackay Radio & Tel. Co. v. Radio Corp. of Am., 306 U.S. 86, 94 (1939) ("a scientific truth"); Rubber-Tip Pencil Co. v. Howard, 87 U.S. 498, 507 (1874) ("an idea of itself"); *Le Roy*, 55 U.S. at 175 ("[a] principle, in the abstract," "a new power," and "any other power in nature").

122. *Prometheus*, 566 U.S. at 70; *Myriad*, 569 U.S. at 589; *Alice*, 573 U.S. at 216. The same formulation had appeared in *Diehr*, 450 U.S. at 185.

perceived by the senses. *Laws of nature* are also relationships or phenomena in nature, but they are not so readily perceptible and instead operate, so to speak, "underneath." In this scheme, then, *laws of nature* is an intermediate category that borders *abstract ideas* on one side and *natural phenomena* on the other.

More concretely, abstract ideas include, for example, the rules of differentiation,[123] the Fundamental Theorem of Calculus,[124] and Fermat's Last Theorem (or Fermat's Conjecture).[125] As the examples show, abstract ideas are often expressible in mathematical form (see the footnotes), and they are comprehensible without reference to tangible real-world things.[126] This does not mean, of course, that they have no real-world analogues or applications. The examples from calculus, for instance, have innumerable applications in physics and engineering.[127]

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123. For example, $\frac{d}{d\theta} sin(\theta) = cos(\theta)$.

124. This can be expressed in two statements:

(1) Let *f* be a continuous real-valued function on [*a*, *b*] and define *F*, for all $x \in [a, b]$, as $F(x) = \int_a^x f(t)dt$. Then *F* is uniformly continuous on [*a*, *b*] and differentiable on (*a*, *b*), and $F'(x) = f(x)$.

(2) Let *f* be a real-valued function defined and integrable on [*a*, *b*] and *F* a continuous function on [*a*, *b*] such that, for all $x \in (a, b)$, $F'(x) = f(x)$. Then $\int_a^b \mathrm{f(x)dx} = \mathrm{F(a)} - \mathrm{F(b)}$.

125. No three positive integers *a*, *b*, *c* satisfy the equation $a^n + b^n = c^n$ for any integer value of *n* greater than 2.

126. One can get bogged down in philosophical debates about the relation of mathematics to "the real world" and whether mathematical truths are invented or discovered (*see, e.g.*, Mario Livio, *Why Math Works*, 305 SCI. AM. 80, 81 (Aug. 2011)), but such debates are not useful for understanding the subject matter exclusions. *See infra* notes 230–240 and accompanying text.

127. The foregoing definition conceives of an "abstract idea" as a binary variable: An invention or a patent claim either is or is not an abstract idea. But one can equally think of the *level* of the invention's abstractness—i.e., the extent to which the idea can be expressed and comprehended without recourse to real-world referents—as a continuous variable, such that ideas above some threshold of abstractness would be an "abstract idea" and those below the threshold would not. That is the view taken, for expositional purposes, in the graphs illustrating the "single-crossing condition" (Figures 1-2). Ultimately, though, this does not matter to the analysis: The arguments this Article makes against the abstract-ideas exclusion would hold (and the formal statement of the single-crossing condition in footnote 150 would apply) regardless of whether "abstract idea" is a binary, polytomous, or continuous variable.

Laws of nature include, for example, the first law of thermodynamics,[128] Boltzmann's equation (or Boltzmann's entropy formula),[129] the famous formula for mass-energy equivalence,[130] the Central Dogma of molecular biology,[131] and the modern statement of Newton's law of gravity.[132] These examples illustrate the point made before that "laws of nature" is an intermediate category. Many of these laws are, like abstract ideas, expressible in mathematical form (see the footnotes). The difference is that here, the terms in the equations refer to real-world things.[133]

On the other side, the examples show the affinity of laws of nature with natural phenomena. The Central Dogma, for example, expresses a real-world phenomenon; but, because it is not readily perceived by the senses (indeed, it was not understood until the mid-twentieth century), it is more usefully called a law of nature than a natural phenomenon. The gravity formula is another instructive example: At the level of precision expressed in footnote 132, the concept of gravity is not readily perceivable by the senses, so it is more properly classified as a law of nature than a natural phenomenon; however, on a less precise level—such as, "if you throw up an apple it's bound to come down"—the notion of gravity is sufficiently immediately perceptible that it would be more usefully classified as a natural phenomenon.

Here, then, are some examples of natural phenomena: rain, earthquakes, a particular earthquake, lightning, Steamboat Geyser, the Americas, the variegated golden frog (*Mantella baroni*). These, unlike the examples listed as laws of nature, are immediately perceptible to the senses, so this Article classifies them as natural phenomena.

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128. In a closed thermodynamic system (meaning one where there is no transfer of matter in or out), the change in internal energy of the system is equal to the difference between the heart supplied to the system and the work done by the system on its surrounding. That is, $\Delta U = Q - W$.

129. The relationship between entropy ($\mathcal{S}$) and the number of possible microstates (Ω) of a thermodynamic system is described by the equation $S = k_B ln\Omega$ where k_B is Boltzmann's constant, equal to 1.380649×10^{-23} J/K.

130. $E = mc^2$.

131. Genetic information flows only in one direction, from DNA, to RNA, to protein, or from RNA directly to protein. In simpler terms, DNA makes RNA, and RNA makes protein.

132. Every point mass attracts every other point mass by a force along the line intersecting them, which force is proportional to the product of the two masses and inversely proportional to the square of the distance between them. That is, $F = G\frac{m_1 m_2}{r^2}$ where *G* is the gravitational constant.

133. For example, $E = mc^2$ does not hold for some abstract *E*, *m,* and *c* but rather refers to the energy of a particle in its rest frame (*E*) measured in Joules, the particle's mass (*m*) measured in kilograms, and the speed of light (*c*) measured in meters per second.

An alternative classification scheme would be to say that laws of nature refer to *processes* whereas natural phenomena refer to *things*. But that superficial scheme has been appropriately rejected by the Supreme Court.[134] Such a scheme would have difficulty classifying hybrid process-things like rain, lightning, and earthquakes, which the caselaw would classify as natural phenomena, so a distinction based on ready sensory perception is preferable and adopted here.

Moreover, this Article's definitional scheme helps to see that the three categories implicate different policies.[135] In particular, natural phenomena are fundamentally different from abstract ideas and laws of nature. It seems—without wishing to foreclose deeper investigation of the theoretical grounding for their patent ineligibility—that natural phenomena are susceptible to three powerful arguments against patent eligibility that do not apply to the other categories.

First, natural phenomena are "out there" or "preexisting" in an immediate sense that does not apply to abstract ideas or laws of nature. This problem cannot be ameliorated by saying that it is a problem of novelty rather than patent eligibility, nor by saying that although the phenomenon itself might have been preexisting, knowledge of it was not.[136] The first argument is unavailing because having a proto-novelty basis does not vitiate a categorical exclusion. If a category systematically and routinely fails novelty—which the natural-phenomena category, as defined, does—then it makes sense to exclude the category *in toto*. That is the point of having categorical exclusions. The second argument is also unavailing because, given the definition of natural phenomena based on ready perceivability by the senses, even knowledge of

134. *Flook*, 437 U.S. at 593 ("The rule that the discovery of a law of nature cannot be patented rests, not on the notion that natural phenomena are not processes, but rather on the more fundamental understanding that they are not the kind of 'discoveries' that the statute was enacted to protect.").

135. That is, as will be shown, this Article defines the categories such that its thesis applies to abstract ideas and laws of nature but not to natural phenomena. Of course, whether you prefer one or another definitional scheme should not change your assessment of this Article's argument, but you would have to adjust the scope of the argument's application to fit the categories as you have defined them—a question of terminology, not substance.

136. *Cf.* Syed, *supra* note 9, at 1937 ("In a nutshell, . . . the object of patent rights is always and only an intangible space of 'knowledge of' something, and never some 'thing' itself."). Syed's statement that patent law "only" protects knowledge of something and "never" the thing itself is too strong. For example, the owner of a patent on a chemical compound has the right to exclude others from using or making or selling the compound itself, irrespective of anyone's state of knowledge. *See* 35 U.S.C. § 271(a); *see also infra* note 145 and accompanying text. But Syed is right to underscore the importance of knowledge and distinguish it from a physical thing.

natural phenomena has existed since time immemorial. Recall the discussion of the difference between a general, intuitive notion of gravity (natural phenomenon) and a precise formulation of its workings (law of nature).

Second, and related to the first point, the problem of identifying the proper patentee would be insurmountable because natural phenomena are so widely known that their initial knowledge cannot be pinned down to any one person.[137] (It is immaterial, and only a question of semantics, whether that person is called an "inventor" or a "discoverer.") This problem is compounded by the tendency of a community—especially one that is militarily or economically powerful—to limit the idea of knowledge to its own knowledge, disregarding other communities. Witness, for example, Columbus's "discovery" of America. There is thus both an insurmountable conceptual problem and a compounding political-economic difficulty.

Finally, given the tangible thingness of many natural phenomena, the problem of private rights in *them* (as opposed to their knowledge) belongs to the ken of property rather than intellectual property law. Property law is likewise better positioned to handle problems of first possession and multiple pursuers.

Therefore, this Article's thesis questioning the theoretical underpinning of subject matter exclusions does not apply to natural phenomena. It applies only to abstract ideas and laws of nature, both of which will often be called "abstract ideas" for short in this Article. The abstract-ideas exclusion that this Article targets is thus similar to the conventional wisdom that patents are appropriate for "applied technology" or "applied science," but not for "basic science."

Having clarified what abstract ideas are, it is useful also to point out what a patent claim on them would look like if the eligibility bar were to be lifted. Because patent law requires that an invention be useful and, more to the point, that it be enabled, a patent specification would have to include more than the idea itself.[138] Newton, for example, could not come along and, after explaining and establishing the truth of his formula for the law of gravity, claim it as such. He could, however, obtain a patent on that law by putting it to use in an invention which he enables and discloses, for example, a new flour mill whose construction relies on the gravitational formula (say, in gauging the component parts' mass and distance). This example, of course, takes great liberties with

137. *Cf. Ex parte* Latimer, 1889 Dec. Comm'r Pat. 123, 126 (rejecting a patent claim for a fiber found in certain pine needles on the grounds that otherwise "patents might be obtained upon the trees of the forest and the plants of the earth, which of course would be unreasonable and impossible").

138. *See supra* notes 40, 43–46 and accompanying text (explaining utility and disclosure).

history to assume that Sir Isaac lives in the United States today and his statement of the law meets the non-subject-matter requirements of patentability. For a more realistic illustration, take the law of nature at issue in *Prometheus*—namely, the correlation between the concentration of specific metabolites in a person's blood and the proper dosage of autoimmune-disease drugs.[139] In *Prometheus* it was taken as given that the law of nature itself is patent-ineligible, and the only question was whether the patent claim did enough to "transform [the] unpatentable law of nature into a patent-eligible *application* of [the] law."[140] But if the law were patent-eligible, then there could be a patent on the diagnostic method using the law (assuming other patentability requirements are met).

A crucial point in both examples is that permitting patents on abstract ideas would not do away with requirements of utility and enablement; however, once an invention based on the abstract idea is enabled (be it a thing or a process), then the patent would cover not just that particular process or thing but also the abstract idea itself. What, then, would such a patent cover? Whom would it ensnare as an infringer?

A misconception to be emphatically disavowed is this: Patenting an abstract idea would *not* entail that there is an infringement every time the idea operates in the world. Allowing such patents would not require the absurd conclusion that once a law of nature is patented, everyone or indeed nature itself is henceforth in a perpetual state of infringement. Rather, as mandated by the Patent Act, infringement requires that a person use the patented law.[141]

Concretely, in the Newton example, it would make no sense to say that there is an infringement every time the force of gravity operates on objects, an interpretation that would find the world in a perpetual state of infringement. What is more, there is no warrant to say that any person who understands and makes use of the operation of gravity—as opposed to Newton's precise articulation of the law of gravity—infringes Newton's patent. For example, a circus juggler who throws balls up in the air in the firm expectation that they will come down and with an understanding of how fast they will come down depending on how hard he throws them up is using the law of gravity but is not infringing Newton's patent. That is because the juggler is using the law of gravity at an intuitive level that has been understood from time immemorial; he is not using Newton's articulation of the law of gravity. In other words,

139. *See Prometheus*, 566 U.S. at 72–74.

140. *Id.* at 72.

141. 35 U.S.C. § 271(a) ("[W]hoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefor, infringes the patent.").

under the foregoing definitional scheme, the juggler is using an unpatentable "natural phenomenon," not Newton's patented "law of nature." To infringe Newton's patent, a person would have to do more than employ the law of gravity at a general, intuitive level; they would have to use the specific mathematical articulation of the relationship of the force of gravity to the mass of objects and the gravitational constant which (in our hypothetical world) is what Newton contributed and what makes his work patentable.[142] For example, someone who makes and sells a toy model of balls revolving around each other, whose construction required the use of Newton's formula to figure out the proper weight and distance of the balls, would be an infringer.

Likewise, in the *Prometheus* diagnostic-methods example, it would be absurd to say that there is an infringement every time the law operates. If the patented relationship actually holds in nature, then the law is operating in the body of anyone who ever took autoimmune-disease drugs, whether before or after the law's discovery and patenting. It would make no sense to say that everyone who takes such drugs is infringing the patent, even if they took no heed of the law in determining the drug's dosage, because they are not *using* the law in any meaningful sense. But a person who uses the law to calibrate the proper dosage of drugs would infringe the patent.

These illustrations show that allowing patents on abstract ideas would not result in an unworkable situation where everyone is constantly infringing. Patent claims on abstract ideas, like those on applied ideas, are capable of bounded construction and application.

But the illustrations cannot, of course, answer every question about the scope of patents on abstract ideas. What, for example, would be the scope of Newton's hypothetical patent? Would it be restricted to the operation of the law of gravity in *his* kind of flour mill? In all flour mills? In all uses substantially similar to his use in flour mills? Or would it encompass *all* uses of the law of gravity as articulated by Newton, whether or not connected to flour mills? Such questions would have to be worked out case-by-case by courts, and some of them will be discussed below.[143] But the crucial point, for purposes of this Article, is patent law's *different* treatment of abstract and applied ideas. Before bristling at the suggestion that Newton could get a patent on anything broader than his particular enablement of the law of nature he discovered, note that that is precisely the rule in the context of other patents: "The doctrine is so familiar as not to require citation of authority that a patentee is entitled to every use of which his invention is susceptible, whether such use be known or

142. *See supra* note 132.
143. *See infra* Sections III.D–III.E.

unknown to him."[144] In the case of patented compounds, for example, a "claim to the compound, per se, dominates every method of making that compound and every single use of that compound, every single mixture of different components that includes that compound, and every end use composition inclusive of the compound."[145]

You might think that such a rule of claim scope is not a good one; the question here, however, is not whether it is good but whether it should be different for abstract ideas and other subjects of patents. To conclude that it should demands some justification for treating abstract ideas differently. The main thesis of this Article is that such a justification is lacking. This Article does not argue that abstract ideas should be patentable; all it argues is that *different* treatment of abstract and applied ideas, of basic and applied science, is unwarranted.

B. THE STANDARDS OF ARGUMENT

For the abstract-ideas exclusion to make sense, there must be reasons for distinguishing abstract ideas from other subjects of patents. Any argument against patenting must apply to abstract ideas but not (or not as strongly) to the other subjects. There are plausible reasons for questioning the efficacy of our patent system compared to alternative institutional designs of innovation policy such as reliance on public or private prizes, fellowships, government funding for scientific research, compulsory licensing, market mechanisms such as first-mover advantage, trade secrecy, norms and "intrinsic" rewards, and combinations of these.[146] It is acceptable, of course, to argue that some of these mechanisms are a better fit than patents for abstract ideas. But such an argument would not be a sufficient justification for the second-class treatment of abstract ideas. For the question is not whether an alternative institutional design outperforms patents in the context of abstract ideas; the question is whether an alternative institutional design outperforms patents *to a greater extent* in the context of abstract ideas than in other contexts. Otherwise the argument would be an argument against patents altogether, not against the patenting of abstract ideas. A justification for the abstract-ideas exclusion must justify the *different* treatment of abstract ideas.

144. *In re* Thuau, 135 F.2d 344, 347 (C.C.P.A. 1943).

145. HAROLD C. WEGNER, PATENT LAW IN BIOTECHNOLOGY, CHEMICALS & PHARMACEUTICALS 177 (1992).

146. *See, e.g.*, Michael Burstein, *Exchanging Information Without Intellectual Property*, 91 TEX. L. REV. 227 (2012). For different perspectives on IP protection, see *infra* notes 231, 243 and accompanying text.

C. THE PREEMPTION RATIONALE

Having clarified the scope of the argument, this Part will now assess different justifications for excluding abstract ideas from patents. The first one to be discussed is preemption, which is the Supreme Court's current justification and the one to which many others return. The idea is that abstract ideas should not be patentable because they are "basic tools" or "building blocks" of scientific and technological work, so patenting them would inhibit a great deal of future innovation.[147]

The assumption that abstract ideas have greater potential than applied ideas to serve as tools of future innovation seems plausible, as far as such categorical assumptions go, and this Article shall not contest it.[148] The real problem with the Court's rationale is its failure to see that such greater building-block potential signals not only a greater *cost* of patenting an idea but also a greater *benefit* of incentivizing it, which is what a patent aims to do. The very feature that implies a greater deadweight loss of monopolization also implies a greater benefit of incentivization. An idea's capacity to serve as a tool of future innovation makes it more valuable, and hence, more important to incentivize. It would be perverse to declare a category of innovations unpatentable because of their great value.

Therefore, for abstract ideas' building-block potential to cut *against* patentability, it must be true that the benefits of incentivizing their production through patent rights are outweighed by the costs of such rights. Something must happen as an (otherwise patentable) invention becomes more abstract that overturns the usual assumption that the access costs of a patent are worth bearing because of its incentive benefits. An increase in abstractness must raise the social costs of patenting at a greater rate than it raises social benefits, such that the benefit and cost curves cross at some threshold of abstractness and the benefit-cost balance flips from positive to negative beyond this threshold.

147. *Prometheus*, 566 U.S. at 71–72, 86; *Myriad*, 569 U.S. at 589; *Alice*, 573 U.S. at 216.

148. *But see* Strandburg, *supra* note 9, at 577–78 ("Not all '[p]henomena of nature, . . . mental processes, and abstract intellectual concepts' have sweeping downstream impact . . . ."). Strandburg's observation is important in cautioning us not to confuse abstractness with impact (*see infra* notes 192–195 and accompanying text). Strandburg is right that "not all" abstract ideas have a great downstream impact. But the question is not whether *all* abstract ideas have great downstream potential; the question is whether, all else equal, their downstream potential tends to be significantly greater than applied ideas. The Court seems reasonable in assuming so, given that abstract ideas are fundamental and apply to a variety of contexts.

This key assumption—the *single-crossing condition*—is illustrated in Figure 1,[149] reproduced below for ease of reference.[150]

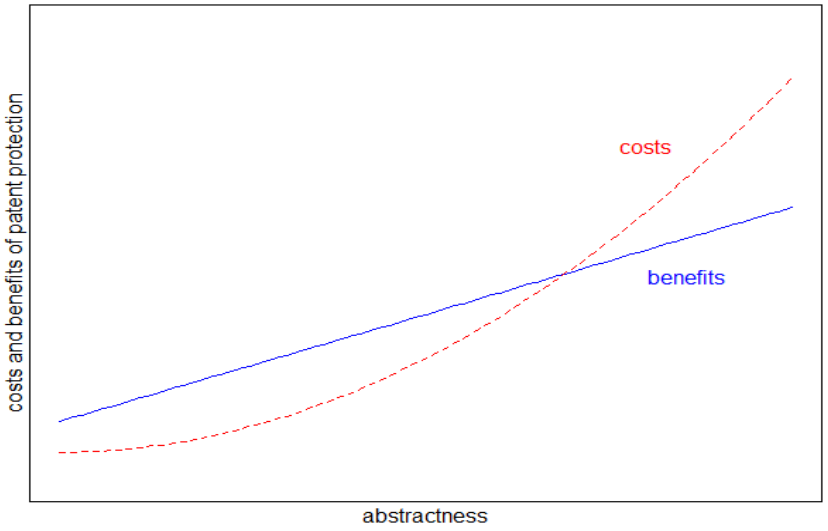

Figure 2 [same as Figure 1]: The social costs and benefits of patent protection as a function of an innovation's abstractness, as implicitly hypothesized by the Supreme Court.

But the Court has never explained why it thinks the single-crossing condition is satisfied. It has never told us why we should believe that abstraction raises costs faster than it raises benefits—rather than, say, raising benefits faster than costs or raising costs and benefits at the same rate, as in the lefthand and righthand panels of Figure 3, respectively. Indeed, the Court has never acknowledged the single-crossing condition as a necessary condition for its conclusion, let alone offered any justification for it. And there *is* no convincing justification. There is no sound theoretical reason to believe that abstraction raises costs more than it raises benefits—just as there is no reason to posit such a differential effect on costs and benefits along any number of factually meaningful but legally immaterial dimensions of invention (like the

149. What matters in the Figure is its illustration of the single-crossing condition, not the particular functional forms plotted (linear or exponential or something else).

150. The figure is a heuristic. To enable nice graphical representation, it assumes that costs and benefits are continuous in abstractness and portrays them as a function only of abstractness. A rigorous, formal statement of the single-crossing condition is as follows: Let $x \in X \subset \mathrm{R}^{\mathrm{n}}$ denote the relevant attributes of an invention, let x_i denote (increasing) abstractness, and let $b: X \rightarrow R^{+}$ and $c: X \rightarrow R^{+}$ be the benefits and costs of patentability (respectively). Then, for the preemption argument to be valid, the following condition must hold when all other patentability requirements are met: $\exists\, x_i^{*} \in X_i$ such that $b(x) - c(x) > 0\ \forall\ x_i < x_i^{*}$ and $b(x) - c(x) < 0\ \forall x_i > x_i^{*}$. *See also* the discussion in *supra* note 127.

materials used in the invention or whether the inventor habitually wears red socks). All that courts have done is point out that the cost of patenting is higher because abstract ideas have many applications in downstream innovation; but, again, the same point also shows that abstract ideas are highly valuable, so the *benefits* of incentivizing them by patents are concomitantly higher. For the valuableness of abstract ideas to count *against* their patentability, there must be some reason to believe that abstractness raises the costs of patenting more than it raises benefits, such that the benefit-cost balance flips from positive to negative. No one has offered such a reason; no one has offered a principled distinction between abstract and applied ideas that speaks to the benefit-cost balance, rather than just the cost side of the balance. Without a good reason to believe that the single-crossing condition holds, the preemption rationale crumbles.

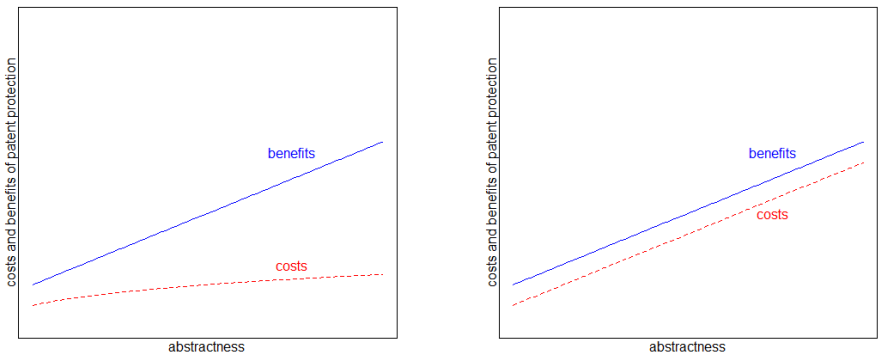

Figure 3: The social costs and benefits of patent protection as a function of an innovation's abstractness, hypothesized differently than the Supreme Court. In the lefthand panel, abstractness raises benefits faster than it raises costs; in the righthand panel, abstractness raises benefits and costs at the same rate.

A comparison with copyright law, where there *is* good reason to believe in something like the single-crossing condition, drives home the point. One might think that patent law's exclusion of abstract ideas is justified by analogy to copyright law's exclusion of ideas.[151] The argument by analogy proceeds as follows: It is black-letter law that copyright protects an *expression* of an idea,

151. *See* Peter Lee, *The Evolution of Intellectual Infrastructure*, 83 WASH. L. REV. 39, 43–44, 64 (2008) (analogizing patent law's subject matter exclusions to copyright's idea-expression dichotomy in that both allow exclusive rights in "applications" but not in "intellectual infrastructure").

not the idea itself.[152] Part of the rationale for this "idea-expression dichotomy" is that copyrighting ideas would amount to monopolizing the constituents of future expression—almost like monopolizing language itself—imposing intolerable costs on society.[153] But if bottling up the source of future expression by giving exclusive rights to ideas is not permitted in copyright law, shouldn't bottling up the tools of future innovation by giving exclusive rights to basic scientific truths be prohibited in patent law? Does copyright's exclusion of ideas justify patent's exclusion of abstract ideas? Or, conversely, does rejecting the preemption rationale in patents undermine the idea-expression dichotomy in copyright?

The answer to all these questions is no. To see why, it is helpful to distinguish two facets of the idea-expression dichotomy—first, its exclusion of scientific/technical/practical ideas, and second, its exclusion of aesthetic/literary/artistic ideas (for lack of better terms).[154] In its first aspect, the idea-expression dichotomy performs what one might call a "channeling" function: steering technical innovations away from copyright, which is designed with its minimal threshold and greater duration of protection for aesthetic creations, and guiding them to patent, with its meatier protection requirements and examination process, which screens innovations for novelty and nonobviousness before granting exclusive rights.[155] The principle is nicely illustrated by the classic case *Baker v. Selden*, where the Supreme Court explained that protecting a method of bookkeeping is "the province of letters-patent, not of copyright," because granting exclusive rights in such a method, "when no examination of its novelty has ever been officially made, would be a surprise and a fraud upon the public."[156]

The second facet of the idea-expression dichotomy applies to what one might call aesthetic ideas—such as the idea of a love story between a poor boy and a princess, or the sonata form in classical music, or genre tropes and conventions (*scènes à faire*) like a pirate with a wooden leg or a *femme fatale* in a film noir.[157] Here, the principle is not that such ideas should be channeled to another IP regime but that they are not protectable at all. The principle is

152. Mazer v. Stein, 347 U.S. 201, 217 (1954); 17 U.S.C. § 102(b).

153. Lee, *supra* note 151, at 59–60; Leslie A. Kurtz, *Copyright: The Scenes a Faire Doctrine*, 41 FLA. L. REV. 79, 96 (1989).

154. *See* BJ Ard, *Creativity Without IP? Vindication and Challenges in the Video Game Industry*, 79 WASH. & LEE L. REV. 1285, 1320–22 (2022).

155. Sepehr Shahshahani, *The Design of Useful Article Exclusion: A Way Out of the Mess*, 57 J. COPYRIGHT SOC'Y U.S.A. 859, 885 (2010).

156. 101 U.S. 99, 102 (1879).

157. *See, e.g.*, Lee, *supra* note 151, at 61.

illustrated by *Nichols v. Universal Pictures Corporation*, which held that the copyright in a popular play about a Jewish boy and an Irish Catholic girl falling in love and marrying despite their fathers' prejudices was not violated by a film also featuring a Jewish boy and an Irish girl falling in love over their parents' objections.[158] Judge Learned Hand wrote, "A comedy based upon conflicts between Irish and Jews, into which the marriage of their children enters, is no more susceptible of copyright than the outline of Romeo and Juliet."[159] In other words, no one can monopolize the general idea of a love story between children of hostile families.

Now let us analogize patent law's abstract-ideas exclusion to these two facets of copyright's idea-expression dichotomy. The first facet is clearly not analogous because there is no alternative IP regime for patent law to channel abstract ideas to; there is no IP regime specifically designed to protect abstract ideas or basic scientific truths.[160]

Less obviously, the second facet is also disanalogous. The reason lies in a fundamental difference between the kinds of innovation that the copyright and patent systems aim to promote. Copyright's domain is artistic creativity, and in that domain abstraction is not an important contribution. Soul-enriching art manifests itself, not in the general or abstract statement of propositions or feelings, but in the particular expression given to those feelings.[161] The grandest peaks of artistic achievement become platitudes when reduced to an abstract statement of their underlying ideas.[162] The glory of heroism, the pangs of love and loss, the presence and immediacy of nature, determination in face of adversity—these ideas are utter banalities that communicate nothing of the profound beauty of, respectively, Beethoven's Eroica symphony, the ghazals of Hafez and Sa'di, Bashō's haiku, Hemingway's *Old Man and the Sea*.

158. 45 F.2d 119, 123 (2d Cir. 1930).

159. *Id.* at 122.

160. Of course, some might argue that the job of incentivizing basic science is best left to innovation-policy regimes *outside* IP, an argument that will be contended with in Section III.G below.

161. *Cf.* LUDWIG WITTGENSTEIN, CULTURE AND VALUE 58e (Peter Winch trans., G.H. von Wright & Heikki Nyman eds., 1980) ("[T]he work of art does not aim to convey *something else*, just itself."); ROGER SCRUTON, BEAUTY: A VERY SHORT INTRODUCTION 95 (2011) ("For the most part you can say much about the meaning of a poem, a painting—even a work of music. But what you say will not explain the particular intensity of meaning which makes the work of art into the irreplaceable vehicle of its content.").

162. *Cf.* Ezra Pound, *A Few Don'ts by an Imagiste*, 1 POETRY 200, 201 (1913) ("Go in fear of abstractions.").

"Progress" in the artistic sphere[163] cannot possibly mean the production of such banalities, and their promotion cannot be the *raison d'être* of copyright.[164]

Figure 4 illustrates the point. It shows that the single-crossing condition is satisfied in copyright. Indeed, not only is it true that the social costs of copyrighting a creation increase at a greater rate than its social benefits as the creation becomes more abstract; it is probably true that social benefits *decrease* in abstractness.

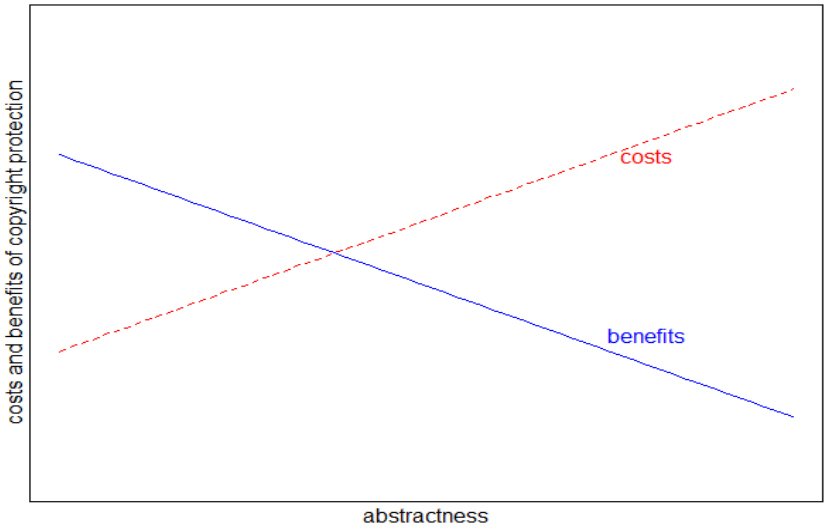

Figure 4: The social costs and benefits of copyright protection as a function of an artistic creation's abstractness.

163. *See* U.S. CONST. art. I, § 8, cl. 8 (authorizing Congress to promulgate copyright and patent laws to "promote the Progress of Science and useful Arts").

164. One might contest this understanding by arguing that certain artistic ideas are a major contribution, for example the style of cubism. The argument is unavailing because the artistic contribution lies not in *stating* an idea but in pulling it off in application. The cubist pioneers' work would not have counted for much if instead of painting cubist pictures, they had simply issued manifestos urging artists to "show different viewpoints at the same time and within the same space and so suggest their three dimensional form" and "[i]n doing so . . . emphasize[] the two-dimensional flatness of the canvas instead of creating the illusion of depth," as a prestigious museum's glossary explains "cubism." *Cubism*, TATE, https://www.tate.org.uk/art/art-terms/c/cubism (last visited Apr. 29, 2025). Indeed, when people say Picasso and Braque "invented" cubism, what they mean is that they were the first to execute the style successfully; articulating the style in the abstract would not have amounted to much. Those who disagree—those, that is, who think introducing abstract ideas is often a central contribution of art—will have a hard time justifying copyright law's exclusion of ideas. For them, this Article's arguments against the abstract-ideas exclusion in patent law, in particular about the single-crossing condition, should apply with equal force against the idea-expression dichotomy in copyright law.

In the scientific sphere of patents, by contrast, abstractions are emphatically a contribution. The laws of thermodynamics, the fundamental theorem of calculus, and the Fourier inversion theorem are not banalities—they were deep, difficult, useful findings that opened vast vistas to human understanding and innovation. In science, unlike in art, it is not the case that the abstract idea is trivial and the contribution is in expression; to the contrary, uncovering and articulating and proving the abstract idea is sometimes far more profound and difficult than its subsequent adaptation for use.[165] Thus, whereas in copyright the protection of ideas forecloses entire fields to artistic creativity without any corresponding benefit, abstract ideas are eminently worth incentivizing in patent. In short, copyright's idea-expression dichotomy does not support patent's abstract-ideas exclusion. By the same token, busting the foundation for the abstract-ideas exclusion does not weaken the underpinnings of the idea-expression dichotomy.

Before closing out the topic of preemption, a related concern floated by some commentators is worth discussing. Namely, to the extent abstract ideas constitute raw elements of scientific activity, one might worry that patenting them would prohibit others from *thinking about* a subject. In other words, "the rationale for the per se exclusion of abstract ideas from patentability [might be] that patents should not intrude on the autonomy of human thought."[166] This is potentially a graver concern than preemption, for the fear is not just tying up future innovation but restricting research and thought itself. Such a fear might have assumed greater proportions since 2002, when the Federal Circuit eviscerated the "research exception" or "experimental use defense" that exempted certain kinds of scientific research from patent liability.[167]

Ultimately, the anti-thinking rationale does not provide a strong basis for excluding abstract ideas for two reasons. First, the Patent Act clearly does not prohibit thinking about a patented principle or its subject matter. Second, how an upstream patent affects downstream research is a question of patent scope and infringement, not patentable subject matter.

On the first point, the anti-thinking concern is overstated because the act of thinking does not come within the Patent Act's definition of infringement. Nor does research per se. The Patent Act defines infringement as the

165. *See, e.g.*, Abraham Flexner, *The Usefulness of Useless Knowledge*, 179 HARPER'S MAG. 544, 544–45 (1939) (describing Marconi's contribution to the invention of radio as "practically negligible" compared to the earlier scientific work of Maxwell and Hertz).

166. Strandburg, *supra* note 9, at 591.

167. *See* Madey v. Duke Univ., 307 F.3d 1351, 1362 (Fed. Cir. 2002) (giving a "very narrow and strictly limited" scope to the experimental use defense).

unauthorized making, using, offering to sell, selling, or importing of a patented invention.[168] Nowhere does it list thinking about or researching a patented invention as an infringing act. The Federal Circuit explained this important principle of (non)infringement in a recent case:

> Classen's view of its [patent] claims appears to have been that they covered "thinking" about their subject matter. That is, of course, incorrect. The information in patents is added to the store of knowledge with the publication/issuance of the patent. An important purpose of the system of patents is to negate secrecy, and to provide otherwise unknown knowledge to the interested public . . . . The disclosure required by the Patent Act is the *quid pro quo* of the right to exclude . . . . In turn, the subject matter of patents may be investigated and verified and elaborated; the technological/ scientific contribution to knowledge is not insulated from analysis, study, and experimentation for the twenty years until patent expiration.[169]

Importantly, the principle that thinking about a patented invention does not constitute infringement is independent of any research exception. The research exception insulates an otherwise infringing act from liability;[170] by contrast, the act of thinking is not infringing in the first place.[171]

Drawing attention to well-established law that thinking is not an infringing act does not imply that all is well with how our patent system deals with downstream research. The question of how patents can promote creative incentives for upstream inventors while preserving the freedom to undertake follow-on research is one of the most fundamental questions of innovation

168. 35 U.S.C. § 271(a).

169. Classen Immunotherapies, Inc. v. Biogen IDEC, 659 F.3d 1057, 1072 (Fed. Cir. 2011) (citations and quotation marks omitted).

170. For example, in the case often cited as a progenitor of the research exception, Justice Story opined that *making* a patented machine, which unlike thinking *is* one of the acts listed in the Patent Act's definition of infringement, would not constitute infringement if done "merely for philosophical experiments, or for the purpose of ascertaining the sufficiency of the machine to produce its described effects." Whittemore v. Cutter, 29 F. Cas. 1120, 1121 (C.C.D. Mass. 1813).

171. *Cf.* Kevin Emerson Collins, *Propertizing Thought*, 60 S.M.U. L. REV. 317, 319 (2007) ("I have a legal privilege to think about the idea that animates [a] patented . . . invention and to communicate my understanding of it to others."). Note, though, that this "legal privilege" is secured by the Patent Act's definition of infringement; it requires no assistance from the doctrine of patentable subject matter.

policy, inspiring a voluminous literature in law[172] and social science.[173] This Article does not claim that the Patent Act by its definition of infringement strikes this fundamental balance just right. After all, though research per se is not an infringing act, many activities that are frequently undertaken in connection with research do come within the statutory definition of infringement.[174] That is why a number of commentators have advocated more robust immunity for research.[175]

The problem these commentators articulate is a genuine one, but it is not a problem peculiar to abstract ideas. It is, rather, an endemic and important problem of patent policy in general. And it is a problem which is most often and most usefully understood in terms of patent scope and infringement, not patentable subject matter.[176] After all, the concern here is with what someone else does with the patented invention, not with the nature of the invention. That is perhaps why, quite appropriately, the anti-thinking concern has not played a major part in courts' and commentators' arguments for the abstract-

172. *See, e.g.*, Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017 (1989) (analyzing the proper scope of an experimental use exception); Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989 (1997) (analyzing how copyright and patent laws balance the rights of original and follow-on innovators); Janet Freilich, *Paths to Downstream Innovation*, 55 U.C. DAVIS L. REV. 2209 (2022) (explaining how downstream research may proceed with or without a patentee's permission and proposing a broad research exception).

173. *See, e.g.*, Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSPS. 29 (1991) (exploring the implications of the cumulative nature of innovation on the optimal design of patent law); Alberto Galasso & Mark Schankerman, *Patents and Cumulative Innovation: Causal Evidence from the Courts*, 130 Q.J. ECON. 317, 321 (2015) (finding that a patent's invalidation leads to a substantial increase in citations to the patent, but the effect varies widely by research area); Bhaven Sampat & Heidi L. Williams, *How Do Patents Affect Follow-On Innovation? Evidence from the Human Genome*, 109 AM. ECON. REV. 203, 217–19, 232 (2019) (finding that human gene patents had little or no effect on follow-on scientific publications, clinical trials, or diagnostic tests); Janet Freilich & Sepehr Shahshahani, *Measuring Follow-On Innovation*, 52 RSCH. POL'Y 104854, 104854 (2023) (finding that gene patents close to expiration caused an increase in follow-on research but those that were far from expiration had no effect).

174. Freilich, *supra* note 172, at 2218.

175. *See, e.g.*, Eisenberg, *supra* note 172, at 1078; Rochelle Dreyfuss, *Protecting the Public Domain of Science: Has the Time for an Experimental Use Defense Arrived?*, 46 ARIZ. L. REV. 457, 471–72 (2004); Katherine J. Strandburg, *What Does the Public Get? Experimental Use and the Patent Bargain*, 2004 WIS. L. REV. 81, 83 (2004); Freilich, *supra* note 172, at 2267–69.

176. *See* Dreyfuss, *supra* note 175, at 468 (arguing that changing the definition of patentable subject matter is not a good way of fostering a "creative environment" for research because it does "not change the dual character of the fruits of modern science"—namely, that they constitute both fundamental research and end products—and may under-incentivize activity in excluded subject matters).

ideas exclusion. To the extent abstract ideas are foundations of downstream research, making them patent-eligible would make recalibration of the research exception ever more imperative. But a concern that patents should not prohibit thinking or downstream research, well-founded as it might be, does not justify categorically excluding abstract ideas from patents.

D. THE OVERBREADTH RATIONALE

As we saw in Part II, a prominent judicial rationale for the abstract-ideas exclusion is to weed out overbroad patent claims.[177] Commentators have picked up on this concern.[178] In an influential article, Mark Lemley, Michael Risch, Ted Sichelman, and R. Polk Wagner recast the abstract-ideas exclusion as "an overclaiming test," arguing that

> the rule against patenting abstract ideas is an effort to prevent inventors from claiming their ideas too broadly. By requiring that patent claims be limited to a specific set of practical applications of an idea, the abstract ideas doctrine both makes the scope of the resulting patent clearer and leaves room for subsequent inventors to improve upon—and patent new applications of—the same basic principle.[179]

The authors explain, "As claims become broader—and necessarily more general and abstract—they become more indefinite and difficult to understand, and more likely to ensnare future inventions embodying the inventive principle."[180] This rationale is similar to the preemption rationale in that it is concerned with broad downstream effects, but it is distinct to the extent it posits that claims on more abstract ideas are more likely to be vague or overbroad.

The rationale is unpersuasive. To begin, the problem of overbreadth or vagueness is not a problem of patentable subject matter; it is a problem of claim scope or precision, and patent law has separate doctrines designed specifically to deal with that. The set of doctrines known as disclosure, now codified in § 112 of the Patent Act, are aimed precisely at weeding out overbroad and vague claims.[181] Disclosure has at least three aspects:

177. *See supra* notes 54–95 and accompanying text.

178. *See, e.g.*, Kevin Emerson Collins, Bilski *and the Ambiguity of "An Unpatentable Abstract Idea,"* 15 LEWIS & CLARK L. REV. 37, 42 (2011); Lemley et al., *supra* note 9, at 1315.

179. Lemley et al., *supra* note 9, at 1315.

180. *Id.* at 1337–38.

181. *See supra* notes 43–46 and accompanying text.

enablement, written description, and claim definiteness.[182] The enablement requirement disallows claims beyond what the inventor has actually invented or what the materials disclosed in her patent application would enable skilled practitioners in the field to produce. For example, in the *Incandescent Lamp Case* the Supreme Court invalidated a claim for any "incandescing conductor for an electric lamp [made] of carbonized fibrous or textile material" where the inventor had only invented one species of conductors made of such material (namely, carbonized paper), which did not work well.[183] The written description requirement likewise ensures that the patent's specification provides sufficient notice of exactly what the claimed invention is.[184] And the claim definiteness requirement disallows unclear claims.[185] It would seem odd, given these doctrines specifically designed to weed out vague and overbroad claims, to assign the same task to a categorical exclusion of subject matter.

This would not be so odd, perhaps, if there were reason to believe that abstract ideas as a category are particularly susceptible to vagueness or overbreadth problems. But there is no reason to think that. One searches the caselaw and commentary in vain for any plausible showing that abstract ideas are generally more unclear or overbroad than applied ideas. To the contrary, given that abstract ideas are often expressible in the language of mathematics, abstract ideas tend to be more precise. Recall the examples of abstract ideas and laws of nature given in Section III.A—all unpatentable, and all far clearer than most patent claims.[186]

The confusion, I suspect, comes from the evolution of the term "abstract" in the caselaw. As documented in Part II, early American cases such as *Wyeth* and *Morse* that are often cited in connection with patent eligibility are in fact purely about overclaiming: What they held was that the patentee's claims went beyond what he had actually invented and disclosed.[187] When these opinions said a patent was too "abstract," they simply meant that the claim was overbroad.[188] Indeed, the claims at issue in those cases, concerning methods of cutting ice and communicating by electronic telegraph, are emphatically not "abstract" in the modern sense of being expressed without recourse to real-

182. *See* 35 U.S.C. § 112. There is also a "best mode" requirement in § 112, but it is insignificant in modern practice. *See* ROBERT PATRICK MERGES & JOHN FITZGERALD DUFFY, PATENT LAW AND POLICY 519 (8th ed. 2021).

183. *Incandescent Lamp Case*, 159 U.S. at 468.

184. *See, e.g.*, *Gentry Gallery*, 134 F.3d at 1479.

185. *Nautilus*, 572 U.S. at 910.

186. *See supra* notes 123–132 and accompanying text.

187. *See supra* notes 76–77, 82–89 and accompanying text.

188. *See supra* notes 90–92 and accompanying text.

world referents or applications. It was only later cases, specifically *Benson*, that subtly shifted the ground by turning from using abstractness as a synonym for overbreadth to using overbreadth as a justification against the patenting of abstract ideas in the modern sense of "abstract."[189] Crucially, though, *Benson* did so without providing any reason why abstract ideas should be less clear or more overbroad than applied ideas. Commentators have not done any better.

Seeking to distinguish their abstract-ideas-as-overclaiming interpretation from the § 112 disclosure requirements, Lemley and coauthors explain that § 112 is about "whether the disclosure is sufficient to warrant the claims" whereas "[o]verclaiming under § 101 . . . is primarily concerned with removing obstructions to follow-on innovation . . . . In the words of the Supreme Court, such claims 'wholly pre-empt' all present and future uses of the inventive principle."[190] On this account, however, the overbreadth rationale collapses back onto the preemption rationale and fails for the same reason. Namely, it fails to recognize that a greater potential to serve as a building block of future innovation signals, not only a greater cost of monopolization, but also a greater benefit of incentivization, and it fails to show that the necessary single-crossing condition on the social benefits and costs of patenting is satisfied.[191]

In this connection, it is also important to point out a conceptual problem in Lemley and coauthors' "overclaiming" argument—a conflation of the concept of abstractness or basicness on the one hand with breadth or generality or impact on the other.[192] As discussed, it is not unreasonable to assume (as the Supreme Court has) that greater abstractness is positively correlated with greater downstream impact[193]—but that does not mean that the two concepts are the same. And although it might be that, holding the technological context fixed, increasing abstractness implies broader impact, there is no warrant to think that broadening a claim necessarily implies greater

189. *See supra* note 94. As noted above, the only early opinion that can be read (with some squinting of the eyes) to use considerations of scope as a justification against patenting abstract ideas is Justice Heath's opinion in *Boulton*. *See supra* note 93.

190. Lemley et al., *supra* note 9, at 1330 (quoting *Bilski*, 561 U.S. at 610).

191. *See supra* Section III.C.

192. *See supra* note 180 and accompanying text; *see also* Lemley et al. *supra* note 9, at 1339 (observing, under the heading of "identifying abstract ideas," that claims are "too broad when they assert coverage over general ideas unmoored to any specific use"); *id.* (stating that the "generative nature" of a field, meaning whether research in the field builds successively on prior research, is a consideration in identifying whether an invention is abstract); *id.* at 1340 ("[C]laims that are not described and enabled are also more likely to be abstract.").

193. *See supra* note 148.

abstraction.[194] For example, a claim for "[a]n incandescing conductor for an electric lamp, of carbonized fibrous or textile material" is broader than one for "[t]he incandescing conductor for an electric lamp, formed of carbonized paper," but it is in no sense more abstract.[195] Broadness and abstractness are different, though the authors conflate them.

A similar (though not identical) conflation characterizes James Bessen and Michael Meurer's discussion of abstract claims. In their sweeping and penetrating critique of the patent system, Bessen and Meurer single out abstract claims as a prominent example of the patent system's failure to provide clear notice of the boundaries of patent rights.[196] The authors do not explicitly define what they mean by "abstract," but their discussion shows that in their usage an abstract claim means one that has a broad array of often unknown referents.[197] That is a very different definition of abstractness than the one used in this Article and the one which forms the basis of the abstract-ideas exclusion, at least in its current form.[198] Indeed, none of the leading contemporary examples chosen by Bessen and Meurer as examples of problematic "abstract" claiming are abstract in the sense defined herein.[199] Moreover, if one *defines* abstract ideas as those with a range of unidentifiable referents, then it is tautological to castigate them as failing to provide clear notice of property rights.

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194. *But see* Lemley et al., *supra* note 9, at 1337–38 ("As claims become broader—and necessarily more general and abstract—they become more indefinite and difficult to understand, and more likely to ensnare future inventions embodying the inventive principle."). This key passage embodies two errors: (1) It confuses breadth with abstractness, (2) it asserts, without any support, that more abstract claims are "more indefinite and difficult to understand."

195. The examples are from the *Incandescent Lamp Case*, 159 U.S. at 468.

196. *See* JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 198–212 (2008).

197. *See, e.g.*, *id.* at 199 ("The distinguishing feature of an abstract patent claim is . . . that it claims technologies unknown to the inventor."); *id.* ("With abstract patent claims, . . . the words cover unknown territory, claiming technologies that are unknown at the time the patent is filed."); *id.* at 206.

198. *See supra* Section III.A (defining abstract ideas as "ideas that can be expressed with little or no recourse to real-world referents" and providing examples).

199. Namely, the terms "point of sale location" and "material object" in the E-Data patent, the term "frame" in the Wang patent, and Pinpoint's patent in a certain matching algorithm. *See* BESSEN & MEURER, *supra* note 196, at 194–98. None of these terms claim an abstract idea in the sense of the definition given in *supra* Section III.A, "ideas that can be expressed with little or no recourse to real-world referents." If anything, the problem with these inventions was that they could *not* be clearly expressed without recourse to real-world referents, notwithstanding the patent claim's attempt to do so.

This is not to criticize Bessen and Meurer's diagnoses of certain patent problems; they have insightful things to say about software patents which this Article will draw on in its discussion of policy implications.[200] The point here, however, is that it's not compelling to define abstract ideas as those having unknowable referents and then justify their exclusion on the basis of their unknowability. It is more useful to keep the concept of abstractness separate from vagueness or precision. When that distinction is observed, one sees that abstract ideas tend to be more, not less, precisely knowable than applied ideas.[201]

Conflating abstractness with breadth has implications for how one understands and implements the subject matter exclusions. In Lemley and coauthors' interpretation, the abstract-ideas exclusion becomes a way to effectuate not just a prohibition on *over*claiming but a prohibition on *broad* claiming altogether. That is why, in the end, their overclaiming rationale collapses back onto the preemption rationale.[202] But the(se) rationale(s) cannot get any help from a general prohibition against the patenting of broad or high-impact claims—because there is no such prohibition in patent law. Of course there is a prohibition on claims beyond what you have invented or disclosed, but there is no doctrine that says you cannot claim a broad invention *that you have actually invented and disclosed* (provided the other requirements of patentability are met).[203] As the dissent in *Morse* pointed out, "The patent law and judicial decisions may be searched in vain for a provision or decision that a patent may be impugned for claiming no more than the patentee invented or discovered."[204] The Court in the *Telephone Cases* took the same line, rejecting

200. *See infra* notes 322–328 and accompanying text.

201. *See supra* notes 123–132 and accompanying text; *see also* text accompanying note 186.

202. *See supra* notes 190–191 and accompanying text.

203. There was historically such a thing as claim "overbreadth" or "undue breadth" doctrine, but the doctrine addressed § 112 concerns, mostly lack of enablement and sometimes indefiniteness. *See In re* Cavallito, 282 F.2d 357, 360 (C.C.P.A. 1960); *In re* Rainer, 305 F.2d 505, 508–09 (C.C.P.A. 1962); *In re* Boller, 332 F.2d 382, 386 (C.C.P.A. 1964); *In re* Grier, 342 F.2d 120, 126–27 (C.C.P.A. 1965); *In re* Corr, 347 F.2d 578, 580 (C.C.P.A. 1965); *In re* Borkowski, 422 F.2d 904, 910 (C.C.P.A. 1970); *In re* Skrivan, 427 F.2d 801, 805 (C.C.P.A. 1970); *In re* Fouche, 439 F.2d 1237, 1242–43 (C.C.P.A. 1971); *In re* Hawkins, 486 F.2d 569, 575–76 (C.C.P.A. 1973); *see also In re* Vaeck, 947 F.2d 488, 492 n.20, 495–96 (Fed. Cir. 1991). Among ancient cases, those advancing the now-firmly-discarded proposition that processes are unpatentable may also be interpreted as espousing a general prohibition on claim breadth. *See supra* notes 58–60 and accompanying text (discussing Justice Heath's opinion in *Boulton*). Among more recent cases, *Benson* comes closest to suggesting a prohibition of broad claims. *See Benson*, 409 U.S. at 69.

204. O'Reilly v. Morse, 56 U.S. 62, 135 (1853) (Grier, J., concurring and dissenting).

the contention that Bell's patent should be invalidated because he had made a great and sweeping invention:

> It may be that electricity cannot be used at all for the transmission of speech, except in the way Bell has discovered, and that therefore, practically, his patent gives him its exclusive use for that purpose; but that does not make his claim one for the use of electricity distinct from the particular process with which it is connected in his patent. It will, if true, show more clearly the great importance of his discovery, but it will not invalidate his patent.[205]

But *should* there be a general prohibition on broad claims, even if it finds no support in patent doctrine? One might think that an argument grounded in diminishing marginal utility supports such a prohibition. The argument would be that because the marginal benefit to a patentee declines as the rewards to a patent increase, limiting the scope of a patent to specific applications is a good way to limit social costs while preserving incentives to innovate.[206]

As a general matter, the logic of diminishing marginal returns is sound—at least as applied to individual innovators.[207] But, as a justification for the exclusion of abstract ideas, the argument fails on multiple fronts. First, it misidentifies the relevant costs and benefits. The question for the abstract-ideas exclusion is whether the costs of a patent *to society* increase at a greater rate than its benefits to society *as an invention becomes more abstract* such that the costs exceed the benefits if (and only if) the invention is sufficiently abstract. That is the question that determines whether the single-crossing condition is satisfied. The diminishing-returns argument does not answer that question. Rather, it says that the benefits *to a patentee* increase at a decreasing rate *as the patent rewards increase*. These are two separate relationships, and the second does not illuminate the first. That is, it does not follow from the fact that *a patentee's* marginal returns from *increasing patent rewards* are diminishing that *society's* marginal returns from *increasingly abstract inventions* should also be diminishing.

The diminishing-returns argument supplies a good reason for capping a patentee's exclusive rights. It helps explain, for example, the wisdom of short patent terms. But the logic is not limited to abstract ideas and applies equally to other categories of innovation. Moreover, limiting the *subject matter* of

205. *Telephone Cases*, 126 U.S. at 535.

206. Thanks to Mark Lemley for suggesting this argument.

207. It does not apply to firms, which are overwhelmingly the owners of high-value patents. Firms' utility is the profit function, which is linear in patent-related payoffs. Thanks to Mike Meurer for this point. Ultimately, a satisfying theory of incentives must be microfounded on individuals, but individual innovators may not be the right target.

patents to effectuate the diminishing-returns logic is a bad idea because subject matter limitations distort creative incentives at the level of deciding what to innovate. Knowing that abstract innovations will not be rewarded except in application, even when the innovation covers and enables more than the application, makes potential innovators more likely to channel their inventive effort into areas of applied science and technique, and more abstract-minded ones may choose not to innovate at all.[208]

To sum up, the overbreadth rationale is unpersuasive for a host of reasons. It supplies no reason to think that more abstract ideas are more likely to be overbroad or vague (the contrary seems more likely). It confounds a problem of claim scope, which is governed by separate disclosure doctrines, with a problem of patentable subject matter. And to the extent it is distinguishable from disclosure concerns, it collapses back onto the preemption rationale and fails for the same reason. Finally, neither the preemption nor the overbreadth rationale can claim any support from a more general prohibition on the patenting of broad claims because there is no such prohibition in patent law and because such a prohibition would not make sense.

E. THE PROBLEM OF UNFORESEEN APPLICATIONS

Closely related to overbreadth, another rationale for the abstract-ideas exclusion is that an abstract idea may have many embodiments or applications that the original innovator did not intend or even envisage, some of which may be more valuable than the original innovation.[209] To give the original innovator an exclusive right that could block subsequent innovators from exploiting these valuable and originally unknown follow-on innovations might be too great a social cost to bear.[210]

The problem here is not with overbroad affirmative rights but with overbroad negative rights.[211] Appreciating this distinction requires looking closely at how patent law allocates rights between original and follow-on innovators. In a nutshell, the law is that a patent does not give the patentee an exclusive right to practice someone else's follow-on innovation that comes within the scope of the original patent claim if the follow-on innovation itself meets the requirements of patentability; rather, the follow-on innovator may

208. One might argue that there are better, non-IP ways of incentivizing innovation in basic science, but that is a separate argument from diminishing returns, and it will be discussed in Section III.G below.

209. *See*, *e.g.*, *Benson*, 409 U.S. at 68; *Morse*, 56 U.S. at 113.

210. *See* Janet Freilich, *The Replicability Crisis in Patent Law*, 95 IND. L.J. 431, 470 (2020); Strandburg, *supra* note 9, at 573.

211. *See*, *e.g.*, BESSEN & MEURER, *supra* note 196, at 4, 6, 199.

independently patent such an innovation.[212] However, the original patentee may block the follow-on innovator from practicing the new invention, just as the follow-on patentee may block the original patentee from practicing the new invention (though not from practicing the original invention).[213] This situation is referred to as "blocking patents."[214] To illustrate, suppose Ahmad concocts and patents a new chemical compound (Glachomycetirin) that is useful in polishing wood. Bethany later discovers that Glachomycetirin is useful in treating skin rashes and invents a process for turning it into an ointment to be applied to skin. Assuming that Bethany's innovations meet the requirements of patentability—for example, the discovery of Glachomycetirin's new properties and the process of turning it into an ointment were novel and nonobvious—Bethany can obtain a patent on the new ointment and the process of producing it. At that point, Bethany cannot use or market her ointment without Ahmad's license, nor can Ahmad do the same without Bethany's license (though Ahmad can continue to use and market Glachomycetirin in its original wood-polishing application).[215]

As this explanation illustrates, blocking patents is a rather ingenious device for managing rights between original and follow-on innovators. It incentivizes the original innovator by giving her rights extending to the full limit of what she has invented while also providing incentives for follow-on innovators by giving them rights over the use of their improvements.[216] The balance thus struck by the doctrine, which also facilitates mutually profitable agreement to bring the improvement to practice, has been amply praised by commentators.[217] On the whole, then, blocking patents gives us confidence in the capacity of the patent system to handle innovations with many potential unforeseen applications.

This is not to say, however, that patent law strikes the perfect balance between the rights of original and follow-on innovators. It might be that when bargaining breaks down, such as when the improvement would render the

212. *See* 35 U.S.C. § 101 (authorizing patents in "any new and useful improvement" of an existing invention); *see also* Prima Tek II, L.L.C. v. A-Roo Co., 222 F.3d 1372, 1379, 1379 n.2 (Fed. Cir. 2000).

213. *Prima Tek II*, 222 F.3d at 1379, 1379 n.2.

214. *Id.*

215. For a real-world example involving hepatitis C drugs, see Freilich, *supra* note 172, at 2216–17.

216. *See id.* at 2217–18.

217. *See* Robert Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75, 81 (1994); Lemley, *supra* note 172, at 991–92; Freilich, *supra* note 172, at 2217–18.

original invention obsolete or cut into its market, the law should give the follow-on innovator more leverage to force a breakthrough, for example by providing for a compulsory license (though this is a problem more relevant to applied than abstract upstream innovations).[218] Or it might be that the law should allow some follow-on work, particularly scientific verification or testing of the original innovation, without requiring a license, as discussed above in the context of the research exception.[219] More generally, one might reconsider black-letter law that where a patent application sufficiently shows one use, the patent covers all applications of the claimed invention for *other* uses.[220]

But these are questions of patent scope and infringement, not patentable subject matter. They concern what someone else should be permitted to do in the face of an existing patent, not whether certain inventions should be categorically ineligible, especially given that the problems apply to all upstream-downstream conflicts and not just to abstract ideas. Indeed, some aspects of the conflict, such as a new application making an old one less valuable, apply with greater force to applied than abstract innovations. So, while the problem of unforeseen applications does prompt one to think harder about how the patent system manages conflicts between upstream and downstream innovators, it does not provide a persuasive justification for the abstract-ideas exclusion. In the end, to argue that an innovation should be unpatentable because it might have many applications is to make an innovation's valuableness a bar to its patentability, the same perversity to which the preemption and overbreadth rationales fall victim.

F. THE INVENTION-DISCOVERY DICHOTOMY, OR THE "PREEXISTING" PROBLEM

As discussed in Part II, another argument against the patentability of abstract ideas is that they are discoveries, not inventions.[221] This does not sound like a promising argument as a matter of positive law—the Patent Act uses both "discovers" and "invents" to describe acts that could entitle one to a patent,[222] and it defines "invention" to include "discovery"[223]—but the argument is worth pausing on as a normative justification.

At one level, the argument amounts to question-begging. If all that the labels "discovery" and "invention" do is separate patent-ineligible abstract

218. *See* Joseph A. Yosick, *Compulsory Patent Licensing for Efficient Use of Inventions*, 2001 U. ILL. L. REV. 1275, 1293–98 (2001); Merges, *supra* note 217, at 104–05.

219. *See supra* notes 167–176 and accompanying text.

220. *See supra* notes 144–145 and accompanying text.

221. *See supra* notes 96–101 and accompanying text.

222. 35 U.S.C. § 101.

223. 35 U.S.C. § 100(a).

ideas from patent-eligible applications, then saying that abstract ideas should not be patentable because they are discoveries does no more than restate the conclusion that abstract ideas should not be patentable. To make the argument non-vacuous, one would have to identify some feature of discoveries, in contradistinction to inventions, that makes them ineligible for patenting.

One apparent distinguishing feature is that discoveries point to something preexisting whereas inventions create something new.[224] Similarly, the invention-discovery dichotomy could be taken to distinguish "human-made" things from things that are already "out there" in nature.[225] The argument could be that only the former should be patent-eligible because only they owe their existence to human ingenuity.[226] By contrast, being on the wrong side of the invention-discovery dichotomy amounts to failing the novelty requirement.[227]

To the extent the invention-discovery dichotomy is meant to prohibit patenting things that are immediately perceptible, this Article has already incorporated that idea in its definition and exclusion of "natural phenomena." Recall that natural phenomena were defined as phenomena existing or occurring in nature that can be readily perceived by the senses, such as rain or earthquakes.[228] And this Article argued that there are three reasons to doubt that natural phenomena, so defined, are suitable for patent protection: Knowledge of them is pervasive and goes back to time immemorial; the right discoverer or inventor cannot be pinpointed; and, to the extent finding a physical thing is worthy of incentivizing, that task belongs to property rather than intellectual property law.[229] That is why this Article is focused on abstract ideas and laws of nature, not natural phenomena.

Apart from pointing to natural phenomena, a category that this Article has already excluded from the analysis, the invention-discovery dichotomy is utterly irrelevant to patent policy. The standard justification for intellectual property rights is to incentivize the provision of public goods that would

224. *Flook*, 437 U.S. at 593 n.15 ("The underlying notion [that justifies subject matter exclusions] is that a scientific principle . . . reveals a relationship that has always existed."); *see supra* notes 96–101 and accompanying text.

225. *See* Syed, *supra* note 9, at 1942–43 (calling this reasoning "a central refrain of courts").

226. *Id.*; *see also In re* Bilski, 545 F.3d 943, 1013 (Fed. Cir. 2008) (Rader, J., dissenting) ("Natural laws and phenomena can never qualify for patent protection because they cannot be invented at all. After all, God or Allah or Jahveh or Vishnu or the Great Spirit provided these laws and phenomena as humanity's common heritage.").

227. *See Flook*, 437 U.S. at 593 n.15; Collins, *supra* note 178, at 57 (claiming that laws of nature "would be inherently anticipated under section 102, as the states of affairs described by the claims long predated their discovery by humankind").

228. *See* discussion *supra* Section III.A.

229. *Id.*

otherwise be under-provided because of freeriding.[230] This rationale is theoretically plausible, albeit hotly contested.[231] But, whatever one's view may be of the rationale for IP protection, what is clear is that its validity does not depend on whether the innovation being incentivized is best characterized as a discovery or an invention. Neither the public good aspect of an innovation nor its value depends in any way on that classification. Take, for example, Guglielmo Marconi's "invention" of radio following the groundbreaking "discoveries" of James Clark Maxwell, whose theoretical work predicted the existence of electromagnetic waves, and of Heinrich Hertz, who experimentally verified the waves' existence.[232] The public good characterization (nonrivalrous and nonexcludable) applies equally to the basic discoveries of Maxwell and Hertz as to later applications by Marconi. Nor can it be said that the basic science was in any sense less innovative or difficult or worthy of incentivization than its application; if anything, the opposite was true,[233] as is often the case.[234]

By the same token, the idea propounded in *Flook* that abstract ideas and laws of nature would categorically fail the novelty requirement is manifestly false.[235] The very example chosen in *Flook*—"Newton's formulation of the law of universal gravitation"—demonstrates its falseness.[236] The Court was right that "this relationship always existed—even before Newton announced his celebrated law"[237]—in the sense that the force of gravity operated before Newton knew anything about it. But it is surely not true (assuming the accuracy of standard histories of physics) that knowledge of Newton's equation

230. *See supra* notes 34–39 and accompanying text.

231. *Compare, e.g.*, MICHELE BOLDRIN & DAVID K. LEVINE, AGAINST INTELLECTUAL MONOPOLY (2008) (advocating IP abolition), *with* RONALD A. CASS & KEITH N. HYLTON, LAWS OF CREATION: PROPERTY RIGHTS IN THE WORLD OF IDEAS (2013) (advocating strong IP rights). For reviews of the range of scholarly views on IP protection, see Shahshahani, *supra* note 34, at 50; Richard Gilbert, *A World Without Intellectual Property?*, 49 J. ECON. LITERATURE 421 (2011).

232. *See generally* Marconi Wireless Tel. Co. of Am. v. United States, 320 U.S. 1 (1943); SUNGOOK HONG, WIRELESS: FROM MARCONI'S BLACK-BOX TO THE AUDION (2001).

233. *See* Flexner, *supra* note 165, at 544–45 (describing Marconi's contribution as "practically negligible" compared to the earlier scientific work).

234. *See supra* Section III.A (providing examples of abstract ideas that were demanding to derive); *supra* Section III.C (showing that in science, unlike in art, the abstract statement of an innovation's working principle is far from trivial).

235. *See Flook*, 437 U.S. at 593 n.15.

236. *See id.*; *see also supra* note 132.

237. *Flook*, 437 U.S. at 593 n.15.

preceded his ingenuity.[238] As such, granting him a patent would not have "deprived [the public] of any rights that it theretofore freely enjoyed."[239] Indeed, the Court's statement that laws of nature "always existed" could be taken to invalidate pretty much any patent, as all innovations are ultimately the reduction to practice of scientific principles that "always existed" in the Court's sense.[240]

In short, the "preexisting" argument applies only to immediately perceptible things that fall into the category of natural phenomena, which was already excluded from analysis in Section III.A, not to abstract ideas and laws of nature, which are the subject of this Article. The need for a patent right does not depend on the invention-discovery classification. That human knowledge of a law of nature does not predate human discovery (even if the law itself does) is all that matters for purposes of patent policy because the discovery produces precisely the kind of public good that patents are meant to incentivize.

G. NON-IP REGIMES TO INCENTIVIZE BASIC SCIENCE

A final justification for the abstract-ideas exclusion rests on a comparative institutional analysis of basic and applied science. The argument is that IP rights do a good job incentivizing applied science and technology, but non-IP regimes are better suited to promoting basic science.[241]

Before assessing this justification, it is useful to repeat a point about the standards of argument: An acceptable comparative-institutional argument must *distinguish* abstract ideas from other subjects of patents—it must provide a reason against patenting that applies to abstract ideas but not (or not as strongly) to other subjects.[242] It is not enough to demonstrate (or, more realistically, to plausibly suggest) that a non-IP regime would do better than IP in governing basic science; it must be shown that the non-IP regime's advantages are greater in basic science than in applied science. Otherwise, the argument would be one against patent rights *tout court*, not against patent rights

238. *Cf.* Syed, *supra* note 9, at 1937, 1942, 1943 (insisting that what patent law protects is not just a physical object but also the knowledge of constructing or using the object).

239. *See supra* Section III.A (discussing what a hypothetical patent on Newton's law of gravity would cover).

240. *Cf. Diamond v. Diehr*, 450 U.S. 175, 189 n.12 (1981) ("To accept the analysis [based on *Flook*] would, if carried to its extreme, make all inventions unpatentable because all inventions can be reduced to underlying principles of nature which, once known, make their implementation obvious.").

241. *See, e.g.*, Syed, *supra* note 9, at 1945–46.

242. *See supra* Section III.B.

in basic science. The superiority of IP rights to other institutional arrangements for incentivizing innovation is very much an unsettled and speculative proposition.[243] But the question here is not whether patent rights should exist; the question is whether there is a reason to extend patent rights to all sorts of innovations but not to basic science. A justification for the abstract-ideas exclusion must justify the *different* treatment of abstract ideas.

Some attempts at building a comparative institutional case for the abstract-ideas exclusion effectively repeat the building-block rationale, which was disposed of in Section III.C.[244] Beyond that, I can discern two primary rationales are discernable in the literature under the comparative-institutional umbrella, which will be discussed in turn.

1. Unimportance of Profit Motive

The first rationale for leaving abstract ideas out of patents is that people engaged in basic science are motivated not so much by financial profit as by values such as advancing the frontiers of science, curiosity, the intrinsic pleasures of discovery, and scientific status.[245] As such, offering financial rewards from patents would do little to motivate basic scientists to innovate while imposing monopoly deadweight loss and access costs on society.[246] John Golden, in his revealing study of the American biotechnology ecosystem, succinctly articulates this view: "By extending its reach to subject matter traditionally reserved for the public domain of natural science, patent law risks creating obstacles to future research and invention without adding proportionately to the actual motivations of those who do the inventing."[247]

The argument from motivations has not been a centerpiece of judicial rationales for the abstract-ideas exclusion, and one can see why: It seems a

243. More than 60 years ago, Fritz Machlup concluded his careful survey of the patent system by stating that "[n]o conclusive empirical evidence is available to decide" the conflict between pro-patent and anti-patent views, so "the safest 'policy conclusion' is to 'muddle through.'" SUBCOMM. ON PATS., TRADEMARKS, & COPYRIGHTS OF THE S. COMM. ON THE JUDICIARY, 85TH CONG., AN ECONOMIC REVIEW OF THE PATENT SYSTEM 79–80 (Comm. Print 1958) (report of Fritz Machlup). Today, despite the mass of social scientific evidence (and even greater mass of polemic) brought to bear on the question, strong scholarly disagreements remain. *See supra* note 231 (outlining different views); *supra* note 173 and *infra* note 256 (reviewing some of the social scientific literature).

244. *See* Syed, *supra* note 9, at 1982 (arguing that basic science should not be patentable because it "serves as a *foundational platform* for all subsequent researchers").

245. *See* John M. Golden, *Biotechnology, Technology Policy, and Patentability: Natural Products and Invention in the American System*, 50 EMORY L.J. 101, 144 (2001); Syed, *supra* note 9, at 1985.

246. Golden, *supra* note 245, at 144; Syed, *supra* note 9, at 1991.

247. Golden, *supra* note 245, at 110.

little unfair to punish scientists for being pure, to tell them the system shall give you less money because you are less of a moneygrubber. However, given the creative-incentives framework of American intellectual property law,[248] the argument is a serious one. It would be a strong argument against patentability if the availability of patents for abstract ideas would add to access costs while doing little to advance creative incentives.

The strength of this rationale depends on the accuracy of its claims about scientists' creative motivations. As someone who left a BigLaw job for a PhD program, I would be the last to doubt the nonpecuniary attractions of the life of the mind. It is not clear, however, that the divide between external-profit-motivated and internal-rewards-motivated innovators approximates the divide between applied and basic scientists.[249] Just as there have been many basic scientists who were in it for the love of pure science, there have been many applied scientists and technologists, from Benjamin Franklin[250] to Steve Wozniak,[251] who were in it for the love of tinkering and to serve others. Conversely, there have been many basic scientists who were driven by the profit motive.[252] Moreover, some of the most prominent movements with a

248. *See supra* notes 34–39 and accompanying text.

249. Indeed, the management consultants quoted by Golden on the importance of nonmonetary motivations for employee innovation are speaking of "inventor-type people" in the context of applied science in industry. *See* Golden, *supra* note 245, at 159–60.

250. Franklin refused on principle to patent his inventions. *See* Benjamin Franklin, *The Autobiography of Benjamin Franklin* (1793), THE ELECTRIC BEN FRANKLIN 55, https://www.ushistory.org/franklin/autobiography/page55.htm (last visited July 31, 2025) ("Governor Thomas was so pleased with the construction of this stove, . . . that he offered to give me a patent for the sole vending of them for a term of years; but I declined it from a principle which has ever weighed with me on such occasions, viz., *That, as we enjoy great advantages from the inventions of others, we should be glad of* an *opportunity to serve others by any invention* of ours; and this we should do freely *and generously*.").

251. *See* Jonathan Vanian, *Apple Co-Founder Steve Wozniak Talks Innovation, Microsoft, and Being Introverted*, FORTUNE (Apr. 21, 2017), https://fortune.com/2017/04/21/steve-wozniak-apple-microsoft/ ("I didn't want to be near money, because it could corrupt your values . . . . I went the other way. I did not want to be one of them. I invested early in things like museums in the city I love, San Jose . . . . I really didn't want to be in that super 'more than you could ever need' category."); Emmie Martin, *Why Apple Co-Founder Steve Wozniak Doesn't Trust Money*, CNBC (Apr. 21, 2017), https://www.cnbc.com/2017/04/21/why-apple-co-founder-steve-wozniak-doesnt-trust-money.html (contrasting Wozniak's $100 million net worth with Steve Jobs's $10.2 billion and noting that an "initial reason for this divergence in net worth is Wozniak's disinterest in money from the start" and his 1980 decision, unlike Jobs, to offer $10 million of his own stock to early Apple employees).

252. For example, Herbert Boyer, whose basic scientific work helped establish the field of genetic engineering, moved from academia to industry early on to cofound Genentech, the first biotechnology company. *See Our Founders*, GENENTECH, https://www.gene.com/about-us/leadership/our-founders (last visited Apr. 29, 2025).

nonprofit, communitarian attitude toward innovation, such as the open-source software movement, come from the world of technology and applied science, not basic science.[253]

But these are details. Let us assume, for the sake of argument, that the proportion of people who are not strongly motivated by pecuniary considerations is significantly higher in basic science than in applied science. There is a deep problem with inferring from this assumption that the introduction of patents would do little to incentivize more creative work in basic science. That deep problem is *endogeneity*. What the proponents of the creative-motivations rationale are missing is that the mix of motives and characteristics of innovators in basic science is endogenous to the innovation policy regime governing basic science. The proportion of profit-motivated people in a field depends on the field's profit potential, which in turn depends on the availability of IP rights in the field. When one of two adjacent career paths offers greater promise of financial rewards through IP, it would be no surprise to see a greater proportion of profit-motivated people drawn to that path. But such differences in innovators' motives in the two fields would be a function of the different policy regimes governing the fields.

These observations about endogeneity have an important policy implication: You cannot accurately estimate the impact of a change in patent eligibility by reference to the *current* motivations of innovators in basic science because a change in policy would change the selection of innovators and their motivations. Just as the current mix of innovator characteristics is a function of the current IP regime, the future mix will be affected by the future regime. Greater availability of patent rights would likely change the *selection* of innovators into the field. That would be expected to accelerate the rate of basic scientific innovation—not just by adding fuel to the creative fire of those who were *already* doing basic science but also by bringing in *new* people who otherwise would not have entered the field.[254] In sum, the argument that

253. *See generally* ERIC S. RAYMOND, THE CATHEDRAL AND THE BAZAAR: MUSINGS ON LINUX AND OPEN SOURCE BY AN ACCIDENTAL REVOLUTIONARY (1999); Yochai Benkler, *Coase's Penguin, or, Linux and* The Nature of the Firm, 112 YALE L.J. 369 (2002).

254. Some of the results that might be expected from a change in patent policy have already materialized due to changes in industry and patenting culture that have made remunerative careers more available. Two decades ago, Golden wrote that the "supermajority" of life science PhDs being employed by government labs, universities, and research institutes (as opposed to biotech industry) "appears safe for years to come." Golden, *supra* note 245, at 146. In fact, the supermajority has been eliminated. *See* NAT'L CTR. FOR SCI. & ENG'G STAT., NAT'L SCI. FOUND., NSF 22-300, DOCTORATE RECIPIENTS FROM U.S. UNIVERSITIES: 2020 22–23 (2021) (finding that "[d]uring the past 2 decades, regardless of citizenship status, the proportion of doctorate recipients with definite postgraduation commitments for employment

making abstract ideas patent-eligible would not add much to creative incentives because today's basic scientists are not primarily profit-motivated is circular.

Nor can the argument be saved by contending that we should not mess with the incentive structure of basic science because the present structure "appears to have served science and society well."[255] It is difficult to estimate the optimal rate of innovation in basic science (or any other area of innovation, for that matter). And the lack of meaningful experience with the relevant counterfactual—that is, an innovation policy system that *does* award patents for abstract ideas—makes it almost impossible to compare different systems.[256] Therefore, commentators have little basis for taking comfort in the current state of affairs.

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in academia has declined and those in the industry or business sector has grown," and providing figures contradicting the claim of a "supermajority" in government and academia); NAT'L CTR. FOR SCI. & ENG'G STAT., NAT'L SCI. FOUND., NSF 23-319, SURVEY OF DOCTORATE RECIPIENTS DATA: 2021, at tbl. 12-1 (2021), https://ncses.nsf.gov/pubs/nsf23319/table/12-1 (showing that the combined percentage of academic and government jobs does not rise to a supermajority, neither in sciences as a whole nor in biological sciences); NAT'L CTR. FOR SCI. & ENG'G STAT., NAT'L SCI. FOUND., NSF 21-319, U.S. EMPLOYMENT HIGHER IN THE PRIVATE SECTOR THAN IN THE EDUCATION SECTOR FOR U.S.-TRAINED DOCTORAL SCIENTISTS AND ENGINEERS: FINDINGS FROM THE 2019 SURVEY OF DOCTORATE RECIPIENTS, at tbl. 2, fig. 2 (2021), https://ncses.nsf.gov/pubs/nsf21319 (showing that a plurality of PhD holders in science, engineering, and health who reside in the United States are employed in business or industry, and that the combined share of education and government sectors does not rise to a supermajority); *see also* Christopher T. Smith, *A Deep Dive into Ph.D. Employment Data from NSF*, CHRISTOPHERTSMITH.COM: REFLECTIONS BLOG (May 24, 2023), https://www.christophertsmith.com/reflections/a-deep-dive-into-phd-employment-data-from-nsf (finding, on the basis of the Survey of Earned Doctorates and the Survey of Doctorate Recipients, that industry has replaced academia as the leading employer of life science PhDs and that the share in industry is greater than the combined share of academia and government).

255. Golden, *supra* note 245, at 110.

256. There is, however, a rich literature that attempts to use credible causal identification strategies to estimate the effect of patent policy on innovation. The historical strand of this work is particularly relevant for isolating the effect of different policy regimes (as opposed to the effect of patents *given* a particular policy regime). *See generally* Petra Moser, *Patents and Innovation: Evidence from Economic History*, 27 J. ECON. PERSPS. 23 (2013) (reviewing the literature). But the deep differences between the contexts studied in such historical work and the present American context make it hard to infer policy conclusions (though it's better than proceeding by *ipse dixit*). Moreover, there are few empirical studies bearing on the patentability of abstract ideas. *But see* James Hicks, *Do Patents Drive Investment in Software?*, 118 NW. U. L. REV. 1277 (2024) (finding no effect of patent grant on a business-methods software startup's ability to attract early-stage venture capital).

To go by the judgment of many scientists, things are *not* just fine. After highlighting how a few techniques developed by basic biological research enable much of current applied biological and biomedical research, Isobel Ronai and Paul Griffiths conclude that "[b]asic research is not sufficiently valued by the scientific reward system, funding agencies, or the general public."[257] Robbert Dijkgraaf, a prominent theoretical physicist who served as director of the Institute for Advanced Study, has warned that "the state of scholarship [in basic science] has now reached a critical stage" following a decades-long "retrenchment" from the strong pro-science position of the postwar decades.[258] Dijkgraaf points to steadily declining public funding for basic science coupled with diminished support from an increasingly short-termist private sector.[259] "As a consequence of the priorities and politics of the time, basic research is too blithely given short shrift, its budget often ending up as the remainder of a growing series of subtractions."[260] Similar warnings have been sounded by prominent scientists and scientific institutions.[261] All this makes a "fine as it is" attitude hard to sustain.

Nor can one rescue the motivation-based argument by reference to "norms of science" such as "openness and sharing," "disinterestedness," and "impartiality."[262] This statement of the norms is clearly idealized. More fundamentally, relying on current norms to justify the current institutional structure suffers from the same endogeneity fallacy as relying on individual motivation: The norms of different fields are endogenous to the policy regimes

257. Isobel Ronai & Paul E. Griffiths, *The Case for Basic Biological Research*, 25 TRENDS IN MOLECULAR MED. 65, 66 (2019).

258. Robbert Dijkgraaf, *The World of Tomorrow*, *in* THE USEFULNESS OF USELESS KNOWLEDGE 1, 33 (2017).

259. *Id.* at 33–34.

260. *Id.* at 35.

261. *See, e.g.*, Eric Hand, Beth Mole, Lauren Morello, Jeff Tollefson, Meredith Wadman & Alexandra Witze, *A Back Seat for Basic Science*, 496 NATURE 277 (2013); MIT COMM. TO EVALUATE THE INNOVATION DEFICIT, THE FUTURE POSTPONED: WHY DECLINING INVESTMENT IN BASIC RESEARCH THREATENS A U.S. INNOVATION DEFICIT (2015), https://www.aau.edu/sites/default/files/AAU%20Files/Key%20Issues/Innovation%20%26%20Competitiveness/Future-Postponed.pdf; Robbert Dijkgraaf, *We Need More "Useless" Knowledge*, CHRON. HIGHER EDUC. (Mar. 2, 2017), https://www.chronicle.com/article/we-need-more-useless-knowledge/; Craig A. Tovey, *In Defense of Basic Research*, 355 SCIENCE 804 (2017); Jeffrey A. Bluestone, David Beier & Laurie H. Glimcher, *The NIH Is in Danger of Losing Its Edge in Creating Biomedical Innovations*, STAT (Jan. 3, 2018), https://www.statnews.com/2018/01/03/nih-biomedical-research-funding/; Giuliana Viglione, *NSF Grant Changes Raise Alarm About Commitment to Basic Research*, 584 NATURE 177 (2020).

262. Syed, *supra* note 9, at 1992.

governing the fields, so the supposed fact that *current* basic scientists are animated by "sharing" norms does not imply that introducing patents would not appreciably add to creative incentives, because introducing patents would be expected to attract *new* basic scientists.

2. Uncertain Prospects

A second comparative-institutional justification for the abstract-ideas exclusion is that the road from basic scientific discovery to commercial application is long and uncertain, so basic science would not be adequately incentivized if it were left to market-based mechanisms such as patents which are focused on short-term rewards.[263] The argument's premise is sound: There are many examples of basic scientific discoveries whose applications were not developed until long after the initial scientific breakthrough—from how Newtonian/Leibnizian calculus undergirds the marvels of modern engineering, to the use of Maxwell's classical theory of electromagnetic radiation in radio and television broadcasts, to the application of mathematical group theory in spectroscopy, to the use of Einstein's theory of relativity in the design of GPS devices, to how quantum theory helps with work on microprocessors and lasers, to the use of basic biochemical discoveries in genetic engineering and cloning.[264]

But this is a curious argument to employ *against* patents—because it shows that basic science needs *more*, not less. It may well be that, given the long and uncertain monetary payoffs of basic science, public funding would still be necessary even if patents were made available. But it's hard to see how this argues against patentability. If no work would have been done on applications during the patent's term, then the patent will have done no harm; meanwhile, for basic discoveries that do have plausible short-term applications, the patent adds to creative incentives.

A possible counterargument is that the availability of a patent may do harm by "crowding out" other motivations. The prospect of profit may turn away those who are attracted to science for reasons other than short-term monetary gain, or may reorient their values, to the detriment of basic research.[265] A nice illustration of this idea comes from a study of a daycare facility where the introduction of a fine for parents who were late picking up their child led to

263. *See id.* at 1988.

264. *See* Flexner, *supra* note 165, at 545–48; Dijkgraaf, *supra* note 258, at 18–20; Ronai & Griffiths, *supra* note 257, at 65–66.

265. *See* Golden, *supra* note 245, at 145 ("Second (and somewhat more speculatively), by commercializing research, the government could drive away, or demoralize, those attracted by the relative asceticism of modern science.").

an *increase* in late arrivals, which might be because the fine led the parents to conceive of the situation in a market framework, obviating norms-based compunctions they might have had about being late.[266] In other words, the monetary fine may have crowded out nonmonetary considerations. By analogy, the introduction of patent-based financial incentives might diminish the nonmonetary motivations of pure scientists or turn away more internally motivated innovators.

This argument is clever but too speculative. To begin, "motivation crowding out" is not the only plausible interpretation of the daycare study. As the authors acknowledge, an equally plausible interpretation is that the fine system's effect was informational: By specifying exactly what would happen if parents were late, the fine system ruled out more drastic forms of punishment for lateness, reassuring parents that paying a nominal fine is the only consequence of being late and thereby making them less punctual.[267] Another study by the same authors was even less supportive of a motivation-crowding interpretation, supporting the informational interpretation instead.[268] Other studies have gone one way or the other, and the literature is inconclusive.[269] A recent study, critically reviewing over one hundred prior tests and reporting on a well-designed field experiment that fills in many earlier studies' methodological holes, concludes that "results on output, productivity and quits are most consistent with a standard economics model than with a crowding out one."[270]

266. Uri Gneezy & Aldo Rustichini, *A Fine Is a Price*, 29 J. LEGAL STUD. 1, 3, 13–14 (2000).

267. *Id.* at 3, 10–11.

268. *See* Uri Gneezy & Aldo Rustichini, *Pay Enough or Don't Pay at All*, 115 Q.J. ECON. 791, 793–95, 807 (2000) (finding that monetary incentives had a nonmonotonic effect—a small monetary incentive reduced performance relative to no monetary reward, but a large monetary incentive boosted performance—and concluding that "the most convincing explanation" for this finding is that the introduction of a monetary incentive provides more specific information about the consequences of one's actions, not that it crowds out nonmonetary considerations).

269. *Compare* Edward L. Deci, Richard Koestner & Richard M. Ryan, *A Meta-Analytic Review of Experiments Examining the Effects of Extrinsic Rewards on Intrinsic Motivation*, 125 PSYCH. BULL. 627, 627 (1999) (finding that extrinsic rewards "significantly undermined free-choice intrinsic motivation"), *with* Judy Cameron & W. David Pierce, *Reinforcement, Reward, and Intrinsic Motivation: A Meta-Analysis*, 64 REV. EDUC. RSCH. 363, 363 (1994) (finding that "overall, reward does not decrease intrinsic motivation"), *and* Judy Cameron, Katherine M. Banko & W. David Pierce, *Pervasive Negative Effects of Rewards on Intrinsic Motivation: The Myth Continues*, 24 BEHAV. ANALYST 1, 1 (2001) (finding that "in general, rewards are not harmful to motivation to perform a task").

270. Constança Esteves-Sorenson & Robert Broce, *Do Monetary Incentives Undermine Performance on Intrinsically Enjoyable Tasks? A Field Test*, 104 REV. ECON. & STAT. 67, 67 (2022).

In addition to these weighty empirical concerns, there is a conceptual problem with embracing motivation-crowding as a justification for excluding abstract ideas: The argument could apply equally to applied science. If (against the weight of the evidence) we accept the idea that patents would crowd out nonpecuniary motivations, we should be concerned that patents are already doing that in applied science and technology. We do not know, after all, that the current mix of innovators and motivations in those areas is optimally calibrated. Accepting this rationale would thus be a general argument against patentability, not an argument against the patentability of abstract ideas. We are back at the important requirement that a persuasive justification for excluding abstract ideas must distinguish abstract ideas from other subjects of patents.[271]

H. AN "UNPRINCIPLED" ARGUMENT

This Section will close the discussion of justifications for the abstract-ideas exclusion with a justification that has not been put forth by courts or commentators but which I suspect animates some of the resistance to patent eligibility. That justification does not rest, as a principled justification must, on any distinction between abstract ideas and other subjects of patents. Rather, it rests on a general aversion to patents or a sense of precaution. It proceeds from skepticism about the value of patents or, more specifically, from concern about the overprotective character of the American patent system.[272] The idea is that the cons of patents are real and immediate—costlier access to patented innovations—but the pros in terms of creative incentives, though theoretically plausible, are not empirically well-established, and the benefit-cost balance does not look good compared to other innovation policy regimes that do not involve temporary monopolies.[273] Even those who are not skeptical about patents in general may be concerned about certain features of the American patent system that are too favorable to patentees at the expense of end users and downstream innovators.[274] They might embrace the abstract-ideas exclusion as a second best substitute for a first best world of no patents or drastically curtailed patents. One might say, in other words, "I will take a

271. *See supra* Section III.B.

272. *See* Shahshahani, *supra* note 34, at 50 n.18 (noting that "most legal and economic experts consider the present [IP] system to be overly protective" and citing a range of skeptical expert views); Eli Dourado & Alex Tabarrok, *Public Choice Perspectives on Intellectual Property*, 163 PUB. CHOICE 129 (2015) (critically reviewing the IP system with a focus on regulatory capture).

273. *See* Burstein, *supra* note 146 (providing a critical view of IP compared to other ways of promoting information diffusion). For a brief survey of conflicting perspectives, see *supra* notes 231, 243 and accompanying text.

274. *See supra* note 272; *see also* Bessen & Meurer, *supra* note 196 (emphasizing the patent system's failure to provide clear notice of property rights).

reduction in patent rights anywhere I can get it; if it happens to be for abstract ideas, so be it."

As mentioned, this justification is unprincipled in the sense that it fails to distinguish abstract ideas from other subjects of patents. But it need not be unprincipled in a broader sense. The argument *is* principled to the extent its suspicious attitude toward patents derives from well-thought-out misgivings about patents or the present patent system. If we think the present system is way overprotective of patent rights, then we can hardly rule out the possibility that any random curtailment of patent protections might be net beneficial. It is true that if the policy distinction between abstract and applied ideas is essentially arbitrary, as this Article has argued it is, then the patent system's recognition of this arbitrary distinction distorts incentives, especially potential innovators' selection into or out of basic science;[275] however, for someone who thinks patents should be nonexistent or drastically weaker, the costs of this distortion could be overcome by the benefits of patent curtailment. So, given a skeptical baseline policy position, it would be hard to fault someone for taking whatever they can get.

For those in this skeptical camp, hopefully the value of this Article is to clarify their reason for supporting the abstract-ideas exclusion. There is a world of difference between embracing the abstract-ideas exclusion on the basis that it reflects a policy-relevant distinction between abstract and applied ideas—which has been the avowed position of courts and commentators—and accepting it as an arbitrary distinction that might nevertheless do more good than harm. As scholars rather than pure advocates, we should be loath to embrace a specious distinction just because it leads to desired outcomes. What is more, greater clarity about our reasons for supporting a doctrine helps achieve greater clarity about the proper design and application of the doctrine and its alternatives. The next Part turns to those issues.

IV. POLICY IMPLICATIONS

This Article's contribution is primarily theoretical, but the theory has implications for patent law's ground-level application. This Part briefly sketches out some of these policy implications.

A. THE FAR-OFF VISION OF EQUAL TREATMENT

The takeaway message from Part III is that there is no good justification for the unequal patent eligibility of abstract and applied ideas. It might appear that the policy upshot of this message is to make both abstract and applied

275. *See supra* Section III.G.

ideas patent-eligible or patent-ineligible. But that does not follow. Although the analysis in Part III prescribes equal eligibility treatment of abstract and applied ideas for an institutional designer working on a blank slate, the same is probably not true for one who is working within the current patent system. That is because the current innovation policy regime has evolved a number of institutions proceeding from the premise that abstract ideas are not patent-eligible but their applications are; altering that premise while leaving its derivative institutions intact might be worse than continuing with the premise, faulty as it is. For equal treatment to work, then, a number of other things about the patent system would also have to change.

To begin, there is an entire ecosystem of public support for basic science which is premised in part on the unavailability of patents. This ecosystem includes massive federal funding and additional funding from state governments and taxpayer-supported nonprofits.[276] It involves a network of federal agencies,[277] congressional committees,[278] and offices within the executive branch,[279] as well as less important state equivalents.[280] Most of these government entities' work is devoted to applied, not basic, science,[281] and much of their work even on basic science would have to continue regardless of whether abstract ideas are patentable. Nevertheless, the existing infrastructure of public support for basic science would have to be significantly altered if the bar on patenting basic science were lifted. In some areas, a public-funding-*and*-patent system might create an unjustified double benefit for innovators, who get both free funding and patent rights, and a double burden for taxpayers, who must both fund the research and pay for its fruits. In other areas of basic science, federal funding would still be needed because of the

276. *See* NAT'L SCI. BD., NAT'L SCI. FOUND., NSB-2022-1, SCIENCE AND ENGINEERING INDICATORS 2022: THE STATE OF U.S. SCIENCE AND ENGINEERING, at fig. 18 (2022), https://ncses.nsf.gov/pubs/nsb20221 (showing that the federal government provides a plurality of funding for basic research whereas the funding for applied research and R&D is dominated by businesses).

277. For example, the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), the National Institutes of Health (NIH), and research divisions in the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA).

278. For example, the House Committee on Science and Technology and the Senate Committee on Commerce, Science and Transportation and their subcommittees.

279. For example, the Office of Science and Technology Policy, the President's Council of Advisors on Science and Technology, and the National Science and Technology Council.

280. For example, the California Council on Science & Technology.

281. *See* LAURIE HARRIS, CONG. RSCH. SERV., R44307, U.S. RESEARCH AND DEVELOPMENT FUNDING AND PERFORMANCE: FACT SHEET 4-5 (2022).

long and uncertain road to commercially profitable applications.[282] In any event, we would have to make fundamental decisions about whether and how to alleviate some of the restrictions that a patent places on public access to publicly subsidized innovation. Experience with the analogous problem in the context of publicly funded applied research, governed by the Bayh-Dole Act, does not fill one with confidence about the prospects for public rights.[283]

In addition to the public infrastructure supporting basic science, some existing patent doctrines would have to be recalibrated if abstract ideas were to become patentable. For example, broadening the research exception would become imperative given abstract ideas' importance in research.[284] The doctrine of blocking patents may also have to be reformed to allow more room for forcing through downstream breakthroughs when the blocking patentees cannot come to agreement.[285] Addressing these doctrines together would take concerted judicial effort along multiple fronts; but at least it would be doable with *judicial* effort, whereas the reforms described in the preceding paragraph would require major legislative and executive action.

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282. *See supra* notes 263–264 and accompanying text. Moreover, as Talha Syed has noted, the unavailability of patents sends a signal that public support is imperative. Syed, *supra* note 9, at 2001. It would be dangerous to take away that signal without a corresponding push to raise awareness of the importance of basic science, especially at a time of declining public support. *See supra* notes 257–261 and accompanying text.

283. Before 1980, the government generally retained title to innovations made pursuant to federal funding. The Bayh-Dole Act of 1980, 35 U.S.C. §§ 200–212, granted greater rights to recipients of government funding, out of a belief that the existing structure did not provide sufficient incentives to commercialize innovations. But research has cast doubt on Bayh-Dole's effectiveness. *See* David C. Mowery, Richard R. Nelson, Bhaven N. Sampat & Arvids A. Ziedonis, *The Growth of Patenting and Licensing by U.S. Universities: An Assessment of the Effects of the Bayh-Dole Act of 1980*, 30 RSCH. POL'Y 99, 99 (2001) (finding that Bayh-Dole "was only one of several important factors behind the rise of university patenting and licensing" and had "little effect on the content of academic research"); Jeannette Colyvas, Michael Crow, Annetine Gelijns, Roberto Mazzoleni, Richard Nelson, Nathan Rosenberg & Bhaven N. Sampat, *How Do University Inventions Get Into Practice?*, 48 MGMT. SCI. 61 (2002) (finding mixed evidence of Bayh-Dole's effectiveness); Arti K. Rai & Rebecca S. Eisenberg, *Bayh-Dole Reform and the Progress of Biomedicine*, 66 L. & CONTEMP. PROBS. 289 (2003) (criticizing the great discretion given to university recipients of federal funding and arguing that funding agencies should have more say over patenting); Sara Boettiger & Alan B. Bennett, *Bayh-Dole: If We Knew Then What We Know Now*, 24 NATURE BIOTECH. 320 (2006) (recommending legislation to align universities' interests with the public interest in access to publicly funded innovations); Arti K. Rai & Bhaven N. Sampat, *Accountability in Patenting of Federally Funded Research*, 30 NATURE BIOTECH. 953 (2012) (lamenting noncompliance with Bayh-Dole's reporting requirements).

284. *See supra* note 175 (surveying scholarly calls for broadening the research exception).

285. *See supra* notes 218–220 and accompanying text.

Overall, then, adjusting the innovation policy system to the patentability of abstract ideas would require significant action on the part of all branches of government, for which there does not seem to be much appetite today. Nor is there any prospect for abolishing patents altogether, which would be the other way to equalize the eligibility treatment of abstract and applied ideas.

This is not to give up on the idea of equal treatment. If this Article is successful in persuading others that the exclusion of abstract ideas is unwarranted on first principles, perhaps we can create a more favorable discourse supporting deep reform. A more hospitable political environment, and more detailed proposals for adjustment, might then emerge. Given the long odds, though, this Article will leave the task of outlining foundational reforms to future work and focus here on incremental reforms of the patent system.

B. THE BLESSED INCOHERENCE OF THE ALICE TWO-STEP

As discussed, the Supreme Court's jurisprudence has culminated in adoption of the "preemption" (or "basic tools" or "building blocks") rationale for the abstract-ideas exclusion. To effectuate this rationale, the Court in *Alice*, following an earlier line of cases, set forth a two-part test: A court must first ask whether a patent claim is "directed to one of th[e] patent-ineligible concepts," namely natural phenomena, laws of nature, and abstract ideas.[286] If it is not so directed, then the claim does not run afoul of the eligibility bars. If it is so directed, the court must proceed to the second step, to "consider the elements of each claim both individually and as an ordered combination to determine whether the additional elements transform the nature of the claim into a patent-eligible application."[287] The second step is thus a search for an "inventive concept" which ensures that the claim covers not an ineligible concept but an eligible application of it.[288] To pass the second step, the application must involve more than "well-understood, routine, conventional activities" previously known to those skilled in the field.[289]

The problem is that this test does not align with the Court's preemption rationale for the abstract-ideas exclusion.[290] The second step asks a nonobviousness-type question—whether the claimant has taken a large

286. *Alice*, 573 U.S. at 217.

287. *Id.* (quotation marks omitted).

288. *Id.* at 217–18.

289. *Id.* at 225.

290. *See* Strandburg, *supra* note 9, at 613 ("The preemption rubric simply doesn't fit with the inventive concept rule"); Syed, *supra* note 9, at 1976 (noting a "basic disconnect" between the rationale and the test of ineligibility).

enough leap beyond the state of the art.[291] But this question has nothing to do with the "danger that the grant of patents [on abstract ideas] will inhibit future innovation premised upon them."[292] The danger of a negative effect on downstream innovation is in no way lessened by the fact that the application is inventive. Nor is it persuasive to say that an inventive concept transforms a patent claim on an abstract idea into a claim on its application.[293] An application is an application regardless of whether it is inventive. Whether the application is inventive cannot change what the patent claim is.

Commentators and judges have criticized the incoherence of the *Alice* test with its preemption rationale.[294] But the analysis in Part III suggests that the incoherence is good. That analysis debunks all extant justifications for the abstract-ideas exclusion—including preemption.[295] It follows that a doctrine coherently policing subject matter boundaries based on preemption would coherently enforce an ill-founded principle. By contrast, a doctrine that effectuates the subject matter exclusion based on a proto-nonobviousness criterion enforces a well-founded requirement of patentability—not in spite of, but because of, being unmoored from the preemption rationale.

But if the principle effectuated by *Alice*'s two-step test is essentially redundant with a different requirement of patentability, then what is the point of the test?[296] What additional contribution does it make? The answer is that it makes a *procedural* contribution.

C. ACCELERATING PATENT INVALIDITY DETERMINATIONS

The procedural contribution of the new patent eligibility doctrine is to enable a speedy invalidation of questionable patent claims. Under the new framework, eligibility determinations under § 101 of the Patent Act can be

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291. *Alice*, 573 U.S. at 225; *Prometheus*, 566 U.S. at 79–80.

292. *Prometheus*, 566 U.S. at 86.

293. *See Alice*, 573 U.S. at 217–18.

294. *See supra* note 290; *see also* Interval Licensing LLC v. AOL, Inc., 896 F.3d 1335, 1351 (Fed. Cir. 2018) (Plager, J., concurring in part and dissenting in part).

295. *See supra* Section III.C.

296. *Alice*'s second step is not technically redundant with nonobviousness because it gets to the inventive-concept inquiry only after reading out any patent-ineligible part of the claim, namely abstract ideas, laws of nature, and natural phenomena. *See* 573 U.S. at 217. This might exclude more than what the nonobviousness requirement would, because an invention might be nonobvious as a whole without being nonobvious if the patent-ineligible parts are filtered out (say, if one comes up with a nonobvious mathematical result and applies it in an obvious way). Nevertheless, for inventions whose claim to inventiveness lies in the application and not the underlying idea—which is almost always the case with business methods, like the claims at issue in *Bilski* and *Alice*—the inventive-concept and nonobviousness inquiries are identical.

made early in litigation—before discovery, often on motion to dismiss or motion for judgment on the pleadings.[297] By contrast, nonobviousness determinations under § 103 ostensibly require ascertaining the state of the art before determining whether the patentee has made a nonobvious improvement over it, which often requires discovery.[298] The need for discovery prolonged patent litigation and made it expensive, even when patentees asserted highly dubious claims, which gave patentees a powerful weapon to hold over users and innovators. The prospect of quick invalidation under the rubric of patentable subject matter has diminished the *in terrorem* potential of such lawsuits. As a result, the new patent eligibility doctrine has made a tangible contribution to innovation policy by altering the procedure of patent litigation, even though the new doctrine's substantive content is essentially indistinguishable from nonobviousness in most cases.[299]

As Paul Gugliuzza has pointed out, the Court's patent-eligibility intervention was part of a cluster of developments occurring in the 2010s that promoted faster patent invalidity determinations.[300] These included Supreme Court decisions in other areas of patent law,[301] amendments to the Federal Rules of Civil Procedure,[302] and, perhaps most importantly, a new process for *inter partes* review established by the America Invents Act.[303] These developments deserve recognition for streamlining the removal of invalid patents, reducing the *in terrorem* potential of strike suits, and enhancing notice and freedom for users and follow-on innovators. The Supreme Court should also be commended for upholding the constitutionality of *inter partes* review against Article III and Seventh Amendment challenges, though it left open the possibility of accommodating other constitutional challenges.[304]

Questions have arisen, however, about the propriety of deciding the patent eligibility issue before discovery. After all, *Alice* requires a determination of

297. *See* Gugliuzza, *supra* note 27, at 575.

298. *See id.* at 575–76.

299. *See supra* note 296.

300. Paul R. Gugliuzza, *Quick Decisions in Patent Cases*, 106 GEO. L.J. 619, 620–23 (2018).

301. *See id.* at 621 (collecting cases).

302. *See* ORDER OF THE SUP. CT., RULES OF CIVIL PROCEDURE (Apr. 29, 2015), https://www.supremecourt.gov/orders/courtorders/frcv15(update)_1823.pdf.

303. *See* 35 U.S.C. §§ 311–319. This process permits any person to petition the PTO for review of another person's patent. If the PTO institutes review, the petitioner and the patentee are entitled to conduct discovery, file memoranda and other materials, and receive an oral hearing before the Patent Trial and Appeal Board, after which the Board issues a validity determination—all in short order (relative to litigation).

304. *See* Oil States Energy Servs., LLC v. Greene's Energy Grp., LLC, 584 U.S. 325, 329, 344 (2018).

whether an abstract idea's application involved more than "well-understood, routine, conventional activities" previously known to those skilled in the art,[305] an inquiry that presupposes an understanding of the state of the art before the invention, which seemingly requires discovery. Commentators have struggled with the issue.[306] And the Federal Circuit, after initially embracing the district courts' discretion to render pre-discovery eligibility decisions, has since issued opinions disapproving of the practice.[307] How, then, should courts strike the proper balance between preserving the efficiency-enhancing benefits of the Supreme Court's new doctrine and learning enough about the state of the art? Or, as one commentator has framed the question, "Is patent eligibility a pure question of law, or does it have factual aspects?"[308]

That last formulation, this Article submits, asks the wrong question. In deciding whether courts should resolve a patent eligibility question before discovery, the relevant inquiry is not the nature of the *question* but whether the *answer* to the question is clear-cut. If the answer is sufficiently clear then the courts can decide it before discovery.

To illustrate, suppose there is an antitrust complaint alleging that Bill Gates and Steve Jobs met in a coffee shop on a certain date and agreed to fix the prices of laptop computers made by Microsoft and Apple.[309] And suppose the defendants dispute that the meeting ever happened. This is clearly a dispute of "fact" rather than "law." Yet the issue might be appropriate for resolution by the court at different stages of litigation, depending on what is known about the world at the time the court is asked to make the decision. If discovery has occurred and the evidence is such that a reasonable jury could reach one or another conclusion about whether the meeting took place, then the question must proceed to trial; however, if discovery has produced evidence so one-sided that any reasonable jury would have to conclude that the meeting did (or did not) occur, then the court may resolve the issue on summary judgment.[310]

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305. 573 U.S. at 225.

306. *See* Gugliuzza, *supra* note 27, at 571–76 (praising the "trend toward quick invalidations" but not "as an unalloyed good").

307. *See* Aatrix Software, Inc. v. Green Shades Software, Inc., 882 F.3d 1121 (Fed. Cir. 2018); Berkheimer v. HP Inc., 881 F.3d 1360 (Fed. Cir. 2018).

308. Gugliuzza, *supra* note 27, at 579. For an analysis of how different standards of appellate review for trial courts' factual and legal determinations affect the strategic interaction between trial and appellate courts, see Sepehr Shahshahani, *The Fact-Law Distinction: Strategic Factfinding and Lawmaking in a Judicial Hierarchy*, 37 J.L. ECON. & ORG. 440 (2021).

309. *See* 15 U.S.C. § 1 (outlawing contracts, combinations, and conspiracies in restraint of trade).

310. *See* Anderson v. Liberty Lobby, Inc., 477 U.S. 242, 242–43, 248, 251–52 (1986) ("[S]ummary judgment will not lie . . . if the evidence is such that a reasonable jury could return

Moreover, there are circumstances when this clearly factual question should be decided *before* discovery. For example, if the complaint alleges that the meeting occurred in January 2024, the court could take judicial notice that Steve Jobs had passed away long before that date and dismiss the case without requiring any discovery.[311]

The analogy to the second step of *Alice* is clear. Here, too, ascertaining the state of the art prior to the claimed invention is, under any sensible understanding of "fact" and "law," a question of fact. But that does not mean—contrary to the assumption that the fact-law determination is dispositive of the necessity of discovery—that discovery is required. Rather, in some cases, the application is so clearly "well-understood, routine, conventional"[312] that a judgment of invalidity can and should be rendered before discovery. That was the case in both *Bilski* and *Alice*, which involved claims on routine applications of the principle of hedging risk and of intermediated settlement, respectively.[313] The essence of the Supreme Court's procedural contribution is to encourage such early-stage judgments.

Understood as such, the procedural contribution could extend beyond patent eligibility. It applies with equal force to the nonobviousness requirement (which, again, is often indistinguishable from the *Alice* second step): Nonobviousness must be assessed according to the state of the art at the time of the invention, and ascertaining that state is a question of fact. But there are circumstances when the difference between what is claimed and what was known is so clearly minimal that the patent can be invalidated as obvious without much or any discovery. The same is true of the novelty requirement.

This is contrary to common practice in infringement litigation,[314] but it represents a logical and policy-wise extension of the Court's analogous reasoning in the eligibility context. We should welcome and encourage such an

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a verdict for the nonmoving party . . . . [T]he inquiry . . . is . . . whether the evidence presents a sufficient disagreement to require submission to a jury or whether it is so one-sided that one party must prevail as a matter of law.").

311. *See* FED. R. EVID. 201(b) ("The court may judicially notice a fact that is not subject to reasonable dispute because it: (1) is generally known within the trial court's territorial jurisdiction; or (2) can be accurately and readily determined from sources whose accuracy cannot reasonably be questioned."); FED. R. CIV. P. 12(b)(6) (providing for a pre-discovery motion to dismiss for "failure to state a claim upon which relief can be granted").

312. *Alice*, 573 U.S. at 225.

313. *See Bilski*, 561 U.S. at 599; *Alice*, 573 U.S. at 213–14.

314. *See* Gugliuzza, *supra* note 27, at 575–76 (noting that it is "widely recognized" that questions of novelty and nonobviousness "cannot be resolved until summary judgment at the earliest and often must wait until trial").

extension by the courts, which would improve innovation policy by enabling faster invalidation of bad patents.

D. SUSPECT CATEGORIES

Part III demonstrates that there is no persuasive justification for singling out abstract ideas and laws of nature as patent ineligible. Nevertheless, as Section IV.C explains, the Supreme Court's intervention in patent eligibility has improved innovation policy by providing a rapid procedure to invalidate bad patents. Section IV.C also shows that the benefits of rapid procedure are not limited to questions of patent eligibility and can be extended to issues of novelty and nonobviousness. The upshot is that current doctrine is at once too restrictive and too permissive: It excludes nontrivial abstract ideas too aggressively while failing to exclude some trivial nonabstract ideas.

A good approach to resolving this problem of simultaneous over-and under-inclusion would be to rethink the law's classification of suspect categories of innovation. Instead of targeting field-transcending concepts like abstract ideas, we should target substantive fields that are more likely to witness unworthy patent claims.

Such a reform would not be entirely inconsistent with previous judicial efforts. Observe that the Court's interest in the question of patentable subject matter has often arisen in response to a surge of patents in certain fields of art: *Benson* concerned software patents,[315] *Flook* and *Diehr* similarly involved computer programs,[316] and *Bilski* and *Alice* were about business methods.[317] Indeed, *Bilski* was originally intended to resolve whether business methods are patentable, but the Justices could not reach a consensus and the case instead became the first step in the patent-eligibility revolution.[318] Rather than being connected by reference to field-transcending concepts like abstract ideas, these cases should be linked by recognizing the high incidence of dubious patents in their fields of art.

Business methods are particularly notorious in this respect.[319] Under the Federal Circuit's permissive regime, trivial claims on long-known ideas abounded, including the "invention" of hedging bets by taking positions in

315. *See* 409 U.S. at 72–73.

316. *See Flook*, 437 U.S. at 587–88; *Diamond v. Diehr*, 450 U.S. 175, 178–79 (1981).

317. *See Bilski*, 561 U.S. at 597–98; *Alice*, 573 U.S. at 212–13.

318. *Compare Bilski*, 561 U.S. at 606–07 (declining to exclude business methods categorically), *with id.* at 614 (Stevens, J., concurring in the judgment) (favoring such a categorical exclusion).

319. *See, e.g.*, Robert P. Merges, *As Many as Six Impossible Patents Before Breakfast: Property Rights for Business Concepts and Patent System Reform*, 14 BERKELEY TECH. L.J. 577, 589–90 (1999).

opposite directions (*Bilski*)[320] and computer-implemented intermediated settlement (*Alice*).[321] Such patent claims are flawed not because they are directed to abstract ideas but because they are glaringly obvious.

Bessen and Meurer make a similar observation about software patents. Their critique labels software patents as "abstract," but as previously discussed, their definition of abstractness differs from the one given in this Article and modern caselaw.[322] Their critique highlights problems that stem less from abstractness and more from the peculiar nature of software patents. "Computer algorithms might be equivalent," Bessen and Meurer write, "but computer scientists might not *know* that they are equivalent" because the same invention may have many different representations, some of them unknown and uninvented at the time the patent is filed.[323] As such, a software patent may claim an ostensibly new algorithm that turns out to be equivalent both to algorithms in prior art and to subsequent algorithms that the patentee did not envision and certainly did not invent.[324] Somewhat similarly, Kevin Collins argues that patent doctrines designed to curb claim overbreadth often fail in the case of software because software's unique "functional" nature makes it possible for an inventor to get away with not specifying the "physical, structural properties" of her invention.[325] All this makes it difficult to ascertain the boundaries of a software patent claim, so software patents often fail to provide clear notice of what they cover.[326] That is why software patents are much more likely than other patents to be litigated.[327] The problem of unclear boundaries is compounded by the proliferation of trivial or obvious software patents, especially in e-commerce.[328]

320. 561 U.S. at 599.

321. 573 U.S. at 213.

322. *See supra* notes 196–201 and accompanying text.

323. BESSEN & MEURER, *supra* note 196, at 201. This is related to "the problem of unforeseen applications" discussed in Section III.E. To the extent Bessen and Meurer are arguing that innovations with many after-arising applications should not be patentable, this Article disagrees with that argument because it perversely makes an innovation's valuableness a bar to its patentability and because it confuses questions of patent scope with eligibility. *See* discussion *supra* Section III.E. But Bessen and Meurer also seem to be singling out features of computer-algorithm claims that make their boundaries difficult to understand, which would be a persuasive reason for being suspicious of such claims.

324. *See id.* at 202–03.

325. Kevin E. Collins, *Patent-Ineligibility as Counteraction*, 94 WASH U. L. REV. 955, 963–64, 1012–13 (2017).

326. BESSEN & MEURER, *supra* note 196, at 202.

327. *See id.* at 191–93.

328. *Id.* at 212–13.

This discussion shows that certain fields of art such as software and business methods are overpopulated with dubious patents, be it for reasons of novelty/nonobviousness or disclosure. It is patents in these fields—not claims on abstract ideas or laws of nature—that the patent system should target for early-stage pruning. The definition of suspicious fields may develop over time and in reaction to prevailing patenting practices. The quality of patents in different fields may vary over time as potential patentees observe the courts' suspiciousness of certain fields and select out of them, but some fields like business methods may be consistently overpopulated with bad patents.[329]

This proposed approach would be no less tethered to the Patent Act than the currently prevailing approach (which, after all, has been entirely judge-made[330]). To the contrary, it would be firmly anchored to the Patent Act's requirements of novelty (§ 102), nonobviousness (§ 103), and disclosure (§ 112). These statutory provisions do not specifically call for different judicial approaches to different fields, but if patents in some fields are systematically susceptible to novelty, nonobviousness, or disclosure problems, then it is entirely appropriate for courts to show a more receptive attitude to early-stage invalidity determinations in such fields.[331] After all, recall that one of the justifications for excluding abstract ideas—that they preexist human innovation—was supposedly tied to failing the novelty requirement.[332] And, beyond patent law, the practice of courts developing different procedural attitudes toward different substantive fields when the statute does not specifically call for it is well-established and successful. For example, courts are reluctant to certify class actions, especially mandatory (non-optout) class actions, for mass tort claims, not because the class-certification rule singles out such claims but because they are not likely to meet the rule's requirements.[333]

In short, a judicial approach to early-stage patent validity determinations that is based on the high incidence of unworthy patents in particular fields has numerous advantages over the current approach of relying on the field-

329. A field of art need not mean a specific industry. Bessen and Meurer note that the problems they identify are features of software *patents*, not the software *industry*. *Id.* at 190. Business-method patents may also be present in any number of different industries.

330. *See supra* notes 109–119 and accompanying text.

331. *Cf.* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1577 (2003) ("[A]lthough patent law is technology-neutral in theory, it is technology-specific in application."); DAN L. BURK & MARK A. LEMLEY, THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT (2009) (recommending that courts treat patents in different industries differently).

332. *See Flook*, 437 U.S. at 593 n.15; Collins, *supra* note 178, at 57.

333. *See, e.g.*, Amchem Prods., Inc. v. Windsor, 521 U.S. 591, 594 (1997); Ortiz v. Fibreboard Corp., 527 U.S. 815, 843 (1999). *See generally* FED. R. CIV. P. 23 (setting forth the requirements for class certification).

transcending concept of abstract ideas: It would have a valid policy rationale (and therefore breed a coherent doctrine); it would extend the procedural benefits of early invalidation to a greater number of bad patents; and it would not exclude meritorious patents.

V. CONCLUSION: ANTI-INTELLECTUALISM OR SCIENTIFIC FETISHISM?

This Article has debunked the rationales for excluding abstract ideas and laws of nature from patents, showing that these rationales fit badly in the American tradition of intellectual property protection, which seeks to balance creative incentives against access costs. Where, then, does the abstract-ideas exclusion fit? What is its place in the broader framework of American law and thought? Two opposite answers may be suggested by way of speculation.

The first is that the abstract-ideas exclusion is consistent with the tradition of anti-intellectualism. In this view, patent law's second-class treatment of abstract ideas is harmonious with a prominent streak in American culture that disdains the exercise of the thinking power in the abstract and as an end in itself, as opposed to its exercise as a means to some concrete functional end. The distinction, as Richard Hofstadter elaborated it more than half a century ago, is between "intelligence" as an "excellence of mind" directed to immediate problem solving and "intellect" as the "contemplative side of mind" that "ponders, wonders, theorizes, criticizes, imagines." [334] Interestingly, Hofstadter's leading illustration of the phenomenon is relevant to the abstract-ideas exclusion: The "most impressive illustration" of Americans' dual attitudes, he thought, is "the American regard for inventive skill as opposed to skill in pure science."[335]

It is important to note what this anti-intellectual interpretation is *not*. First, it is not a claim that the American context is unique. The abstract-ideas exclusion is not a uniquely American doctrine.[336] And anti-intellectualism is surely not a uniquely American phenomenon. To point out an affinity between the abstract-ideas exclusion and anti-intellectualism is not to single them out as distinctly American. Second, the anti-intellectual interpretation does not assert that patent law's second-class treatment of abstract ideas was caused by

334. RICHARD HOFSTADTER, ANTI-INTELLECTUALISM IN AMERICAN LIFE 25 (1963).

335. *Id.*

336. *See, e.g.*, Norman Siebrasse, *The Rule Against Abstract Claims: History and Principles*, 26 CAN. INTELL. PROP. REV. 205 (2011) (reviewing the abstract-ideas exclusion in Canadian law); Weiwei Han, *Overview of Patent-Statutory Subject Matter in Biotechnology in the U.S., Europe, Japan and China*, CCPIT PAT. & TRADEMARK L. OFF. (Apr. 8 2013), https://www.lexology.com/library/detail.aspx?g=b722c90c-a871-4775-a31a-e7857eecee30.

anti-intellectual attitudes, nor that any commentator or judge defending this exclusion harbors such attitudes. One can perfectly well be agnostic or even optimistic about the *motives* of judges and commentators while contending that the *effect* of their views is anti-intellectual.

The anti-intellectual interpretation may supply a *leitmotif* connecting different areas of patent law. For example, one might find a similar anti-intellectual tendency in the famous case *Brenner v. Manson*, which invalidated a patent on a newly invented process for making a known steroid on the basis that the inventor had not disclosed any utility for the steroid.[337] The Court's holding—that demonstrating that the steroid's "potential usefulness is under investigation by serious scientific researchers" is not sufficient to prove its utility[338]—can be seen as a verdict on the uselessness of basic science.[339] The opinion evinces contempt for basic scientific results that do not have immediate cash value, and it includes the statement that gave this Article its epigraph: "[A] patent system must be related to the world of commerce rather than to the realm of philosophy."[340]

The second interpretation of the abstract-ideas exclusion is the opposite of the first. In this view, the exclusion signifies not denigration but veneration of pure science and knowledge for knowledge's sake. All the high-minded talk about the nonpecuniary motivations of pure scientists and the collaborative spirit of the scientific community[341] can thus be seen as a form of exceptionalism bordering on hagiography. Similarly, one can interpret the fears attending the prospect of pure science's propertization—fears that have not been sufficiently grave to congeal into categorical exclusions in cases of applied science or art—as a sign of exaggerated importance. Patent law, then, excludes abstract ideas, not because it does not think of them highly enough, but because it thinks of them too highly. It finds them too precious, too elevated, to be subjected to the same crude incentive structure that is appropriate for applied science and technology (and, on the copyright side, for art). Like the anti-intellectual interpretation, the scientific-fetish interpretation does not depend on assumptions about American exceptionalism or about judges' and commentators' personal motives; it can rest simply on a judgment about the

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

338. *Id.* at 531.

339. *See id.* at 539 (Harlan, J., concurring in part and dissenting in part) (expressing concern that the Court's approach would under-incentivize the production and prompt publicization of basic scientific research).

340. *Id.* at 536 (quoting *In re* Ruschig, 343 F.2d 965, 970 (C.C.P.A. 1965)).

341. *See supra* notes 245–247, 262 and accompanying text.

consistency of the exclusion's effects with certain broader trends in American thought.

Somewhere in between these polar interpretations, one can understand the abstract-ideas exclusion as a relic of now-discarded conceptions of patent law's aims. English patent law at its inception was concerned chiefly, if not solely, with advances in the machinery and products of commerce. Given such a mindset, it was natural to think of patentable subject matter purely in terms of tangible things, as reflected in the key statutory term "manufacture."[342] Recall that this preoccupation was so strong that the foundational *Boulton* case debated not the patentability of abstract ideas but the patentability of methods or processes.[343] Justice Heath thought that something must be "vendible" to be patent-eligible.[344] Though such cramped conceptions have long given way to the canonical view of patent law as a means of incentivizing scientific and technological innovation, the aversion to abstract ideas has survived as an ill-fitting leftover.

These interpretations are offered in the spirit of speculation, and more definitive conclusions should be left to historians. For present purposes, what matters most is not where the abstract-ideas exclusion came from or why it took hold but whether it makes sense. This Article has argued that it does not. The theoretical implication of this answer is profound: A foundational principle of patent law does not rest on a solid foundation. The policy implications are no less significant: By embracing the theoretical incoherence of the *Alice* test, by rendering invalidity determinations early in litigation and extending that practice to patentability requirements other than subject matter, and by replacing field-transcending exclusions with scrutiny of specific fields, courts and policymakers can multiply the benefits of the Supreme Court's new patent-eligibility doctrine while avoiding its pitfalls.

342. *See supra* note 110.
343. *See supra* notes 62–64 and accompanying text.
344. *Boulton*, 126 Eng. Rep. at 661.